METROPOLITAN-VICKERS: ARTHUR FLEMING'S INFLUENCE ON THE ORIGINS AND EVOLUTION OF APPRENTICE TRAINING AND TECHNICAL EDUCATION, WITH PARTICULAR REFERENCE TO FEMALE COLLEGE AND STUDENT APPRENTICES BETWEEN 1945-1967

VERONICA MARY JACKSON

A thesis submitted in partial fulfilment
of the requirements of the Manchester
Metropolitan University for the degree
of Doctor of Philosophy

Department of History, Politics and Philosophy
Manchester Metropolitan University

2016

Abstract

Veronica Jackson ***Manchester Metropolitan University***

Metropolitan-Vickers: Arthur Fleming's influence on the origins and evolution of apprentice training and technical education, with particular reference to female College and Student apprentices between 1945-1967

This thesis examines the significance, influence and limitations of the apprenticeship and technical education system which was developed between the 1900s and 1950s by the Metropolitan-Vickers Electrical Engineering Company under its Director of Research and Education, Sir Arthur P M Fleming. Metropolitan-Vickers was well known in the industry for its highly developed technical skills, industrial research facility and the quality of its technical and vocational education. This thesis argues that this reputation made a significant contribution to the corporate culture which Metropolitan-Vickers fostered within the company and the wider community as an organisation at the forefront of modern engineering training and practices. It assesses the significance of Fleming, the architect of its innovative apprentice training system, which replaced 'premium' apprenticeships with a tiered system of trade, college and schools apprentices who were intended to become skilled 'craftsmen' and professional engineers. This system continued after Fleming's retirement in the mid-1950s and the thesis debates its continuing limitations for females operating in a male-dominated engineering industry in which women's skills and competencies were questioned. Women who trained to become professional engineers faced many difficulties from the First World War until the 1960s and the thesis examines the extent to which a combination of societal pressures, cultural expectations and class issues limited the ambitions of girls who entered grammar schools in the postwar period. It focuses on the implications for the 'exceptional' young girls who did gain entry to the level of technical education in which Metropolitan-Vickers took such pride. These experiences are set within the context of the work undertaken by Isabel

Hardwich, a physicist, largely neglected in the history of technical education, who was responsible for ‘technical women’ in the company’s research department. Hardwich played a prominent part in the Women’s Engineering Society which developed initiatives to encourage more girls into engineering and the thesis questions the extent to which these measures were, or could be, successful in a period when women’s skills were so strongly defined by broader social and cultural pressures. In so doing the thesis highlights the pressures placed on the small number of women who did develop careers in engineering, even within a company like Metropolitan-Vickers that was so intimately associated with innovative training both within the industry and beyond.

Contents

Acknowledgements

Thanks to all the staff at: the Bodelian Library, Oxford University; the British Library; Edge Hill University Library, Ormskirk; Imperial College Archive, London; Institution of Electrical Engineers, London; John Rylands University Library, University of Manchester; London School of Economics (the Women's Library); Manchester Central Reference Library; National Library of Scotland, Edinburgh; National Maritime Museum, Greenwich; North-West Sound Archive, Clitheroe; The National Archive, Kew; Sir Kenneth Green Library, Manchester Metropolitan University; and the Working Class Movement Library, Salford.

Special thanks to Jan Shearsmith at the Manchester Museum of Science and Industry. His archival knowledge and skills have been invaluable, as has his patience in dealing with my many requests. I owe him a debt of gratitude.

Thanks to the Manchester European Research Institute, whose scholarship award allowed me to undertake this research.

Thanks to the staff at Manchester Metropolitan University, especially Deborah Bown who has provided more support and encouragement than she will ever know. Special thanks also to Paul Wake who has been an attentive and encouraging mentor.

The members of the Women's Engineering Society who were kind enough to be

interviewed deserve my heartfelt appreciation of their work and my thanks for their contribution. My thanks also to Dawn Bonfield who arranged these contacts.

I am grateful to Dame Margaret Beckett M P, Diana Bradley, Carol Brent, Pat Dyehouse, Isobel Smith and all the other people who gave their time to be interviewed. Most of these volunteers wished to remain anonymous and so I have adopted the convention of referring to all of them by their initials. Their contributions have been invaluable.

Thanks to Pat Ayers at Manchester Metropolitan University for all her help and guidance in the initial stages of this research. Professor Melanie Tebbutt has continued this process and I am grateful for her insights. These have shaped the way in which the thesis has developed.

Thanks beyond measure to all my family; husband, sister, children, spouses and grandchildren. To K J for much needed good-humour, support, patience and critical analysis; to Nutty for her faith in my ability to complete this, and as amanuensis, proof-reader, and too much else to be able to catalogue; to El for technological wizardry and who, as a fellow PhD student, always put things into perspective and understood the pressures faced when trying to complete a thesis; to Isabelle and Thomas for bringing great fun to the process when it was most needed. The thesis is yours as well as mine, and is dedicated to you.

In memory of Nan and Bill who worked at Metrovicks. To Mary, Mary, Catherine,

and Katie who were all so talented in so many ways but, sadly, were never given the opportunity of accessing higher education. This is my attempt to make it up to you.

Manchester Metropolitan University
October 2015

List of Abbreviations

AMIEE

Associate Member of the Institution of Electrical Engineers

AEI

Associated Electrical Industries Limited

BAWE

British Association of Women Executives

BACIE

British Association for Commercial and Industrial Education

BTH

British Thomson-Houston Limited

CASIG

Careers Advisory Service for Girls

GEC

General Electric Company Limited

ICI

Imperial Chemical Industries Limited

IEE (IET)

Institution of Electrical Engineers (now known as Institution of Engineering and Technology)

IEE NAEST 070

Archive: Sir Arthur P M Fleming

IEE NAEST 92A

Archive: Mrs I H Hardwich

MIEE

Member of the Institution of Electrical Engineers

IMechE

Institution of Mechanical Engineers

MCL

Manchester Central Reference Library

Metrovicks, M-V

Metropolitan-Vickers Electrical Engineering Company Limited

MOSI

Museum of Science and Industry, Manchester

SADVOI

Saddleworth Voices – North West Sound Archive

SWE

Society of Women Engineers

TNA

The National Archive

TNA ED

Collection of papers relating to education and educational establishments

TNA LAB

Collection of papers relating to recruitment and training

WES

Women's Engineering Society

WCML

Working Class Movement Library

Introduction

Summary of argument

There now remain few remnants of the industrial landscape that dominated the north-west of England in the nineteenth and twentieth-centuries. Metropolitan-Vickers Electrical Engineering Company Limited (hereafter Metrovicks) was amongst those industrial behemoths that vanished during this period.[1] The firm was one of a number of organisations, trading under the umbrella of Associated Electrical Industries, including the midlands-based British Thomson-Houston Limited. All of these companies were regarded as separate commercial undertakings, although Metrovicks was the largest within the group. During the time scale covered by this thesis, upwards of twenty-three thousand people were employed at the Trafford Park headquarters of the firm and were engaged in the manufacture of a wide range of products from the Hotpoint brand of 'white goods' to heavy engineering equipment such as transformers, switchgear, traction, and machine tools. As such, it was one of the best known electrical engineering companies both in Britain and around the world. Its stature rested not only upon the renowned engineering and technological skills of its employees but also upon the fact that Metrovicks occupied a singular place in the advancement of industrial research and in the provision of technical and vocational education. In the area of apprenticeship training, the establishment of a ground-breaking scheme, highly

1 The company started to trade under the name of British Westinghouse Electric and Manufacturing Company Limited. It changed its name in 1919 to Metropolitan-Vickers. The company has been referred to variously as M-V, MetroVicks, Metros but for the purposes of this study the preferred name is Metrovicks, though direct quotes might use any one of the other designations.

regarded by politicians, educationalists and industrialists alike, was considered to be the *sine qua non* of good educational practice.

Very few studies have probed into the affairs of this large enterprise aside from an investigation by Jones and Marriott into the merger with the General Electric Company that brought about the demise of AEI.[2] A small number of contributors to the literature have concentrated on scientific and technological innovation undertaken by the firm. This thesis, therefore, is the first piece of research to offer an overview of Metrovicks' standing within the electrical engineering industry and to conduct an examination into the extent to which the company's innovatory and highly regarded College and Schools apprenticeship scheme, designed by Sir Arthur P M Fleming, enabled young women gain to acceptance as professional engineers within a male-dominated industry. Their position had always been precarious and the extent to which they were supported by the education they received at their grammar schools, and by the Women's Engineering Society (hereafter the WES) and government agencies was also in need of interrogation. As a result, neglected archival material has been brought to light and this thesis offers the first opportunity for it to be examined and analysed.

Evidence suggests that the corporate culture developed by the firm was in no small measure based on a belief that its employees were 'the aristocrats of the engineering industry'.[3] This thesis will examine the extent to which such a claim

---

2 R Jones & O Marriott, *Anatomy of a Merger. A History of GEC, AEI and English Electric,* (London: Cape, 1970)
3 Jones & Marriott, p.160

could be upheld by surveying the material retrieved from archives relating to British Westinghouse Limited and to Metrovicks, alongside contemporary sources relating to other local engineering companies, and by analysing material lodged in the archives of Ferranti Limited. Whilst there is no intention here of offering a comparative study, attention will be paid to Ferranti, a smaller but by no means insignificant electrical engineering firm also based in Manchester. Evidence establishes the extent to which the business acumen demonstrated by the managements of both companies as well as the engineering expertise displayed by their employees might be used to determine the validity of Metrovicks' claim to be the 'aristocrats' of the industry. British Thomson-Houston in Rugby was regarded as a 'sister' company in the AEI nexus. The often fractious relationship between the two as they attempted to expand their businesses in the same market pointed to an ever-present rivalry that dogged both concerns before the second world war and which continued until 1967. Additional contemporary sources relating to BTH also highlight this issue and have shown how both Metrovicks and BTH attempted to lay claim to this title. Evidence suggests that there is a demonstrable link between wishing to be defined as the pre-eminent electrical engineering company in the country and publicising this claim to multiple audiences. The way in which the corporate image of a company might be defined, developed and publicised will also be interrogated in this thesis by referring to the literature on this subject, especially the work conducted by Nye in relation to General Electric in the USA.[4] Publicity material from the archives of Metrovicks, alongside material from the Ferranti archive and contemporary literature relating to

4 D E Nye, *Image World.Corporate Identities at General Electric,* (Cambridge, Mass.: The MIT Press, 1985)

BTH and a number of other smaller engineering firms, has provided evidence which has been utilised in order to gain an understanding of the way in which the company positioned itself within the industry.

Evidence also suggests that the marrying of apprenticeship training to industrial research was an important aspect of the corporate culture by which the firm wished to be defined and Fleming was originator of the ground-breaking alliance that made this possible. It is intended to scrutinise this in the light of the contribution made by Cooper who has examined the relationship of science and the electrical engineering industry in Manchester and has acknowledged the part the research establishment at Metrovicks headed by Fleming played in this process. Niblett has also looked into the development of research policy and has recognised the significance of this to the industry in the United Kingdom and Whitfield's recent work has assessed the impact of the research undertaken by the firm in relation to the development of the gas turbine.[5] The company also wished its vocational and education programme to be placed at the heart of the corporate culture that had begun to be developed in the early years of the twentieth-century. The way in which its apprenticeship scheme was configured, however, contained elements of class distinction and gender difference that were difficult to reconcile

5 T Cooper, *The Science-Industry Relationship: the case of Electrical Engineering in Manchester, 1914-1960,* (Unpublished PhD thesis, University of Manchester, 2003); 'The early development of scientific research in industry: the case of Metropolitan-Vickers Ltd, 1901-1933' in 'The History of Science and Technology in the North-West', (ed.) J Pickstone, *Manchester Regional History Review,* 18 (2007), pp. 84-105; C Niblett, *Images of Progress: The Episodes in the Development of Research Policy in the U K Electrical Engineering Industry,* (Unpublished PhD thesis, University of Manchester, 1980); J. Whitfield, *Metropolitan-Vickers, the Gas Turbine, and the State: A Socio-Technical History, 1935-1960,* (unpublished PhD thesis, University of Manchester, 2012); 'Thrust Vector: The RAE, Metrovick, and the gas turbine, 1934-1960', https:www.thrustvector.wordpress.com [1 October 2014]

with the public face that Metrovicks wished to present. It was difficult to mount a challenge to these competing identities when the corporate culture fostered by the firm also stressed the primacy of service to others, of loyalty and comradeship and of the 'democratic spirit' that existed at Trafford Park. [6] One of the main aims of this thesis, therefore, is to examine how this important factor affected both the training undertaken by female apprentices and their entry into the workforce as professional engineers.

This thesis also aims to reinstate the importance of the work of Sir Arthur Fleming to the development of apprentice training in this country. No research has been undertaken into the singular contribution that he made in this respect, and although his work was considered to have had 'an extraordinary influence' on the electrical engineering industry and beyond, he quickly slipped from the record after his death in 1960.[7] Material from his under-utilised archive shows how he developed his educational philosophy and how he promoted this not only in Britain but also in other parts of the world. Evidence suggests that he was influenced particularly by German thinking on the subject of technical education as well on his own experience of an American method of apprentice training. He set out his early thinking on apprentice training in a number of seminal books that he wrote in conjunction with colleagues and these contemporary sources point to the importance that he placed on providing a liberal strand of education within the

6 J Dummelow, *1899-1949,* (Manchester: Metropolitan-Vickers Electrical Company Limited, 1949), p.35

7 Lord Bowden of Chesterfield speaking in the Debate on the Second Reading of the Training Bill. HL Deb 06 February 1964 vol 225 cc 292-303 http:hansard.millbanksystems.com/lords/1965/feb/06/industrial-training-bill-1 [9 March 2015]

curriculum for trainee engineers. This thesis also aims to explain why he wished to offer a radical alternative to the outmoded apprenticeship system that had existed within the engineering industry in the early years of the twentieth-century. Further evidence demonstrates that Fleming was also informed by Victorian precepts that were best found within the ethos of the public school where Christian principles of service and a masculine interpretation of *esprit de corps* predominated. This study also intends to show how he applied these ideals when he set about organising apprentice training at Metrovicks and how his desire to democratise the system often ran counter to the reality of the situation where male apprentices found it easier to identify with this ethos than did their female counterparts.

Archival material and contemporary sources make it apparent that other firms across the region and beyond had organised the training of their apprentices in a different way. Some scrutiny of the apprentice training facilities offered by BTH suggests that the 'sister' company set these up at a later date and that initially there were some differences in the way in which the programmes of study were organised by the firm. Other industrial organisations such as Ferranti also demonstrated these differences. Both the literature and archival material suggests that Metrovicks tied in industrial research with the vocational education of its apprentices and this became common practice amongst the larger engineering firms such as BTH and Ferranti. Contemporary literature demonstrates that this was not always the case and some scrutiny of the apprentice training facilities offered by a limited number of other industrial firms serves to highlight the singularity of the system inaugurated by Fleming.

Evidence points to the fact that Metrovicks admitted young women as engineers and apprentices training to become professional engineers from 1915 onwards.[8] The numbers did not grow significantly, even during the period under scrutiny in this thesis. This study aims to consider the reasons why this was the case. In order to do so, it is necessary not only to focus upon their technical and vocational education as apprentices, but also to examine the way in which the societal expectations that were placed upon them impeded the ability of all but a minority of 'exceptional' women to enter the engineering profession. Spencer described the young women growing up during the 'long 1950s', as the 'forgotten generation'.[9] The provisions of the 1944 Education introduced the tripartite system of education and those girls who entered the grammar schools were encouraged to strive to gain a place at university, the gateway to a professional career. Evidence collected from oral testimonies makes it apparent that this was not the case. These contributions have complemented evidence presented in a number of Reports published during this period, such as the Crowther Report (1950), the Robbins Report (1963) and the Dainton Report (1968).[10] Contemporary literature such as that presented by Ollerenshaw and Newsom questioned the idea that most girls possessed the intellectual capacity to gain entry to university.[11] The

8 I[nstitution] of E[lectrical] E[ngineers] NAEST 92A/1.3.1 G L Entwisle, 'Engineering As A Career For Girls', Talk given at the Portsmouth College of Technology, May 1955

9 S Spencer, *Gender, Work, and Education in Britain in the 1950s,* (Basingstoke: Palgrave Macmillan, 2005)

10 The Crowther Report. A Report of the Central Advisory Council for Education, *15-18,* (London: HMSO, 1959); The Robbins Report, *Higher Education,* (London: HMSO, 1963); The Dainton Report, *Enquiry into the Flow of Candidates in Science and Technology into Higher Education,* (London: HMSO, 1968)

11 J Newsom, *The Education of Girls,* (London: Faber and Faber, 1948); K. Ollerenshaw, *Education for Girls,* 1961)

suggestion that the education of boys and girls should take into account the fact that girls needed to be prepared for marriage and motherhood was indicative of the societal expectations that were placed the 'forgotten generation' and oral testimonies support the findings of work conducted by authorities in the field such as Veness and Seears, *et al.* [12] The education offered by many grammar schools was biased towards the arts rather than the sciences and there was often little encouragement given to girls to take an interest in the study of those subjects so vital for entry into the engineering profession. In any case, the expectations of both teachers and parents were congruent with prevailing attitudes in society which considered engineering to be an unsuitable career for girls. The transmission of what were considered to be appropriate feminine ideologies, therefore, took place within the grammar school. A wide-ranging literature on this subject has been complemented by contemporary sources and also by evidence from all of the women who gave oral testimonies. [13]

The paucity of contemporary records makes it difficult to assess how many women were able to train to become professional engineers in the years before world war two. Baker found that Scottish universities failed to keep records of women who undertook courses in engineering, although details of medical students for

12 T Veness, *School Leavers. Their Aspirations and Expectations.* (London: Methuen 1962); N Seear, V Roberts & J Brock, *A Career for Women in Industry,* (London & Edinburgh: Oliver & Boyd, 1964)

13 N[orth] W[es]t S[ound] A[rchive]. 2010.02 SADVOI S. Dewsbury 8.3.2010; 2013.05 G. Doyle 1.6.2010; The Labour Party Youth Commission, *The Younger Generation,* (London: The Labour Party, 1959); S. Spencer,' 'Be Yourself': *Girl* and the Business of Growing Up in Late 1950s England' in (eds.) K Cowman & L A Jackson, *Women and Work Culture c 1850-1950,* (Aldershot: Ashgate, 2005); P Everett, *you'll never be 16 again,* (London: BBC Publications, 1986); F. Hunt (ed), *Lessons for Life. The Schooling of Girls and Women,* (Oxford: Blackwell, 1987); M Evans, *A Good School: Life at a Girls' Grammar School in the 1950s,* (London: The Women's Press, 1991), for example.

example were retained.[14] Nevertheless, evidence retrieved from archival material and the literature points to the fact that numbers were negligible.[15] Training to become a professional engineer was still an uncommon choice for young women in the middle years of the twentieth-century. The College and Apprentice scheme set up by Fleming at Metrovicks had admitted women graduates into its ranks since the 1920s. By the 1950s, however, 'so few girls' with the 'right aptitude' had applied for training that his successor, Sir Willis Jackson, sought to redefine the meaning of 'engineer' and replace it with a wider interpretation intended to appeal to young women who might wish instead to find work in a clean, office-based environment.[16] Evidence from the Apprentice Register and archival sources suggests that this did not have an immediate effect on numbers. Oral testimonies also suggest that the way in which apprenticeship training was infused with aspects of the corporate culture of the firm that stressed fraternity and mutual assistance within male cabals hampered the progress of women trainees. Contemporary sources backed up these statements and examples of hidden discrimination and overt prejudice were expressed not only by pioneers like Entwisle but also by those of younger women who were interviewed. The extensive literature that investigates the way in which female skills and competencies were viewed within a male dominated industry like engineering

14 N Baker, 'Early Women Engineering Graduates from Scottish Universities', *Women's History Magazine,* 60 (Summer 2009), 21-23

15 IEE NAEST 92A/2.8 I H Hardwich, 'Women Engineers in Industry', speech made at a Conference held at the University of Warwich, 25-26 March 1968; Metropolitan-Vickers Electrical Company Limited, *A Register of ex-apprentices and ex-trainees of the Metropolitan-Vickers Electrical Co. Ltd., 1902-1956,* 4th edn. (Manchester: Metropolitan-Vickers Electrical Company Limited, 1957);M[useum] O[f] S[cience] and I[ndustry] A1996.1735?MS0531/208 J Sewill, 'A Woman in a man's world', *IEE Review,* (June 1989) for example

16 Imperial College Archives (ACRU) B/JACKSON FW16. W Jackson, 'Opportunities for Girls in Electrical Engineering', Women's Engineering Society Report on Conference held at Coventry, 13-14 July, 1957

highlights the kinds of problems experienced by young women wishing to make progress in their careers. Fletcher, Hacker, Cockburn, Kelan as well as McIlwee and Robinson pay particular attention to the way in which engineering is perceived to be a 'masculine' preserve where men have an affinity with technology but where women are often excluded from technical knowledge. [17] The issue of gender is also highlighted in oral testimonies, and the research contained within the literature also coincides with material lodged in the archive of Isabel Hardwich at the Institution of Electrical Engineers (hereafter IEE).[18] Examples of the many other problems faced by female apprentices, such as negative images of women engineers presented in the media, issues surrounding 'wastage' whilst taking career breaks to rear children, caring responsibilities within the wider family, and the prejudice against women being accepted in positions of authority over men are also found in the literature, in archival material and in contemporary sources.[19]

Evidence suggests that attempts to attract new recruits into the profession were fraught with difficulties. Efforts made by the Women's Engineering Society to encourage an interest in engineering amongst young women were not particularly

17 S. Hacker, *Pleasure, Power, and Technology,* (Boston: Unwin Hyman, 1989); E Kelan, *Performing Gender at Work,* (Basingstoke: Palgrave Macmillan, 2009); J S McIlwee & J G Robinson, *Women in Engineering: Gender, Power, and Workplace Culture,* (Albany: State University of New York, 1992);C Cockburn, *Machinery of Dominance: Women, Men, and Technical Know-How,* (Boston:Northeastern University Pres, 1988); J K Fletcher, [Women Engineers], *Disappearing acts: gender and relational practice at work,* electronic book, (Cambridge, Mass.: MIT Press, 1999);

18 IEE NAEST 92A Mrs Isabel H Hardwich. The IEE has been renamed and is now the Institution of Engineering & Technology (IET)

19 IEE NAEST 92A/7.3 B L Godlet. 'The Developing Field of Technical Education', British Association for Commercial and Industrial Education (BACIE), Sixth Conference report, 1-3 May 1957; MCL.Q.631.3.AE2, *AEI News.*Various issues, January 1949-January 1967; Imperial College Archives B/JACKSON FW/16 Women's Engineering Society, 1957-63; IEE 92/08 *The Woman Engineer.* Various issues. 1919-1989 series; S Walby, *Gender, Segregation and Work,* (Milton Keynes: Open University Press, 1998), for example

successful during this period, despite the efforts of women like Isabel Hardwich, one of the stalwarts of the Society whose contribution is central to this investigation. Working in conjunction with Metrovicks, where she was appointed as supervisor of technical women within the Research Department, she strove to improve matters and articles and papers lodged in her archive give testimony to this fact. Both Metrovicks and the WES undertook a number of initiatives in this direction, but the number of apprenticeships available for young women in the wider reaches of the industry varied, as evidence from The National Archive (hereafter TNA) suggests.[20] In addition, government inertia about funding initiatives that hoped to support young professional women in their attempt to advance their careers to executive level shows how female aspirations were stifled, and evidence of this was also located in TNA .[21] During the late 1950s questions were raised by government about improving the overall quality of industrial training in order to facilitate expansion within the engineering sector and this eventually led to the passing of the Industrial Training Act in 1964. The College and Schools apprenticeship system at Metrovicks provided such a high quality of training that it still served as a model for the rest of the industry and was exempt from the provisions of the Act. Archival evidence already cited as well as oral testimonies suggest, however, that the position of 'exceptional' young women setting out on their careers as professional engineers within the company did not improve and, at best, a lukewarm reception greeted their presence at both

20 T[he]N[ational] A[rchive]LAB 19/522 Opportunities for Employment and Training for Girls in Science, Technology and Engineering Industry Fields: correspondence 1955-8; TNA LAB19/472 ILO Enquiry Apprenticeships for women and girls 1954-8; TNA LAB 715 Employment and Training of Girls 1961-5, for example.

21 TNA LAB 19/829 British Association of Women Executives: Proposed Careers Advisory Service on Industry for Girls (CASIG) 1965-9

Metrovicks and within the industry at large during the period covered by this thesis.

These themes underpin this investigation. To re-iterate, the aims of this thesis are to examine the place of Metrovicks and its educational and training system within the context of the electrical engineering industry as a whole. Crucially, the debate will be centralised round the position of young women within that nexus and the way in which their grammar school education as well as their technical and vocational education as College and Schools apprentices at Metrovicks prepared them to become professional engineers during the 'long 1950s'. This thesis also aims to question assumptions about the ability of young women to succeed in a male-dominated industry and in so doing offers the first insight into a hitherto neglected aspect of technical and vocational education and training during this period.

Methodology

In seeking out evidence to support the arguments contained in this thesis it was necessary to take into account the fact that Metrovicks, though once a key employer within the region, was subject to a take-over in 1967 by the General Electric Company (hereafter GEC), which in turn was restructured into many other companies, including the Marconi Corporation. When the remaining, much truncated, site at Trafford Park was finally closed down in 2000 the remnants of the Metrovicks archive were dispersed amongst a number of organisations. To complicate matters further anecdotal evidence from various unrelated sources, some of whom were ex-employees of the company, suggest that parts of the

record were taken to a local aerodrome and were then destroyed.[22] This has made it more difficult to research the history of the company unlike that of Ferranti Limited where the extensive archive has been left largely intact and conveniently situated in one location. Nonetheless it has been possible to examine a great deal of primary evidence by accessing a number of what, at first sight, appeared to be unpromising types of material.

Whilst the vast Marconi archive housed at the Bodleian Library contained a section devoted to some of the documentation that had been retrieved from Metrovicks, this did not prove to be of great use in researching either the history of the Trafford Park firm or in examining the position of women apprentices who worked for the company during this period. Had they survived, these records would have given a valuable insight into the backgrounds of the young men and women who were trained by the company, for the indispensable Apprentice Register, which gave thumb-nail sketches of all apprentices who had enrolled with the firm since its inception, ceased publication in 1957. It was neither possible to find material detailing the relative difference in numbers between male and female trainees, nor to pinpoint accurately the size of the female workforce as a whole. As a result these figures have to remain as estimates. Other tranches of information devoted to the workings of the boardroom and to the minutiae of the trading and general economic standing of the organisation were contained here, but as this was not the intended focus of the dissertation these records would have added little to the

22 The ex-employees of Metrovicks who contributed to this thesis related details independently of each other. Although it has not been possible to confirm the veracity of these claims, it seems likely that this was the case.

overall argument. The Marconi archive, however, did house a variety of useful in-house publications, especially technical journals such as the *British-Westinghouse Gazette* and later the *Metropolitan-Vickers Gazette*, that were published by the firm from 1912 onwards.[23] One periodical, *AEI News*, was an invaluable source of information offering a record of industrial activity both at Trafford Park and within the AEI network of companies, especially BTH at Rugby. It also offered a 'light-touch' commentary on research and development, especially where 'ground-breaking' innovations that would enhance the reputation of the organisation were concerned. More importantly for this study, however, was the fact that this magazine emphasised both the similarities and the differences between the long-standing rivals Metrovicks and BTH which sometimes had been difficult to access from other sources. In addition, the everyday working and social lives of the employees of all the constituent parts of AEI were highlighted here and this provided useful pointers to the way in which the paternalism of the workplace evolved and was accepted as the norm. *Topic,* an in-house newspaper detailing the activities of employees at Metrovicks in Trafford Park and other ancillary sites in the Manchester area, was also housed in the Marconi archive.[24] Numerous articles in *Topic* in the 1960s gave pointers to the history of the company, the day-to-day activities of members of the workforce, as well as giving details of apprentice training for young women. These were particularly useful in complementing knowledge gleaned from *AEI News.* The importance of this kind of

23 Bodleian Library. MSS Marconi 2859-2871 P.9.2 *Metropolitan-Vickers Gazette* 1937-1958; MSS Marconi 3089-3096 R.5.4.a *AEI Engineering* 1961-1967; MSS Marconi 3041-3066 R.4.5.a *AEI News* 1931-1956. Copies of these magazines, and others, have been lodged across a number of other archives but it has been impossible to find a complete 'run' anywhere.

24 MSS Marconi 3067-3077 R.4.5.6. *Topic.* Various copies

literature to the researcher should not be overlooked. At first sight some of the contributions appeared to border on the trivial, even anecdotal, but others proved to be germane to the analysis of how and why young women chose to enter such a 'forbidding' profession. Articles in *Topic* about apprentices of both sexes also proved to be of great value in this respect as they provided insights into their training experience during the time that it was being undertaken. These first-hand accounts avoided some of the problems associated with interviews conducted long years after the training took place, when details recalled were less likely to be sharply defined. Contemporary accounts such as these must also be tempered by the fact that the contributors were more than likely chosen by the firm to present a positive slant on the corporate image it wished to project. These would hardly have involved much in the way of criticism of the apprentice scheme itself or have commented on a raft of other issues, such as career progression, the company's attitude to competition and mergers, trading difficulties, relations with the shopfloor and so on, that might well have occupied them as older, fully-fledged members of the workforce. Plugging the gaps, therefore, has been vital and in this respect the Marconi archive offered a useful addition to this type of primary evidence even though, as at first anticipated, it was neither the best nor the most comprehensive resource accessed during the course of research for this study.

Without a doubt the Manchester Museum of Science and Industry (MOSI), the other main holder of Metrovicks' archival material, was an invaluable reference point. The company material lodged here was wide-ranging in scope and the collection provided not only copies of *AEI News* but also issues of *Rotor,* the

Metrovicks apprentice magazine. Information lodged in these publications gave a flavour of the kind of concerns that occupied the readership at particular moments.[25] The decisions by the respective editorial teams to 'flag up' particular issues drew attention to what they believed their general readership would find appealing and, given the nature of the publications, non-controversial. Much of this information, therefore, was illustrative of the benefits of belonging to an organisation that was proud of its paternalistic attitude towards its workforce; little was found in these volumes that offered a contradictory message. This did not detract in any way, however, from the usefulness of these sources as these monthly updates provided factual details about the activities of the personnel at Metrovicks and the other large industrial concerns that made up the AEI network during the 1950s and 1960s.

The MOSI archive was also remarkable for its store of company images, especially photographs, advertisements and publicity material. These added significantly to an understanding of how the Metrovicks site at Trafford Park rapidly developed at the turn of the twentieth-century and became one of the key industrial complexes in the country. The photographic evidence was particularly telling and showed in time-lapse fashion how the vast, purpose-built modern factory, constructed on American lines, was ushered into being by the founder of the company, George Westinghouse, whose 'over-heated' ambitions quickly resulted in financial crisis.[26] In addition, the collection of images gave some useful indicators as to the way in

25 MOSI YA.1999/39/46; YA.1999/39/47 *Rotor;* YA.1998.16 *AEI News*
26 MOSI, YMSO.76; 0531/1/2 Box 2 Souvenir Brochure '"Laying the Corner Stone". The Westinghouse Works', 3 August 1901

which the company carved out a corporate culture for itself and how this developed over the years. Glossy publicity material, in particular, promoted Metrovicks as the premier provider of apprentice training. Interestingly, these publications tended to focus as much on the social amenities of the Manchester hinterland as on the amenities provided by the firm. This may have been an attempt to emphasise the connection of the working environment to the bustle of a big city and the rural spaces beyond and to distance the firm from any idea that its status was the same as that of any other traditional, run-of-mill factory producing heavy engineering equipment. The corporate image of a research-driven, highly specialised facility peopled by exceptionally well trained skilled craftsmen and professional engineers was reinforced by the type of publicity lodged at MOSI. Tellingly, however, the literature held by MOSI in the Metrovick archive repeatedly failed to refer in any great detail to young women apprentices and focused attention almost exclusively on the position of male trainees. This meant that the history of young females proved to be more elusive and their place in the corporate culture of the Company largely undetermined within these sources. It is possible that the fact that a number of male ex-employees of Metrovicks who donated their own records to the MOSI archive skewed some of the material towards a representation of the male rather than of the female experience of apprenticeship training at Trafford Park. The varied nature of the documents offered by the MOSI collection helped to counterbalance this to some degree, and it was possible, therefore, to plug some of the gaps in evidence relating to their status within the company.

The archive was also home to the Ferranti collection, a smaller Manchester based family business, which shared some parallels with the Trafford Park concern. This material helped in the process of comparing and contrasting research and engineering projects. It also offered useful information in the form of marketing and publicity material, training brochures, workplace photographs, inter-company social activities and apprentice training which contributed towards a greater understanding of how both firms functioned during this period. In addition, some interesting examples of correspondence relating to the training of female apprentices in the earlier part of the twentieth-century emerged from the Ferranti archive and this helped to mark the contrast in attitudes between the two firms, and thus highlighted the pioneering aspect of Metrovicks thinking on this issue. Unfortunately correspondence of this nature has not emerged from any of the archives containing material from Metrovicks; such material which would have greatly enhanced the understanding of how the management of the company viewed the training of its own young women apprentices.

It was necessary, therefore, to turn to an archive curated by a female employee of the company to gain a better understanding of how young women apprentices were recruited, trained and supported during the period under consideration in this study. Isabel Hardwich donated her substantial archive to the Institution of Electrical Engineers, the largest professional engineering society in Europe. This contained papers related to her working life, her involvement with female apprentice training at Trafford Park and her participation in the educational activities of the Women's Engineering Society. As such, it provided a well-spring

of knowledge about the way in which women engineers viewed themselves and the work that they undertook in a variety of situations, both work-based and otherwise. This was a curated archive, rather than a collection dedicated to Hardwich's personal achievements. As a result, it indicated her preoccupation with the promotion of young women wishing to establish themselves within the industry, and with the support that was offered to them by the WES. The newspaper clippings which she assiduously collected, catalogued the numerous activities in which women engineers were involved, from investigating working conditions for women engineers in the former USSR to researching ways in which young engineers combined marriage and motherhood in the USA. Bearing in mind that these articles were selected by Hardwich and that there may have been inherent bias in her choice, there was still a wealth of material that catalogued matters of concern both to young trainees and to those already established as professional engineers. Issues of interest to Hardwich included the problems of recruiting young grammar school leavers and recent graduates as trainee engineers, how apprentice training was experienced by young women at Metrovicks and how the WES responded to various initiatives intended to encourage these young women to develop their skills in relation to the requirements of the profession. She also saw fit to collect a range of articles culled mainly from 'red-top' newspapers which indicated the way in which certain elements of the press depicted female engineers to a general public unused to the idea that women might wish to undertake a career in a male-dominated profession. As she did not annotate any of these cuttings, and many lacked page numbers or dates, it was not easy to discern whether these were given to her by her staff because they knew that she

took an active interest in this matter, or whether she set out deliberately to search for material of this kind.

Hardwich was a keen contributor at a number of conferences arranged to promote the technical and vocational education of young women during the 1950s and 1960s. Her speeches on these occasions have provided a useful insight into how she sought to encourage an up-and-coming generation to take on the challenges they would inevitably face when pursuing a career in a male-dominated environment. These conference addresses also gave some clues as to the reasons why she and her fellow members of the WES felt that they faced an up-hill struggle when trying to encourage young women to take an interest in a career that fell outside the traditional norms for their sex. Resources of this kind were anchored to archival material of a similar nature accessed at both MOSI and The National Archive and, as such, served as a useful cross-reference when researching the difficulties involved in promoting the pursuit of science and engineering amongst girls, their parents and teachers and society at large during the 1950s and 1960s. Papers that Hardwich retained about the activities of the WES focussed on this problem. Letters and notes also clearly indicated worries about a decline in WES membership, and the fact that the organisation did not attract young members; some hints about the reasons why this might have been the case came from oral testimonies collected during the course of research for this thesis. Hardwich's subsequent engagement with the American-based Society of Women Engineers (hereafter SWE) was made apparent in this correspondence. Indeed, she donated part of her archival material to the Society of Women

Engineers Archive lodged at Wayne State University, Michigan, USA, and some papers relating to her engagement with the Society gave an indication of her thinking on a variety of issues of concern to women engineers on both sides of the Atlantic.[27]

Her other correspondence was relatively meagre in content. Hardwich's working life at Metrovicks provided little in the way of personal correspondence with members of staff or with female apprentices. Her views on the topic of technical and vocational training and the place of women within that scheme, tended to be the ones she expressed on a variety of public platforms. As a result, there was a sense in which research into her relationship with Company personnel was hard to capture, although she retained much information about the social activities she and her husband enjoyed at Metrovicks which, along with WES events, appeared to have played a central part in their lives. Hardwich, however, did keep lists of female trainees who came under her aegis in the early 1960s. These have proved to be valuable sources of information about the level of training undertaken and the numbers of young women recruited, especially in light of the fact that the Apprentice Register, the most reliable source of information on these matters, had ceased publication by that date. These lists were not comprehensive, leaving questions about the degree of accuracy that Harwich was able to achieve when calculating her figures. Such material, therefore, remained open to conjecture. The same might also be said about her feelings in relation to the sometimes complex and problematic situations encountered by female apprentices within the

27 S[ociety] of W[omen] E[ngineers], http://www.reuther.wayne.ed/files/LR001536-pdf-UnitedStates

industry, especially in relation to finding work placements, or dealing with unsympathetic male colleagues. These remained somewhat opaque and her attitudes in this respect have had to be deduced more from her public pronouncements than from the more intimate information that might have been written in memoranda, notes, or in a cache of letters. All in all, however, the archive donated to the IEE by Isabel Hardwich proved to be one of the mainstays of this research. As such her collection, which appeared to have been largely overlooked until this point, provided an intriguing insight into the mind-set of an advocate who spent her working life in pursuit of the advancement of young women engineers within the industry.

The archive of A P M Fleming, the architect of the apprentice training system at Metrovicks, is also held by the IEE. Like that of Hardwich, this collection has been sadly neglected and thus is also ripe for other researchers to investigate and analyse so that the importance of his work can be reinstated. This material offered little in the way of information about his early life, nor did it give much indication of what he thought about the years he spent in the USA being trained at the Westinghouse Company which, arguably, was a seminal period in which he must have shaped his ideas about the practical aspects of technical and vocational education. The archive, however, abounded in the kind of literature that spelled out his theories on education and training and ranged in scope from speeches made to grammar school pupils to submissions to Parliamentary Commissions. Unlike Hardwich, Fleming occupied a senior position at Metrovicks at an early stage in his career, and his rapid promotion meant that his ideas had commanded

the attention of a wide audience both at home and abroad. His archive reflected this and contained the many addresses he gave to a panoply of organisations that were concerned with advancements in technical education and training. It was not difficult, therefore, to extract a good deal of information about the way in which he considered that the Metrovicks' model of apprentice training ought to develop. His emphasis on the provision of a broad strand of liberal education within these training schemes was made apparent in such speeches. In other less formal settings, in addressing grammar school pupils for example, his preoccupation with ideas of industry, perseverance, using talents wisely and maintaining good health, pointed to the way in which Fleming harked back to the Victorian precepts prevalent in his youth. These were ideas upon which he continued to base his philosophy of technical and vocational education and training, and to which he continued to refer in many speeches to young people throughout his career.

In the selection of material that has been preserved in this archive there was little to indicate that Fleming was overtly interested in promoting the training of female engineers but, on the other hand, none of his writings suggested that he thought that they should be precluded from entry into the profession. From this evidence he appeared, therefore, to have been a man of his times in this respect. His writings were peppered with references to the place of boys and young men within the industry, but neglected to mention the position of girls in the scheme of things. Transcripts of his addresses to the important Annual Dinners of the Apprentice Association highlighted the prominence that he placed on the fostering of a corporate culture at Metrovicks, which emphasised the masculine nature of the electrical engineering sector.

Fleming's collaboration with Miss E E Wilson, in the National Movement Towards a Christian Order of Industry and Commerce, was also contained in the archive. Their joint presentation at conferences run by the Movement owed something to his views on the development of a corporate culture at Metrovicks that affirmed paternalism as one of the defining features of the relationship between employer and employees and this will be scrutinised in this thesis. The inspiration that he took from his religious belief was apparent here and the documentation provided evidence of historical significance of the National Movement that was formed in the wake of the perceived threat of Bolshevism. Closely allied to his interests in this respect was Fleming's accent upon citizenship. In particular, this was reminiscent of the thinking of the renowned German professor and educational theorist Georg Kerschensteiner (1854-1932), who was the director of public schools in Munich between 1895-1919, and whose ideas had much currency in the early years of the twentieth-century.[28] This material also demonstrated Fleming's insistence upon ideas of duty, a belief in the primacy of Christian ethics and a desire to develop 'character', and thus offered valuable clues about the way in which he drew inspiration from the English public school tradition.

Fleming's archive reflected the fact that he was a public figure, much in demand for his views on technical and vocational education and lauded for his contribution to industrial research. There was surprisingly little in the way of letters, diaries and reminiscences in relation to his working life that were retained at the IEE and it

28 G. Kerschensteiner, *Education for Citizenship,* (London: Harrap, 1912).

may well have been that his various secretaries and assistants dealt with the routine correspondence that came his way and filtered out what was deemed irrelevant. In part, such omissions were off-set by copious articles, speeches, lectures, contributions to journals and reports and these helped to build a picture of the importance of the role that Fleming played in initiating and maintaining the high-level apprenticeship training for which Metrovicks was famed.

Files lodged within TNA were related directly to the employment and training of girls. The 1964 statistics regarding the total numbers of girls in employment included apprentices, others who were attempting to gain professional qualifications and those who had been given planned training at work. It was impossible to discern from these figures whether the small number of young women who were listed as undertaking apprenticeships in the manufacturing industries were indeed being trained as professional engineers. The information given was sparse and it was not possible to locate any more information of this nature within this part of the archive. Notwithstanding, a number of files related to the development of industrial training during this period. In particular, a 1954-8 International Labour Office (hereafter ILO) Enquiry into the provision of apprenticeships for women and girls was useful in both pointing out the complacency displayed by the Ministry of Education in this respect and the conservative attitudes surrounding the idea that young women might wish to train to become professional engineers. Other Ministry of Education documentation highlighted the contradictory nature of the messages about preparing girls for careers in industry. Pronouncements that agreed that girls were being put at an

unfair disadvantage where the provisions of apprenticeships were concerned, were countered by statements that suggested that this was not the case. The idea that girls were more preoccupied with marrying and raising a family than embarking on training for long-term careers was expressed here. A tranche of information supported the argument that widespread societal barriers prevented young women from embarking upon non-traditional careers and a number of press cutting inserted into this file gave credence to this view. Amongst this documentation the idea was often expressed that it was up to the industry itself to dictate the terms upon which girls who wanted to carve out a career in engineering would be welcomed. The type of institutionalised discrimination expressed in such material acted as a signpost to a wider understanding of just how difficult it was for young women to access training that was appropriate in order to develop their skills.[29] Such evidence opened up new lines of enquiry for this study. Concerns about government spending on training were also highlighted, especially in relation to the 1958 Carr Report and the Industrial Training Boards.[30] Correspondence conducted between civil servants regarding the initiatives undertaken by the British Association of Women Executives (hereafter BAWE) to encourage young women to aim to achieve high office in industry also pointed to the stubborn reluctance of government to offer any form of funding for these types of important projects. Summary dismissal of the BAWE proposals provided a useful indicator of just how difficult it was, even for senior women executives, to command attention. Sifting through extensive paperwork relating to technical education and training confirmed

29 TNA LAB 19/715. Letter to James Dance, MP, P.O.317/1964

30 National Joint Advisory Council (The Carr Report 1958), *Training for Skill: Recruitment and Training of Young Workers in Industry,* (London: HMSO, 1958); TNA LAB 51 Industrial Training Boards.

the priority that was given to the needs of young men at the expense of young women, where the assumption was made that it would have been difficult to encourage girls to embark upon a long course of study when marriage was their priority. These files, therefore, provided an important insight into government thinking on this issue and on the provision of technical training for young women wishing to embark upon the route towards becoming professional engineers in the 1950s and 1960s.

Archival research has been complemented by oral testimonies, although this study did not set out to be the type of project that concentrated heavily upon in-depth empirical research, pilot studies and all the extended fieldwork that this normally entails. Interviewees were not easy to locate and various types of appeal proved to be unsuccessful. Indeed, a request for information to a social organisation, once a vital hub for Metrovicks' workers and still retaining a link with older ex-employees, drew no response whilst an advertisement in a local history magazine elicited attention, though not from former female apprentices. Nonetheless, in order to investigate the extent to which young women during this period found it difficult to train as professional engineers, as some of the evidence from TNA and other archival material suggested, it was necessary to gather testimonies from a small number of volunteers in order to investigate aspects of their secondary education and their experience of work and training within the industry. The female ex-employees of Metrovicks who made contact worked in a variety of ancillary occupations. Five of these women offered useful evidence and, apart from one, all had been educated at local grammar schools and had gained

qualifications at GCE Ordinary and Advanced Levels. Although their training at Metrovicks had taken on a different form to that of female engineers, it was decided to include the information about their experience of a number of schemes run by the company to train laboratory assistants, secretaries, technical librarians, clerks, and tracers. These highlighted aspects of technical and vocational education that were common to the training schemes developed for women engineers but also provided a useful counterpoint to the situation in which the 'exceptional women' who went on to become professional engineers found themselves. In addition, the contributions of these women, alongside those of eleven male ex-apprentices, added information to the debate about the corporate culture embedded in the whole of the working population at Metrovicks and thus were vital to the progress of this study. Apart from one girl who had been awarded a place on the elite senior secretarial training course (the Steno Course), the others expressed varying degrees of dissatisfaction with their grammar school education and the subsequent careers paths that were available to them. Oral testimonies from other ex-girls' grammar school pupils have also been included here. Along with interviews lodged in the North-West Sound Archive, these were also utilised in order to gauge the extent to which the company provided an atypical response towards the aspirations of its female trainees during this period. The fact that these women recounted their training as teachers, bank workers and executive secretaries, rather than as engineers, did not detract from the fact that whatever career the young women in this study embarked upon, all of them had been brought up as members of what Spencer, in *Gender, Work and Education in Britain in the 1950s,* called the 'forgotten generation', who left school and university

and entered the workplace during this period.

It was difficult to find women who had trained as engineers during this period. One potential interviewee had been an aeronautics expert but would only agree to speak to me on an informal basis. Nonetheless, her insight into the way in which a male family member encouraged her in her late-entry career was of particular note and male influences on career choice will be duly examined. In order to locate 'elusive' women engineers of the period the current WES President, on my behalf, was able to make contract with three members of the Society who were willing to give oral testimonies about their time they spent in the engineering industry. These women provided invaluable insights into the importance that particular influences had upon them which initially propelled them towards considering engineering as a career. Further they described the extent to which their schooling contributed towards their ability to access the appropriate tertiary education courses which would enable them to study engineering; this was a matter of some concern in the post-war period and evidence from government agencies, industrial leaders and academics will be interrogated. They also described the different ways in which their decision to train as engineers was viewed by their schools, their parents and their wider social networks. Importantly, their views on the extent to which females were able to use their 'skill-sets' within a male-dominated industry provided a crucial entry into a discussion about the way in which the 'culture' of engineering industry made it difficult for women to capitalise in full upon their academic achievement. This issue will be discussed in detail in chapter four of this thesis. This complementary evidence proved to be

particularly effective in highlighting the issues that such women encountered throughout their working lives. Dame Margaret Beckett M P was the only Metrovicks female apprentice whom it was possible to interview whilst conducting research for this thesis. She expressed little surprise about this fact because, in her experience, so few young women were engaged in this capacity by the company during the period that she was a trainee. She felt, as well, that age had probably taken its toll and her attempt on my behalf to contact contemporaries who might have been willing to take part in this study failed to bring other contributors to light. The interview with Dame Margaret, however, proved to be particularly illuminating, especially in regard to the composition of the training she undertook as a Schools Apprentice within the organisation. The way in which Metrovicks handled the work placements of its female apprentices formed part of the wider discussion about how female skills and female technical competencies were viewed by the industry, and Dame Margaret made a number of useful comments about this and these will also be surveyed in the last chapter of this thesis. She also had much to say about the way in which the corporate culture at the company operated and her incisive comments on how this affected female apprentices will also be scrutinised. In addition, she had some apposite remarks to make about grammar school life in the 1950s and 1960s, especially in the Catholic sector. Her reading of the way in which the education of teenage girls often dulled their interest in, and hence impeded their access to, appropriate examination courses in mathematics, physics and chemistry also complemented secondary literature on the subject. The manner in which the aspirations of many pupils at girls' grammar schools were hedged by societal expectations, and the hurdles that were put in

their way as they tried to make it clear that they wished to pursue a career that was often considered to be 'unsuitable' for females was also mentioned by Dame Margaret. Her understanding of why this was so also contributed towards a fuller understanding of the problems faced by this segment of the 'forgotten generation' at an important juncture in their lives.

Historiography

In addition to the primary source evidence and the oral history dimension of this work, it was necessary to turn to a survey of the most pivotal of the secondary sources to mark out the way in which research undertaken throughout this study developed. The historiography used Metrovicks as the locus. The Trafford Park organisation has been little researched and the first chapter of this thesis makes this clear. As a result the potential exists for a more wide-ranging survey to take place than the one that is contained here. In order to place Metrovicks within the broader context of the electrical engineering industry during this period, it has been necessary to offer an overview of its history and a critique of its corporate culture as well as an examination of the delivery of apprentice training and industrial research by the company. The literature that was available to aid this process was not prolific and, as a consequence, it has had to be supplemented by analyses written about other, not dissimilar, industrial organisations. As such, this provided a means of comparing and contrasting the ways in which engineering companies dealt with the various issues that faced them during this era. Notable amongst these texts was the scholarly three-volume work by Wilson who delved deep into the history of the Ferranti organisation. The time-scale that he adopted,

however, meant that only his first two books, *Ferranti: A History – Building a Family Business, 1882-1975* and *Ferranti: A History Volume 2 – From family firm to multinational company, 1882-1975* were contemplated in depth during the course of this research.[31] By detailing the way in which the firm became a centre of engineering excellence and then expanded into a larger and more complex business, the breadth of Wilson's analysis provided a means by which these two particular companies could be compared and contrasted. The fact that Ferranti was established as a more modest, family concern did not detract from the worth of Wilson's observations about how economic and technological challenges were met by the electrical engineering industry during the twentieth century. His analyses pointed to the way in which these factors could be broached when examining a larger industrial concern such as Metrovicks. In addition, his exploration of the Ferranti commitment to both research and development, and to technical education leading to a technology-led strategy for growth, was detailed. In demonstrating how and why firms built 'team research' into the structure of their companies, Wilson's work helped to shape an understanding of the rather different way in which Metrovicks organised its efforts. Where Metrovicks was concerned there was no equivalent author of Wilson's stature to chart its history and so the starting point of this research concentrated on the books written by A P M Fleming in the early part of the twentieth-century. These were concerned with apprentice training, industrial research, the principles of industrial administration, as well as the history of engineering and of engineering as a profession. Apart from one text

31 J F Wilson, *Ferranti: A History – Building a Family Business, 1882-1975,* (Lancaster: Carnegie, 2000); *Ferranti: A History Volume 2 – From family firm to multinational company, 1882-1975,* (Lancaster: Crucible, 2007); *Ferranti and the emergence of the British electrical industry, 1864-1930,* (Manchester: Manchester University Press, 1991)

devoted to industrial research in the United States which Fleming wrote unaided, these works were co-authored with either J G Pearce, R W Bailey or with H J Brocklehurst. The relevance of these early examples of his thinking about the relationship between education and research should not be underestimated. It was hard to imagine that his was not the guiding hand behind all these publications as the arguments offered mirror those presented in numerous speeches and articles contained in his archive and reported widely in the press. Not only did these books demonstrate his belief in the way in which industrial research might aid the production process but they also denoted the emphasis he placed on training a highly skilled workforce in new industrial methods and practices. Indeed *Research in Industry,* written with Pearce in 1923, suggested that this provided the basis of economic progress; the text thus highlighted the necessity of systematically seeking new knowledge in order to introduce the most beneficial methods of production and the 'proper technical and social education' for every grade of worker.[32] His radical way of looking at how these two elements should intermesh and be of benefit to young trainees offered a fundamentally different interpretation of apprentice training to that of the 'premium' system that operated across the industry. Clues as to the philosophy behind this type of education lay in his earlier seminal work *The Principles of Apprentice Training,* also written with Pearce and published in 1916.[33] Here it was apparent that a variety of influences and examples taken from a number of European countries, as well as the United States, made him aware of the necessity for sweeping changes in the way in

32 A P M Fleming & J G Pearce, *Research in Industry: the basis of economic progress,* (London: Pitman, 1922)

33 A P M Fleming & J G Pearce, *The Principles of Apprentice Training with Special Reference to the Engineering Industry,* (London: Longmans, 1916)

which apprentices were trained. His emphasis on offering 'a modern example of apprentice training', however, throw up some challenging notions to a present-day audience and his insistence on the importance of heredity and environment, on 'artisan characteristics', as well as the relatively uncritical references he made to 'physiological characteristics,' made uneasy reading. These matters will be discussed in the main part of this thesis, especially in relation to his contribution to the corporate culture that the firm was beginning to develop in the first decades of the twentieth-century. His book spelled out the importance he placed on ensuring that, at the core of all schemes of instruction, there should be a strand of liberal education that promoted social and cultural activities as being analogous to the well-being of a professional engineer.

The history of technical education has been examined in great detail and carefully analysed by historians specialising in a field that has been well ploughed over the years even if few of these works concentrated on issues associated with the technical and vocational education of young women apprentices. This thesis makes little attempt to add to wide-ranging studies such as *The Missing Stratum,* Sanderson's overview of twentieth-century technical school education.[34] His argument that the provision of this type of education was subject to 'change and decay' during the 1950s and 1960s, which had profound implications for the economic well-being of British manufacturing industry, was a notion that harked back to Fleming's injunction to heed the consequences of such neglect. Sanderson, somewhat faintheartedly, managed to concede that both Fleming and

34 M Sanderson, *The Missing Stratum. Technical School Education in England 1900-1990s,* (London: The Athlone Press, 1994)

Metrovicks were supportive of Junior Technical Schools in the inter-war period but then paid no further attention to the far-sighted policies of the firm and its contribution to technical education and training. In *Education and Economic Decline in Britain, 1870 to the 1990s* he took his argument further, discussing the expansion of university education in the 1960s, the change in status of former Colleges of Technology, and hence the increase in numbers of students choosing to study science and technology at the beginning of the 1960s. Sanderson, however, took note of The Report of the Committee chaired by Frederick Dainton 'The Swing away from Science', the so-called Dainton 'swing' in popular terminology, which demonstrated once more that the popularity amongst students of the arts and social studies by the mid-1960s was reversing the earlier trend.[35] All of this made interesting reading, was highly informative, but came with a caveat. In a particularly important chapter on privilege and relevance, Sanderson's analysis married higher education and the public schools and thus managed to avoid any reference to the status of young women within these institutions, and this 'blind-spot' detracted from what might have been a more sensitive interpretation of the subject as a whole.

The issue of education and economic decline also occupied both Barnett in *The Audit of War: The Illusion and Reality of Britain As a Great Nation* and Wiener in *English Culture and the Decline of the Industrial Spirit*.[36] Both books, though

35 M Sanderson, *Education and Economic Decline in Britain, 1870 to the 1990s,* (Cambridge: Cambridge University Press, 1999); The Dainton Report (1968).

36 C Barnett, *The Audit of War: The Illusion and Reality of Britain as a Great Nation,* (London: Macmillan, 1986); M.J. Wiener, *English Culture and the Decline of the Industrial Spirit,* (Cambridge: Cambridge University Press, 1981)

written in the 1980s, and in many respects politically charged, were interesting to contemplate. Both needed to be examined in the light of waxing and waning of the economic fortunes of Metrovicks in the post-war period, and in relation to the way in which aspects of the corporate culture that developed within the Company paid homage to the public school ethic and, as a result, neglected its female apprentices. Much attention has been paid to Barnett's contention that the long post-war decline of British industry stemmed from deficiencies that were already apparent during the war. His indictment of what he considered to be the unrealistic plans to create a 'New Jerusalem' at the expense of the modernisation of the industrial base was intended to be provocative and, understandably perhaps, was required reading by Conservative politicians at the time of its publication.[37] In considering Barnett's thesis Edgerton believed that, in any case, 'the idea of war as an audit of a nation' was 'dubious' and he went on to suggest that Barnett was 'misleading and often simply wrong in details', especially where technical education and the nature of the British elite were concerned.[38] Indeed, Edgerton's trenchant criticism of Barnett's notion that examples of the expansion of scientific and technological education were 'exceptional' made sense in terms of how the senior management at Metrovicks had positioned the company as an outstanding provider of technical and vocational education.[39] Cooper made this abundantly clear in 'The early development of scientific research in industry: the case of Metropolitan-Vickers Limited 1901-1933', a paper which provided a much needed insight into the origins and development of scientific research within the

37 Barnett, *Audit of War.*
38 Edgerton, 'The Prophet Militant and Industrial: The Peculiarities of Correlli Barnett', *Twentieth Century British History*, 2:3 (1991) pp. 368, 370
39 Edgerton, 'The Prophet Militant', p. 372

organisation.[40] These criticisms contained intellectual currency that was hard to discount. There were, however, still some valid reasons for using these texts, if only to question the relevance of the 'Barnett/Wiener' thesis to the Metrovicks model of industrial organisation, corporate culture and, more importantly, to its model of technical and vocational education and training.

It was hard to ignore Simon's *Education and the Social Order, 1940-1990,* which offered a much needed chronological narrative of changes and developments in the education system since 1944.[41] In *Education in the Post-War Years,* Lowe added little to the debate about technical and vocational education during this period, but his critique encompassed the social dimensions both of the coming of affluence and of higher education in the years between 1951-1964. As a result, his book contained many of the important arguments that surrounded the grammar school education of the 'forgotten generation' of which female apprentices were members. [42] In addition, McCulloch's *The Secondary Technical School: A Usable Past?* looked at attempts to provide an alternative to the grammar schools and demonstrated the fact that the pre-war Junior Technical Schools, whose task was to orientate pupils towards technical, commercial or industrial education, faltered through want of resources and a lack of prestige.[43] His detailed account offered an historical dimension to the tripartite system established in the wake of the 1944 Education Act. By its terms of reference, however, it did not add significantly to the

40 T Cooper, 'The early development of scientific research in industry', pp 84-105
41 B Simon, *Education and the Social Order, 1940-1990,* (London: Lawrence & Wishart, 1999)
42 R Lowe, *Education in the Post-War Years: A Social History, 1945-1965,* (London: Routledge, 1988)
43 G McCulloch, *The Secondary Technical School: A Usable Past?,* (London: Falmer Press, 1989)

debate about the problems that girls' grammar school pupils faced when attempting to access workplace technical education and training as a preparation for professional careers in the engineering industry.

A number of useful papers provided additional background information that helped towards an understanding of how technical education developed over time. Peters' paper 'The Changing Idea of Technical Education', and *British Further Education: A Critical Textbook*, as well as Benavot's paper 'The Rise and Decline of Vocational Education', were amongst the better examples of this genre. In addition, Venables gave much thought to the impact of the Robbins Report and his paper 'Technical Education in Great Britain: Second Thoughts on the Robbins Report' was an incisive review written two years after the publication of the Report and, as such, gave some hint as to how contemporary commentators viewed recommendations which were regarded as being far-sighted for the period.[44] That these texts failed to give space to the position occupied by young women who wished to take up careers in the engineering sector was not surprising. Their 'invisibility' was not often remarked upon during this period.

Summerfield and Evans's *Technical Education and the State Since 1850: Historical and Contemporary Perspectives* covered much ground and in the introductory chapter the three main themes around which the editors chose to

---

44 A J Peters, 'The Changing Idea of Technical Education', *British Journal of Educational Studies,* 11:2, 1963, 142-166 and *British Further Education: A Critical Textbook,* (Oxford: Pergamon Press, 1967); A Benavot,'The Rise and Decline of Vocational Education', *Sociology of Education,* 56 (April 1983, 63-76, P Venables, 'Technical Education in Great Britain. Second Thoughts on the Robbins Report', *International Review of Education,* 11:2, (1965), 151-164

base their study were carefully explained.[45] They dismissed both Barnett and Wiener's 'grandiose explanations' as being 'not necessarily helpful' and demanded a closer scrutiny of the history of technical education, including an examination of the problem of definition, a review of the role of government and an analysis of the response of employers.[46] This was a more measured way of approaching the topic than many other studies. Summerfield and Evans provided a number of useful pointers as to how further analysis might be shaped. Of particular importance was the resistance to technical education displayed by many within the university sector who were preoccupied with issues relating to status and class. This was a factor that the editors conceded was 'consistent with Wiener's interpretation of the relation between British culture and education', a factor which will be examined in the main body of this thesis.[47] Echoing some of Dintefass' reading of the issue, they also suggested that the ideas of 'liberal education' which emphasised 'the ethic of service' were required not only for senior government employees but also for industrialists. As a result vocational training became 'otiose', a situation that continued in the post-war period and this was an important argument that will be scrutinised at a number of points in this thesis.[48] The response of employers to the problem of the shortage of technologists in the 1950s and 1960s was hindered by the fact that 'industrialists were not consulted about the best way to supply them or the numbers required' and, so technical education was not given a national direction. Indeed the recommendations of the

45 P Summerfield & E Evans, (eds.), *Technical Education and the State Since 1850: Historical and Contemporary Perspectives.* (Manchester: Manchester University Press, 1990)
46 Summerfield & Evans, p. 1
47 Summerfield & Evans, p. 4
48 Summerfield & Evans, p. 11

1945 Percy Report *'Higher Technological Education'* which made reference to both colleges and universities, and the 1946 Barlow Report, *'Scientific Manpower'* which recommended that more university places be given to science students, had not been carried out. [49] Summerfield and Evans managed to draw out many of the complicated strands that made up government policy at this time and made the point that the Ministry of Education was not consistently *laissez-faire* in its approach and that employers failed to form a powerful interest group to urge state-directed education.[50]

It was not difficult to identify secondary literature focussing on the social and political changes in the 1950s and 1960s, but the place occupied by young women during this period has been, by and large, neglected. Spencer posited one way of representing the 'forgotten generation', her appellation for those whose childhood was marked by the austerity of post-war Britain, whose adolescence was shaped by the promise of 'You've Never Had It So Good' and whose early adulthood was marked by rapid social and cultural changes in the 1960s.[51] If the history of most members of this generation has been overlooked, then the place occupied by those young women who were preparing themselves to become professional engineers during this time has been further marginalised and neglected. This thesis, therefore, sets out to redress the balance between this and the more generalised surveys of culture, power and identity that sought to throw light upon

49 Summerfield & Evans, p. 11. Ministry of Education (Percy Report), *'Higher Technological Education',* (London: HMSO*,* 1945); Lord President of the Council (Barlow Report). *'Scientific Manpower",* (London: HMSO,1946)
50 Summerfield & Evans, p. 11
51 Spencer, *Gender, Work and Education*

the place of women in society in the mid twentieth-century.

Even the most astute and sympathetic female chroniclers of the period, such as Dyhouse, Wilson and Heron, have trodden lightly in this area despite the obvious influence that entry into the world of work had on the lives of these young women. Spencer, however, provided a way into this study and her focus on the career aspirations of the 'forgotten generation' was a much needed addition to the literature. Wilson's *Only Halfway to Paradise* was an elegant assessment of the period before the emergence of the women's liberation movement which, unlike Spencer's survey, extended the debate into the latter part of the 1960s. Her range was wider than that of Spencer, covered more political ground and, importantly, devoted two chapters to an analysis of the cultural landscape of a period when ideas of feminism lay dormant and 'where it was difficult to articulate or know about any oppression of women'; this had particular resonance when examining the ways in which female apprentices were marginalised in the workplace. [52] Wilson provided an intellectually stimulating argument but, unlike Spencer, she did not predicate her discourse on the place of the young in society. Instead she chose to paint on a wider canvas, although she came to the same inevitable conclusion that 1950s English society was clearly marked along gender lines. *School Leavers. Their Aspirations and Expectations,* Veness's classic study published in 1962*,* provided new ways of looking at schooling and the transition into work and, as a sign of the way in which young people felt these issues during

52 E Wilson, *Only Halfway to Paradise. Women in Postwar Britain: 1945-1968,* (London: Tavistock Publications, 1980), pp. 207**,** 124-162

this period, formed an integral part of this study.[53] Reporting and analysing parental expectations, adolescent preoccupations and career choices, Veness also provided an invaluable guide to the motivational patterns of young people and the way in which they viewed ambition, status and achievement and her findings shed light on issues that were central to the lives of these young girls during this era. In addition, *Truth, Dare or Promise,* Heron's edited collection of vignettes written by girls who grew up in the Fifties, gave voice to many of the issues discussed by both Spencer and Wilson.[54] It also demonstrated the extent to which individuals who benefitted from the provisions of the 1944 Education Act and the introduction of the Welfare State continued to grapple with the fact that equality was 'a long way off'.[55] Dyhouse's survey of the young women who lived through this period, *Girl Trouble*, however, took a somewhat different tack from these works by concentrating on what she called the 'anxiety and social unease' that had surrounded the changes in young women's lives since Victorian times.[56] In charting their progress from the 'Baby Dolls' of the 1950s to the 'Dolly Birds' of the 1960s Dyhouse added another dimension to the social history of this decade, putting into context some of the changes that were taking place when a 'widening of educational opportunities was slowly raising aspirations' but also 'increased the frustration and conflict that would eventually drive social change'.[57] Sharpe, too, examined the contradictions in female education during the 'long' 1950s in '*Just*

53 T Veness, *School Leavers.*
54 L Heron (ed.) *Truth, Dare or Promise. Girls Growing Up in the Fifties,* (London: Virago Press, 1985)
55 Heron, p. 8
56 C Dyhouse, *Girl Trouble. Panic and Progress in the History of Young Women,* (London: Zed Books), p. 7. She pointed out the difficulties in finding the correct terminology to describe females from adolescence to early adulthood and used the terms 'girls' and 'young women' interchangeably. This seems to be sensible and will be employed in this thesis,
57 Dyhouse, p. 134

Like a Girl'. How Girls Learn to be Women, and suggested that 'school does not give equal opportunities to girls and boys' whatever 'egalitarian ideology it may seem to represent' and this resulted in girls being 'still schooled with the marriage market in mind' although 'this may not be acknowledged consciously'.[58] Whilst she based part of her study on a cohort of working-class girls whose opportunities were more limited than those of the female apprentices at Metrovicks, there was much in this analysis that mirrored the concerns expressed by members of the WES about what Sharpe called 'the double-bind situation'. [59] She suggested that 'if girls go after what society deems most important', which she defined as succeeding 'academically', then 'they may lose in femininity', and by further considering 'the irrationality of sex-stereotypes' in the job market she made some pertinent comments about the degree of 'self confidence and courage' needed by young women in order to break through 'the prejudice that surrounds entry into male-dominated careers'.[60] She argued that 'the bias against industry', and especially against the engineering sector, held true when 'real opportunities' were 'manipulated by employers (invariably male) who hold the power' and who had 'highly reactionary ideas about women and their role' as indeed did many male employees because they too were 'exploited' and so held 'grimly on to the exclusiveness of their skills'.[61] Sharpe thus pointed out the many contradictions faced by young women who were trying to establish themselves in the industry during this time. Her arguments were germane to the examination that will take

58 S.Sharpe, *'Just Like a Girl'. How Girls Learn to be Women,* (Harmondsworth: Penguin Books, 1976), p. 130
59 Sharpe, p.133
60 Sharpe, pp. 173, 176
61 Sharpe, p. 177

place in chapters three and four of this thesis as were those of a number of authorities working in the field, most notably Cockburn, Kelan, Hacker, and McIlwee and Robinson.[62] These crucial texts went some way towards elucidating the difficulties faced by women when male engineers both defined and displayed technical competencies in the workplace in ways that were not always congruent with a female experience. The fact that women were far less likely to define and present these skills in the same way as men caused confusion and resulted in a lack of appreciation of the level of expertise they were able to offer. The resultant diminution of prestige in a male dominated environment was brought into sharper focus when both archival material and oral testimonies were also examined and these contributed towards the further development of one of the key themes in this study. Thus, the problems with which young female apprentices at Metrovicks had to contend were related to a masculine interpretation of what it meant to be an engineer. The way in which engineering skills were demonstrated underlined the notion that such competencies belonged to a 'masculine' rather than a 'feminine' domain. These issues formed a major part of a debate that had not previously focussed on those females who were members of the College and Schools Section of the Apprentice Association at Metrovicks. That these apprentices also formed part of Spencer's 'forgotten generation' meant that expectations about the direction in which their education and their future careers might evolve became part of a protracted, and sometimes confusing debate, about the place of young women in society in general. An examination of this discourse formed a necessary background to the understanding of how the aspirations of many girls were

62 C Cockburn, *Machinery of Dominance:* ; E Kelan, *Performing Gender at Work*; S Hacker, *Pleasure, Power, and Technology*; J S McIlwee & J G Robinson, *Women in Engineering*

thwarted but in so doing it also provided a means by which to evaluate the background and the achievements of the minority of 'exceptional' girls who wished to become engineers.

Perhaps inevitably the panoramic surveys of the era by historians such as Kynaston and Hennessy, both of whom wrote in depth about the singularity of the times, failed to allocate much space to the circumstances in which the female population led their everyday lives, let alone contemplate workplace training and employment opportunities for those leaving full-time education. Thus, Kynaston's trilogy *Austerity Britain 1945-51, Family Britain 1951-57 and Modernity Britain 1957-59,* was a fascinating and eminently readable account of the minutiae of everyday life, which offered pointers to the direction in which analysis of some of the societal expectations placed on young women might proceed.[63] It, however, did not offer more than that. Likewise, Hennessy's surveys of the post-war period, *Never Again:Britain 1945-51* and *Having It So Good: Britain in the Fifties,* arguably, tended even more towards androcentrism.[64] Even the illustrations he chose consisted mainly of men and, after surveying his material, the impression remained that the place of young women was marginalised in these volumes. Hennessey's work had value as a guide, especially to the Cold War politicking of the era and of the way in which British society continued to be shaped by wealth, power and influence, but it did not shed light on issues of more immediate concern

63 D Kynaston, *Austerity Britain 1945-51,* (London: Bloomsbury, 2007); *Family Britain 1951-57*, (London: Bloomsbury, 2009); *Modernity Britain. Opening the Box, 1957-59,* (London: Bloomsbury, 2013)

64 P Hennessy, *Never Again: Britain 1945-51,* (London: Penguin Books, 2006); *Having It So Good: Britain in the Fifties,* (London: Penguin Books, 2007)

to this study.

Although she made no pretence of offering an academic discourse, in *Perfect Wives in Ideal Homes* Nicholson's evocation of the lives of women during this period was well researched and, in many respects, better captured the myriad ways in which 'Britain in the 1950s remained a world of stereotypes and impossible ideals' which 'tolerated intolerance, and sanctioned sexism'.[65] Giles had much to say about women's lives in the 'private' sphere and '*The Parlour and the Suburb'* provided an interesting counterpoint to the argument that conflated women, home and femininity 'as more or less synonymous' and 'marginal to the Enlightenment project of producing a rational and democratic moral order'.[66] Her narrative was not directly related to the immediate experience of young female apprentices but it provided a different reading of the period and claimed that 'the forces of modernisation' which 'transformed domestic life' and which 'produced opportunities for change' were 'beneficial for millions of women'.[67] Giles' interpretation suggested that change could also be compatible with the embracing of a professional career in a male-oriented industry and this was also a matter of concern to members of the WES. Her analysis offered a new way of examining some of their prevailing notions about the fear of eschewing domesticity and, consequently, of being regarded as lacking in credentials that were essentially feminine. Unlike *Young Women, Work, and Family in England, 1918-1950,* Todd's recently published large-scale survey of the rise and fall of the working-class, *The*

65 V Nicholson, *Perfect Wives in Ideal Homes: The Story of Women In The 1950s* (London: Viking, 2015), p. 405
66 J Giles, *The Parlour and the Suburb,* (Oxford: Berg, 2004), p. 11
67 Giles, pp. 4-5

People, only devoted part of her analysis to the working lives of young women. [68] In any case, the employment experience of Todd's subjects was somewhat different from that of the female apprentice cohort at Metrovicks in the 1950s and 1960s most of whom, especially the graduates, were better described as resolutely middle-class in origin. Nonetheless, Todd provided a useful analysis of the era that came to be defined by Macmillan's 'alluring message' that the population had 'never had it so good', and her argument that 'the 1950s was a paradoxical decade' was one that proved to be central to much of this work. [69]

Todd's succinct analysis of what she called the 'Golden Age' of the grammar school also formed an important part of the subject matter of this thesis.[70] Her narrative added little that was new, and that had not already been suggested in classic works such as Hoggart's *The Uses of Literacy* and Jackson and Marsden's *Education and the Working Class.*[71] Like them, she explored the dislocation felt by those girls whose teachers 'dissuaded' them from staying on into the sixth form, but she did, however, bring some of their original findings up to date. In pointing out that 'just 4 percent of eighteen and nineteen-year-olds attended university during the 1950s, although a quarter of their age group achieved the entry requirements', Todd stressed that the expansion of the universities, following Robbins's recommendations (which were only implemented when Labour took power in 1964), came 'too late' for the first generation which had received its

68 S Todd, *Young Women, Work, and Family in England, 1918-1950,* (Oxford: Oxford University Press, 2005); *The People. The Rise and Fall of the Working Class, 1910-2010,* (London: John Murray, 2014)
69 Todd, *The People,* p. 211
70 Todd, pp. 216-235
71 Todd, p. 231; R. Hoggart, *Uses of Literacy,* (London: Chatto and Windus, 1957); B Jackson & D Marsden, *Education and the Working Class,* (Harmondsworth: Penguin Books, 1966)

secondary education under the 1944 Education Act.[72] As a result, as she rightly pointed out, whilst many grammar school educated members of the 'forgotten generation' worked in industry as laboratory assistants, draughtswomen, or clerical workers, few were given the opportunity to graduate and then to train as professionals, especially in male-dominated areas like the electrical engineering industry.

A number of other books also explored the limitation imposed by girls' grammar schools in relation to both academic and social expectations. Evans' *A Good School,* analysed the cultural and social homogeneity of these schools and she put forward the case that they were 'riddled with contradictions' [...] 'crucially' over the matters of education for girls and 'the limits of the importance of education in, and to, the class structure'. She thus opened up the debate about the changes that were beginning to take place in the 1960s when the middle class 'if only marginally' was being asked to 'consider its place in the world'.[73] These matters will be examined more closely in the third chapter of this thesis. Evans also gave food for thought about the dichotomous role of grammar schools which pushed a minority of pupils to pursue academic prizes but, as Blackstone suggested, had 'too low' expectations of the post-school destinations of the rest.[74] Where teaching, nursing and secretarial work were designated as norms, the traditional view of the place of women in a 'class based social order' was easily maintained

72 Todd, p. 232
73 Evans, *A Good School,* p. 41
74 T Blackstone, in *Girl Friendly Schooling,* (eds.) J Whyte, R Deem, L Kant & M Cruickshank, (London: Methuen, 1985), p. xiv

throughout this period.[75] These recollections about the ways in which the grammar schools were organised and how they functioned on a day-to-day basis mirrored much of what other investigations and reminiscences described; Rowbotham's *Promise of a Dream,* and Bennett and Forgan's *Convent Girls,* were notable amongst other examples of the genre.[76] These factors also came out strongly in many of the oral testimonies collected for this study. Dame Margaret Beckett also highlighted the fact that little had been written about the academic shortcomings of many grammar schools, especially the enclosed institutions of the direct grant convent grammar schools; the possibility of a larger study that does not merely pander to the received wisdom about the efficacy of this type of eduction is overdue.

Whilst she did not concentrate her attention on the grammar school sector, Deem looked at socialisation and culture in the education of girls and in *Women and Schooling* she gave thought to the ways in which schools 'have many subtle ways of indicating to children which aspects of culture they are supposed to absorb'. [77] As such, she entered the argument about education as 'a process of indoctrination' in which the subordination and differentiation of women on the grounds of sex' took place.[78] Deem's analysis, therefore, added to the examination within this study of the extent to which women engineers were unable to challenge either the ideology or the structure of the sexual division of labour. In

75 Evans, p. 111
76 S Rowbotham, *Promise of a Dream: Remembering the Sixties,* (Harmondsworth: Penguin Books, 2001); J Bennett & R Forgan (eds.), *Convent Girls,* (London: Virago, 1991)
77 R Deem, *Women and Schooling,* (London: Routledge & Kegan Paul, 1978), p.22
78 Deem, p. 23

Schooling for Women's Work, edited by Deem, her contributors also offered a wide-ranging set of papers on the relevance of gender and, whilst these were essentially sociological exercises, the work undertaken by MacDonald on socio-cultural reproduction and women's education examined the way in which schooling 'constructs, modifies and transmits specific definitions of gender' which were located 'within and across class boundaries'.[79] In light of this, her examination added another dimension to the female educational experience, especially where her argument centred on the idea that the 'contradictory nature' of women's position in society was 'accentuated' through schooling rather than being 'resolved through it'.[80]

If Todd *et al* argued that many girls were ill-served by their grammar school education, Ollerenshaw provided a robust analysis of the 'exceptional' girls whom she felt might best benefit from the 'hot-house' atmosphere that was a necessary preparation for entry to university. In *Education for Girls* she invoked some of the ideas already expressed by Newsom in his earlier, and controversial, *The Education of Girls*.[81] It goes without saying that the young women who embarked upon their training as professional engineers at Metrovicks were regarded as 'exceptional', and the earlier history and progress of pioneering women like them has been charted in works such as Robinson's *Bluestockings* and Nicholson's *Singled Out*.[82] Ollerenshaw and Newsom were adamant, however, that few girls

79 M MacDonald, 'Socio-cultural reproduction and women's education', in *Schooling for Womens Work,* (ed.) R. Deem, (London: Routledge and Kegan Paul, 1980), pp. 13-25
80 MacDonald, p. 25
81 K Ollerenshaw, *Education for Girls*; J. Newsom, *The Education of Girls*
82 J Robinson, *Bluestockings,* (London: Penguin Books, 2010); V Nicholson, *Singled Out,*

were equipped to join the ranks of the elite and their writings provided explanations as to why they believed that this was the case. Their deliberations on the issue provided interesting, and often challenging, sets of assumptions about the ability of most young girls to profit from what they considered to be the necessarily intense and academic nature of the education provided by the girls' grammar schools in the post-war period. Both authors subscribed to the view that the few 'exceptional' girls who were capable of benefitting from the rigours of this system should be quickly identified and nurtured so that they could proceed to university to continue their studies. In their opinion, the rest needed to be offered a good general education in preparation for their future roles as wives and mothers. These views were not out of kilter with those held by many members of the general public during the 'long' 1950s and, as such, posed a dilemma to 'exceptional' girls who set their sights upon becoming professional engineers. Their own place in a society that appeared to extol the traditional virtues of marriage and motherhood above that of embarking upon a professional career involved many of them in a delicate balancing act. At one and the same time, they felt it necessary to proclaim their 'femininity' in order to assuage those who might doubt that they possessed this quality whilst also presenting themselves as technically proficient, highly motivated individuals with the ability to compete with their fellow practitioners in a competitive environment, arguably traits more readily associated with male than female engineers. This formed another important strand of the argument central to this thesis, namely that the skills and competencies possessed by women apprentices presented them with dichotomies that were

---

(London: Viking, 2007)

hard to resolve. Although regarded as 'exceptional' young women, the 'complications' surrounding the way their 'gender characteristics interacted with the environment' of the workplace appeared to put them at a disadvantage in relation to their male counterparts and this factor will be looked at in greater detail in chapter four.[83]

The history of workplace cultures that favoured male attributes and male skills has been investigated by a number of authorities. Although Summerfield's monumental *Women Workers in the Second World War: Production and Patriarchy in Conflict* could hardly be ignored as an important source of reference, she addressed the position in which older married women found themselves 'for the duration'.[84] Indeed, she stated that the focus of her work was the 'making and implementation of official policy towards women' during the war and, as a consequence, chapters concerned with child care, shopping, mobilisation and 'dilution' did not correspond directly to the experience of the 'forgotten generation'.[85] In relation to both 'the private zone' of women's work in the home and to paid employment, as Summerfield asserted, 'continuity with pre-war attitudes and practices' was 'considerable', despite 'the expectation of change during the war'.[86] Absorbing women into the industrial structure 'could have broken down' the division between women and men's work but the 'tenacity' displayed by employers to do otherwise, she argued, was a demonstration of the

83 McIlwee & Robinson, p.121
84 P Summerfield, *Women Workers in the Second World War: Production and Patriarchy in Conflict,* (London: Routledge, 1989)
85 Summerfield, p. 2
86 Summerfield, p. 1

conflict between the analysis of women in capitalism and the analysis of patriarchy during this period and, as such, provided a context in which to examine these issues in the light of the experiences of a younger generation of women.[87]

One of the main reasons for embarking upon this study was that there appeared to be a gap in the knowledge that needed to be plugged about the way in which female apprentices operated in the immediate post-war. It was, therefore, one of the main intentions of this study to address some of the issues that had escaped the attention of many of the most diligent historians of the period. The most relevant texts were written in the 1980s and 1990s and unlike Summerfield's exposition of female workers during the Second World War, or Braybon's *Women Workers in the First World War: The British Experience,* important analyses of the workplace experience of young professional women in the electrical engineering industry during the 1950s and 1960s were few and far between.[88] Little secondary literature went to the heart of what trainee engineers thought of their situation, those female apprentices operating at the margins of what was deemed acceptable as a career option. Hacker's 'The Culture of Engineering: Women, Workplace and Machine' was rooted in an American experience but nevertheless looked at the various examples of what she called the 'domination and exploitation of women'.[89] In *Pleasure, Power and Technology,* she added to her wide-ranging investigation into how 'engineering education often serves to maintain gender

87 Summerfield, p. 3
88 G Braybon, *Women Workers in the First World War: The British Experience,* (London: Croom Helm, 1981)
89 S Hacker, 'The Culture of Engineering: Women, Workplace and Machine', *Women's Studies International Quarterly*, 4:3 (1981), pp. 341-353

stratification during periods of rapid change', and highlighted a factor that was also taken into account by Summerfield.[90] This, however, was essentially a sociological survey and whilst Hacker had some sharp observations to make about the way in which she felt that women were ignored and controlled, she did not always add a great deal to a wider understanding of the dimensions that made up the vocational and educational training process in Britain in the mid twentieth-century. Instead her analysis wandered into what she called 'the eroticism of power and powerlessness', described by her as the 'hierarchical, unequal relations between and among men and women'. [91] Much of what she said was thought-provoking in relation to the position that young women engineers and scientists found themselves in when operating in an almost entirely 'masculine' working environment, and the subject of gender inequality will be raised within the body of this thesis. Although there were many short-comings in a text that was centred on conditions in the United States, Eisenhart and Finkel's survey *Women's Science* dealt with work in areas that the authors described as 'outside elite science', such as the electrical engineering industry.[92] They explained how women were 'treated poorly' in workplaces by being excluded from decision making, overlooked for promotion 'and made the brunt of jokes', and went on to interrogate a number of authorities whose accounts of the reproduction of subordinate status they critically appraised.[93] Their work had a great deal of relevance and offered a framework within which to examine some of the reasons why 'the power relation between women and a dominant group in science has somehow been maintained' but

90 Hacker, *Pleasure, Power,* p.xviii
91 Hacker, p. 10
92 M A Eisenhart & E Finkel, *Women's Science,* The University of Chicago Press, 1998), p. 38
93 Eisenhart & Finkel, pp. 39-43

usually at the expense of women themselves.[94] Whilst looking at equality of opportunity in technical education, in vocational training and in employment in *Jobs for Women,* Borcelle also investigated some of the ideas taken up by the previous authors.[95] Although concise, this text was informative and gave some useful background information on a number of issues about equality that will be taken up in this study. In *Women in Engineering,* McIlwee and Robinson also looked at the relationship between gender, power and workplace culture. Again, this work was Amero-centric, and dealt with prevailing conditions at the end of the twentieth-century. Their research, nevertheless, looked at many of the problems that faced young women in mid-century such as segregation, status, and career mobility. Looking at two major theoretical perspectives on women in the workforce, they investigated gender roles and the structural characteristics of school, family and the workplace. This provided additional evidence from which to analyse and evaluate the technical and vocational education of the young female apprentices at Metrovicks. Carter and Kirkup's *Women in Engineering:A Good Place to Be?* reviewed this territory from both a British and an American perspective. Their work gave an overview of the position of women who were engaged in the profession in the last quarter of the twentieth-century, and the authors gave some thought to the issue of combining work with domestic life. Importantly, Carter and Kirkup also looked at the many reasons why female engineers were first inspired to take up a career that was viewed as a decidedly 'masculine' occupation and they offered a useful critique of the preoccupation by female engineers with their career advancement and of their experiences of

94 Eisenhart & Finkel, p. 42
95 G Borcelle, *Jobs for Women: A Plea for Equality of Opportunity,* (Paris: UNESCO, 1985)

discrimination. [96] In similar vein, Mearns and Flin in *Women and Higher Education* looked at the role played by women engineers in the offshore oil industry during the same period and their conclusions were broadly in line with those of Carter and Kirkup.[97] In pointing out the difficulties that faced women in their attempts to make progress when they were 'outside the male group culture of their peers', this paper highlighted the same kind of problems that young female apprentices at Metrovicks had to contend with in the 1950s and 1960s.[98] These studies were, on the whole, representative of the literature that existed on the topic, and all of them provided a theoretical framework upon which some of the arguments contained in this thesis were examined and developed. Little that was contained in these overviews applied to the situation that appertained during the period covered by this study; even Cockburn's classic work *Machinery of Dominance* was still limited by the fact that she based her work on prevailing conditions in the 1980s. It would be hard to dismiss them on this basis, however, and the authors provided many acute observations about the ways in which women engineers were regarded both in the workplace and by society at large. In addition, the significant obstacles that many of them faced whilst trying to navigate their way around the complexities of a male-orientated workplace culture were examined within these texts and they have served to highlight many of the important issues that needed to be developed in this respect.

---

96 R Carter & G Kirkup, *Women in Engineering: A Good Place To Be?,* (Basingstoke: Macmillan, 1990)

97 K Mearns & F Flin, 'Applying science in a man's world: women in science, engineering and technology in the offshore oil industry', pp. 65-72 in *Women and Higher Education. Past, Present & Future,* (eds.) M R Masson & D Simonton, (Aberdeen: Aberdeen University Press, 1996), pp.65-72

98 Means & Flin, p. 66

The issue of gender and patriarchy at work has occupied many academics who, influenced by second-wave feminism, presented discourses on power and the labour process. Their investigations cast light on many of the issues that will be scrutinised in this thesis, even though they too rarely discussed directly the experiences of young women during the 1950s and 1960s. Whilst Lerner's *The Creation of Patriarchy* has been considered to be one of the seminal works in feminist theory, Walby's *Theorizing Patriarchy* provided a more useful point of reference in terms of explaining both a patriarchal and a capitalist structure.[99] Her densely argued case examined the debate between what she called the 'rather crude ideal types' of radical feminism, Marxist feminism and liberal feminism. She provided, therefore, an important theoretical base from which to work. In *Patriarchy at Work,* however*,* she concentrated on the situation facing shop-floor workers; only in very general terms could their experience be said to have equated with that of young women training to become professional engineers. *Gender Inequality at Work,* was a more relevant collection of employment-related papers edited by Jacobs and referred to issues such as earnings inequality and occupational sex-segregation, but the approach came from a sociological perspective.[100] By concentrating on an American experience in the latter part of the twentieth-century this work also had its limitations. That being said, it offered useful indicators as to the way in which sex segregation came to be recognised as 'a linchpin of gender inequality at work'.[101] In also addressing the issue of sex segregation and social control, Jacobs examined the social forces that restricted

---

99 G Lerner, *The Creation of Patriarchy,* (Oxford: Oxford University Press, 1986); S Walby, *Theorizing Patriarchy,* (Oxford: Blackwell, 1990), p. 2

100 J A Jacobs, (ed.)., *Gender Inequality at Work,* (London: Sage Publications, 1995)

101 Jacobs, p. 2

women's options both before and after they entered the job market. He demonstrated that this was 'continually reinforced and recreated' by institutional mechanisms so that, although individual women were able to make non-traditional job choices, overall levels of segregation remained high.[102] Stone reviewed Jacobs' ideas on social control and suggested that his account explained how gender works 'rather than why gender is such a major force in the organisation of work'. [103] She argued that patriarchy was the engine of sex segregation and that men were 'always proactive, women reactive' and that 'male reactions' determined whether 'women will gain access to an occupation'. [104] Benokraitis and Feagin also reviewed some of these issues in *Modern Sexism,* a somewhat dated piece of work but nevertheless one that it would be inappropriate to dismiss out of hand.[105] Undertaken in order to investigate overt, subtle and covert sex discrimination, their work was particularly revealing especially in relation to the fact that two of the women engineers who provided oral testimonies did not concur with some of their conclusions whereas all of the women contributors who had worked in other capacities at Metrovicks recognised the different kinds of discrimination. Why this should have been the case provided the basis for further analysis of an important feature of the working environment that female apprentices had to negotiate throughout their training. In addition, the investigation by the authors into the ways in which women were excluded from old-boy networks, and how the 'like-produces-like features of organisations inhibited the way in which they were able

---

102 Jacobs, pp. 8, 48
103 P Stone, 'Assessing Gender at Work: Evidence and Issues', in *Gender Inequality at Work,* (ed.) J A Jacobs, p. 416
104 Stone, p. 417
105 N Benokraitis & J R Feagin, *Modern Sexism: Blatant, Subtle, and Covert Discrimination,* (Eaglewood Cliffs, N.J.: Prentice-Hall, 1986)

to progress in 'the “man's world” ' highlighted the way in which aspects of the corporate culture developed by Metrovicks were 'unsympathetic' to the needs of its women engineers. [106] This issue was problematic and underpinned the way in which women engineers were bound to be perceived by their male colleagues. The extent to which they were able to overcome these challenges will form an important part of this investigation.

Hakim's well-known work on sex segregation, especially *Key Issues in Women's Work. Female Heterogeneity and the Polarisation of Women's Employment,* offered a British perspective on many of the issues raised by Jacobs *et al.* [107] Her succinct analyses of both Goldberg and Hartmann's views on patriarchy and male dominance were welcomed, as were the chapters dealing with work orientation and commitment, masculine and feminine work cultures and labour mobility. These provided an excellent guide as to the way in which these issues needed to be brought into focus in this thesis. In a more recent review, *Performing Gender at Work,* Kelan scrutinised female workers in the information communication technologies sector and looked at the extent to which gender relations have changed over time. On the face of it, the subjects of her study seemed to have had little in common with the young professional women who entered the engineering industry in the mid twentieth-century**,** but there were a significant number of elements in her analysis that highlighted the ways in which it was possible to express sexism through structures that appear non-sexist but serve

106 Benokraitis & Feagin, p. 21
107 C. Hakim, *Key Issues in Women's Work. Female Heterogeneity and the Polarisation of Women's Employment,* (London: Athlone, 1996)

sexist functions. In addition, by concentrating her research on the responses of individuals from just two companies working in the field, she offered some insights into the ways in which gender issues might be examined in the context of a small-scale investigation. This was an invaluable guide to the way in which a theoretical base might be established in order to question the notion of the social construction of gender. As such, Kelan's work in this direction opened up new lines of enquiry even though, once again, hers proceeded from a sociological perspective rather than an historical standpoint.

The structure of the dissertation

To reiterate, this thesis seeks to plug gaps in the history of an important, but surprisingly under-scrutinised, engineering company and to throw new light on a small, but highly significant, section of its trainee workforce. The introduction has pointed out the direction in which the study will proceed. What follows is broken down into four interlinked chapters. The dissertation starts by placing Metrovicks within the wider context of the engineering industry. That it was imperative for industrial organisations to present a corporate image to the wider world will also be given some thought, and the way in which this was promoted at Trafford Park will be examined in detail. Specific aspects of its corporate culture will be explored , therefore, and particular reference will be made to the intermeshing of its renowned research facility with its ground-breaking technical and vocational educational programme which was inaugurated by A P M Fleming in 1902. Thus the first chapter will offer a brief history of the company in order to put into context the often complicated nature of its commercial and economic standing from its

inauguration in 1899 to its take-over in 1967. An analysis will also take place into the extent to which the firm could claim to be an 'industrial giant' and its workers could claim to be 'the aristocrats of the engineering industry' and the role of the Chairman, Lord Chandos, will be assessed in this connection. The idea that, in Britain especially, engineering was not considered to be an elite profession will be interrogated and the ramifications for the Metrovicks apprentice training scheme of this type of thinking will be assessed.

Chapter two moves towards an in-depth examination of the pioneering role played by Sir Arthur Percy Morris Fleming who acted as a catalyst for far-ranging changes in the way in which this form of technical and vocational education was structured. Attention will be paid to his important connections with industrial organisations both in Germany and the United States, and the extent to which these influenced the development of his philosophy will be probed. In addition, an evaluation of the way in which his ideas had an impact on the development of Metrovick's corporate culture will be offered. Importantly, this chapter will also gauge the degree to which Fleming's ideas enabled young female College and Schools apprentices to expand both their educational opportunities and their career options during the 1950s and 1960s.

The third chapter is a critical examination of some of the cultural and institutional changes in the post-war period that affected these young women trainees at Metrovicks. As such this is intended to provide a much-needed background that will signify the way in which these members of the 'forgotten generation' were

placed in society. Particular emphasis will be placed, therefore, on the education of girls who attended grammar schools during this period. An examination of the ethos of the grammar school will be set against this background in order to offer explanations as to why only a minority of pupils were encouraged in their future career ambitions and why so many felt their aspirations were thwarted. In addition, explanations will be sought as to why those who prospered within the system and were marked out as 'exceptional' pupils often had ambivalent feelings about their status, especially those who chose to follow male-dominated career paths like engineering. Underpinning this investigation is Spencer's idea that this particular generation has been 'hidden from history' and, with renewed interest in investigating aspects of the lives of young women during this period, this chapter intends to add to this debate.

The final chapter of this dissertation will provide the substance of this thesis. The intention will be to assess the place occupied by the female apprentices who chose to undertake their technical and vocational education and training at Metrovicks during this period. At the heart of this examination is the way in which the technical skills and competencies of these young women were valued in the context of a gendered environment where male perceptions of what it meant to be a 'good' engineer were often at odds with the way in which women wished to operate. Also central to this discussion is the ambivalence about their career choice felt by many female trainee engineers, which was often questioned and often misunderstood, in a society that valued marriage and motherhood as the paradigm for all young women. These societal pressures were complicated further

by the tensions that resulted from the position of these apprentices within the powerful authority of a male-dominated workforce and these factors will also be explored carefully. In addition, the attitude of government towards the funding of technical training during this period was marked by a degree of inertia and the impact of this state of affairs will be included in this chapter. In addition, in face of the precarious nature of their identity as females operating in a non-traditional working environment, the degree of support extended to them by the Company, and their own efforts to sustain themselves, will be examined in some detail. A number of women members of the WES, especially Isabel Hardwich who worked at Metrovicks, encouraged young women in this respect. Her supportive role in the field of education and recruitment to the profession will be placed at the heart of this discourse.

CHAPTER 1

A 'giant' of the engineering industry: Metropolitan-Vickers Electrical Engineering Company Limited, Trafford Park, 1945-1967

The aim of this opening chapter is to offer a critical overview of the industrial enterprise at the heart of this research. Originally known as British-Westinghouse Electrical Company, it has also been known variously at M-V, MetroVicks and locally referred to as Metros. Taking Metropolitan-Vickers Electrical Engineering Company Limited as a case study, it is proposed to offer a summary of how and why the business was first set up, and how it was configured and re-configured over the years according to commercial and economic circumstances. It is also proposed to examine how Metrovicks came to acquire a reputation for high level scientific research as well as technical innovation and expertise, and why that reputation masked a number of more troubling business issues that the company failed to address. In addition, this chapter will enquire into the ethos that permeated the organisation and an assessment of the impact that this had on its employees will also take place. Much of this section, therefore, will concentrate on structural issues but this is a necessary preamble to the main body of the work and is intended to give some context to the often convoluted history and background of the company. By doing this it is intended that, as the following chapters take shape, a critical examination and analysis of the provision by Metrovicks of technical education and vocational training for the young female apprentices who worked in the firm in the 1950s and 1960s will be more easily understood.

Metrovicks, 1899-1967: a brief history

In choosing Metropolitan-Vickers Electrical Engineering Company Limited as a case study it is important to acknowledge the fact that, despite its importance both to the national and to the North-West regional economy, no detailed history of this large and influential manufacturing concern has been undertaken. The use of Metropolitan-Vickers Electrical Engineering Company Limited as a case study, therefore, was plagued with a number of difficulties. Dummelow's factual account commissioned by the firm in celebration of its Golden Jubilee had no pretence to be an academic study, and nor did that of Rowlinson who looked at the contribution made by Metrovicks to the war effort, and a number of booklets issued by the company over the years tended to re-iterate the information found in these books.[108] Jones and Marriott, however, offered a readable account of the historical background that led to the merger with GEC that brought about the demise of the AEI organisation as a whole and their book proved to be an invaluable source of reference, especially on the subject of the fraught relationship between Metrovicks and BTH.[109] By concentrating on his own career trajectory the memoirs of Lord Chandos, the influential Chairman of AEI, also failed to offer an in-depth analysis of the company that he led during the 1950s and 1960s.[110] Apart from these authors, few authorities have ventured into the field. Certainly no major research project on the scale of Wilson's survey of Ferranti has been carried out, nor has the firm been subjected to academic enquiry in the same way as, for example, the

---

108 J Dummelow, *1899-1949*; F. Rowlinson, F., (ed.), *Contributions to Victory,* (Manchester: Metropolitan-Vickers Electrical Company Limited, 1947); MOSI YA 1996.1735/MS0531/178 GEC Turbine Generators Ltd, '85 Years in Trafford Park' [n.d. c. 1990]

109 Jones & Marriott, *Anatomy of a Merger.* .

110 O. Lyttelton, (Viscount Chandos), *The Memoirs of Lord Chandos,* (London: The Bodley Head, 1962)

much smaller industrial concern of Dorman, Smith was interrogated by Lee and Stubbs.[111] The limited material still in existence, therefore, was largely out of date and only the occasional article, such as Cooper's investigation into the early development of scientific research in industry and Whitfield's recent (2013) doctoral thesis, had contemporary relevance. This presented both opportunities and problems in equal measure. The paucity of secondary material meant that it was difficult to challenge the variety of ideas and assumptions that usually attend historical discourse and instead necessitated more of a reliance on the use of exemplars from other engineering companies than otherwise might have been the case. On the other hand, the presentation of archival material that had long been neglected or overlooked opened up the chance for further scrutiny and provided fresh opportunities to examine and assess the influence that the company exerted on the engineering industry during this period.

For most of the twentieth-century, until it was subsumed into the General Electric Company (GEC) in 1967, Metropolitan-Vickers Electrical Engineering Company Limited was one of the biggest and most important engineering facilities in Great Britain.[112] Located in Trafford Park, Manchester, it employed around 30,000 people at its peak of production and it played a crucial role in developing heavy industrial products such as generators, turbines, switchgear and transformers. The company was also renowned for technical innovation and alongside its highly diversified product base had secured its reputation as a centre of excellence in

111 N Lee & P C Stubbs, *The History of Dorman Smith, 1878-1972,* (London: Newman Neame, 1972)

112 http://www.gracesguide.co.uk/Metropolitan-Vickers GEC changed its name to Marconi plc in 1999

both research and manufacture as early as the 1920s. In 1922, for example, the BBC's Manchester radio station 2ZY first broadcast at Metrovicks the day after the first radio broadcast had taken place in London. In 1935 a 105 MW steam turbo generator for the Battersea power station was built and was the largest in Europe at that time. In the same year the company became one of only two firms in the world to first construct an axial-flow jet engine, the Metrovick F.2. Work on automatic pilot systems also started in conjunction with the Air Ministry and radar was being built by 1937. In addition agreement was also reached with the Ministry to build a turboprop design under the direction of Hayne Constant. On the eve of the Second World War, therefore, the firm was already established on a war-footing. Metrovicks then took part in a joint venture with Messrs A V Roe to manufacture the 'Manchester', 'Lancaster' and 'Lincoln' bombers and, as described by Whitfield, the development in 1947 of the Metrovick G.1 Gatric gas turbine fitted to gun boat MGB 2009 made it the world's first gas turbine powered naval vessel. The production of the first commercial transistor computer, the Metrovick 950, the design and development of mass spectrometers and electron microscopes, the major expansion into the diesel-electric locomotive market as well as into the domestic appliance market all took place in the post-war period. On the face of it, therefore, it might have seemed that the firm enjoyed a halcyon period during the decades under consideration in this thesis.

There is, however, a more nuanced reading to be offered, beginning with the often byzantine way in which the firm had conducted its affairs from the time when the American businessman George Westinghouse (1846-1914) first started the

manufacturing process in Trafford Park in 1903. After serving in the American Civil War, he worked in his father's engineering shop in Schenectady and by the age of twenty-three he took out his first patent for railway air brakes, which became the foundation of his fortune.[113] He continued his technical work concentrating on developments in relation to transformers, alternating current transmission and the steam turbine, for instance, and obtained a contract for the first hydroelectric plant at Niagara in 1893 as well as putting Tesla's induction motor on the market and taking out a licence to make the Parsons steam turbines for power stations. Such diverse activity pointed to an individual who was keen to promote technical excellence in many areas of the engineering industry though, as Dummelow suggested, 'he made no fundamental electrical inventions'.[114] Side by side with his interest in technological innovation, Westinghouse was an individual whose business acumen appeared to be highly developed. As a result he formed, or acquired, more than twenty companies to commercialise his various technical interests, including the Westinghouse Machine Company and the Westinghouse Electric and Manufacturing Company. Already a successful inventor and entrepreneur, he then sought to extend his interests beyond his main industrial base in Pittsburgh and made his first foray into the British market in 1871 and by 1899 he had set up the Westinghouse Electric Company Limited of London. His opportunity for further expansion came with the development of the Trafford Park Estate, the first dedicated industrial estate in the country, which had come into being when the financier E.T. Hooley bought the patrimony of Sir Humphrey de

113 R P Bradley, *GEC Traction and its Predecessors – 1823 to the present day,* (Oxford: Oxford Publishing Company, 1993), p. 11; Dummelow, pp. 3-11

114 Dummelow, pp 1-11, 39

Trafford in 1896. As a result, Westinghouse bought a 130 acre parcel of land at Waters Meeting Farm on the Bridgewater Canal. He did not countenance small beginnings and a gradual extension of the site but wanted a complete factory laid out from the start. As the British contractors found this to be an impossible task he called in a Canadian, James C. Stewart, who recruited twelve American supervisors trained in his own methods to oversee the work of the local labourers. As a result, within fifteen months of the Westinghouse purchase, a modern, purpose built factory planned on 'a colossal scale' and modelled on his American works in Pittsburgh had been constructed.[115] Westinghouse then insisted on his fellow countrymen, 'the American force in England', filling key engineering and manufacturing positions in the infant company, whilst high calibre British engineers were consigned to subsidiary roles.

Dubbed the 'Holy Forty', it was only when members of this select British group had agreed to undertake a two-year period of intensive training at Pittsburgh, being schooled in Westinghouse methods and techniques, that they were able to take over the senior engineering and managerial posts from the incumbent Americans at Trafford Park.[116] Dummelow suggested that this group was 'neither forty in number nor holy in deed', but they did form a close-knit group which grew out of the camaraderie that was actively promoted by these early trailblazers during their 'exile' abroad. The majority were graduates and thus came from that highly articulate and well-heeled segment of society at the turn of the twentieth-century

115 Bradley, p. 11; Dummelow, pp. 3-11

116 Dummelow, p. 13; MSS Marconi 3041-3066 R.4.5.a R Johnson, 'One of the “Holy Forty” Tells His Story', *AEI News,* 19:9 (September 1949), pp. 6-7

who thought nothing of being able to afford to pay their own travel expenses to the United States and to be able to supplement their salary of 25 cents an hour out of their own purse whilst living there. Once their training was over, however, they had to consent to remain with British Westinghouse in Trafford Park for a period of time so that the parent company was able to realise the investment it had made in them. Although many members of the 'Holy Forty' eventually left the company, there were notable exceptions who stayed on to make a significant contribution to the development of the business, especially in the area of research and education and the part played by Fleming and Johnson in this respect will be interrogated in the following chapter.

Trading as British Westinghouse, the company, however, suffered many vicissitudes during its early years. Although the factory had been designed to the best American standards and was equipped to build steam engines, these were obsolete by the time that the works officially opened. The gas engines that were supposed to replace them ran into repeated difficulties and only the steam turbines, based on the Parsons design, presented no problems. In addition, British engineers objected to using some standard American apparatus, such as screw threads, and this added to the general discontent that was the hallmark of the Trafford Park operation in its early years. Coupled with this, trade recessions, competition from German firms, entanglements with the American parent company, non-existent profit margins, management problems and a lack of understanding on the part of the Americans about British engineering expertise all contributed to an inauspicious beginning. George Westinghouse was rarely seen and had last

appeared at an annual general meeting in 1904 when he was congratulated on "the excellent way in which he had ignored the most ugly facts" surrounding the state of the company.[117] By 1906 he was forced to appoint Newcomb Carlton, the vice-president of American Westinghouse, to take matters in hand but by the autumn of 1907 the parent company went into receivership and by 1910 Westinghouse had to relinquish power. As a result of this change in circumstances, British Westinghouse was able to act independently, if precariously, for the first time. This early and extremely fraught period in the history of the company was covered in some detail by Jones and Marriott.[118] For want of any other in-depth study of the firm, their survey had to serve as an explanation of how the economic fragility of the firm came about and how its dependence on the parent company almost led to its demise. The involved nature of the interplay between the Pittsburgh and the Trafford Park operations was covered in a comprehensive way, in contrast to the hagiography offered by Dummelow which, by its very nature, glossed over both the economic and the organisational difficulties experienced during these years in favour of cataloguing the minutiae of everyday life at the Works.[119] To criticise Dummelow for his omissions and lack of analysis would be unfair. Commissioned by Metrovicks to write the book as a celebration of the progress of an industrial 'giant', it was hardly likely that he wanted, or indeed he would have been able, to venture into the realms of controversy. [120] Though slight in scope this has become, almost by default, an

---

117 Dummelow, p. 29
118 Jones & Marriott, pp. 43-67.
119 Dummelow, pp. 21-39
120 Copies of the book were given to employees as tokens of their service to the Company and Dummelow chose to present information that he thought would satisfy the curiosity of his

invaluable reference work for those wishing to investigate the history of the firm during its first fifty years in operation. When AEI (formerly Metrovicks) merged with other companies to become GEC in 1967, and when the Works finally closed down in June 2000, much of its documentation was destroyed or dispersed, leaving deficiencies in the records, ‘the 'paucity' of which Cooper noted in his 2007 paper.[121] Dummelow, therefore, provided a useful framework for interrogating what remained of scattered archival material.

The examination by Jones and Marriott of the progress of Metrovicks through the following decades was based upon their grasp of the economic and managerial twists and turns taken by the company as it developed new products and captured new markets. They explained how the complications of being an American-controlled firm during World War I led to a British holding company being formed in 1917 to buy up the American shareholding. The instigator of this move was Dudley Docker whose initial plan was to merge British Westinghouse with GEC but this plan ran aground when the members of the board overruled the chairman of GEC, Hugo Hirst. Docker then sold the controlling stake in British Westinghouse to Vickers and a clean sweep of top management ensued with Lang, the managing director, and Blunt, the sales manager, returning to Pittsburgh and the British team of Chandler and Hilton moving in to take over. Davenport-Hines has written in depth about Dudley Docker, explaining how he was instrumental in pushing through a deal which resulted in Vickers Limited acquiring British Westinghouse and changing the name of the organisation to that of the Metropolitan-Vickers

---

audience about the origins of their place of work.

121 Cooper, 'The early development of scientific research in industry', p. 86.

Electrical Company in 1919.[122] As a result, and after two decades of 'staggering from crisis to crisis', Metrovicks was at least on a firmer financial footing by 1920 and was established as one of the four large firms, including English Electric, BTH and GEC, 'dominating the British electrical industry'.[123] Despite this, the following decade did little to relieve the difficulties faced by the industry as a whole. As Dummelow explained, 'business was hampered by post-war conditions: political uncertainties, Government restrictions, raw material and shipping difficulties, and labour unrest'.[124] Metrovicks had, however, put into place a new framework for the organisation of the works in 1921 and this fresh outlook affected both the technical and commercial sides of the business. For instance, the far reaching technical developments were made possible by the establishment of a department of research and education under the leadership of A.P.M. Fleming, where a high level of scientific study was encouraged and fostered.[125] Competition from continental manufacturers, however, was intense; not only Metrovicks but the whole of the electrical engineering industry was in a parlous state. Rationalisation was the obvious answer and in 1927 Docker acquired control of Metrovicks. In the following year he shaped a consolidation which also included BTH, the Edison Swan Electric Company and Ferguson, Pailin Limited. [126] Thus Associated Electrical Industries (AEI) came into being but, importantly, the constituent

---

122 Jones & Marriott, pp. 58-63. Davenport-Hines, R P T., *Dudley Docker: The Life and Times of a Trade Warrior*, (Cambridge: Cambridge University Press, 1984). Unlike his head-line grabbing son, Bernard, who sat on the BSA Board and was known chiefly for his expansive living and his socialite wife whose antics entertained readers of the popular press in the 1950s, Dudley Docker was a more circumspect character who conducted his business activities accordingly.

123 Jones & Marriott, p. 63.

124 Dummelow, p. 75.

125 The work of Fleming will be discussed in detail in the following chapter.

126 Dummelow, p. 119; Jones & Marriott, pp. 89-109

companies retained their original names, their own identities, and their own management structures. Jones and Marriott disentangled details of the machinations of Gerard Swope, the president of General Electric of America, in this process. He wanted monopoly control of the British electrical industry and secretly bought the controlling interest in Metrovicks from Vickers but registered this in the name of Docker. When a Metrovicks-BTH merger was proposed the Metrovicks board believed it to be a scheme led by Docker who had, unwittingly, become the pawn in the much larger game in which Swope intended to gamble.[127]

As with all manufacturing companies, the recession during the 1920s and 1930s had bitten deeply and exports of electrical equipment had nose-dived. Metrovicks had started selling generating equipment to the newly installed Soviet regime in 1922 but in 1933 six Metrovicks engineers working in Russia were arrested for spying and put on trial in Moscow causing much controversy and garnering world-wide attention. At a time of high unemployment a tenth of its employees were engaged on this contract and it was vital to resume business with the Russians; intervention by Parliament ensured that they were all later released.[128] By the mid-1930s, however, the 'lean' years of recession and the laying-off of workers were replaced by an increasing volume of business being undertaken by the company. The Main Works was enlarged to take account of Government and other contracts and a new site to accommodate aircraft building was opened nearby at Mosley Road. The Second World War saw capacity strained to the limit, with both

127 Jones & Marriott, pp. 110-127 for a fuller account of Swope's attempt to control the British electrical engineering industry.

128 MOSI YA 1996.139/8/neg/12/3497 and 12/3499. Letters referring to the Moscow Trial. Letter sent on behalf of King George V to Sir Felix Pole, 24 April 1933 on the subject.

factories working seven-day weeks producing technically advanced military equipment as well as continuing to supply their traditional products to the wider market. The long-standing rivalry between Metrovicks and BTH continued into the post-war period, however, and 'little attempt was made to keep the quarrels within the family of AEI'.[129] The chairman, Sir Felix Pole was regarded as a conservative who stood back from making radical changes that were necessary to combine the two firms together successfully. In any case his tenure had been marked by the many difficulties experienced during the slump in trade in the 1930s and the pressures of conducting business in wartime conditions. When he retired in 1945 it was expected that his successor, Oliver Lyttleton (Viscount Chandos) would be able to resolve the issue.

The Lyttleton family were aristocrats with strong political connections. Chandos was educated at Eton and Trinity College, Cambridge, had been an officer in the Guards during the First World War and had married the daughter of the Duke of Leeds. He worked in the City, was general manager of the British Metal Corporation and accrued directorships in many other companies. When the Corporation was taken over by the Government in 1939 he became Controller of Non-Ferrous Metals. The following year Churchill appointed him as President of the Board of Trade and he joined the War Cabinet as Minister of Production. After the Labour victory in 1945 Chandos accepted an offer to take up the chairmanship of AEI with the proviso that if the Conservatives returned to office he would return to politics. In his first six years *in situ* his aim was to modernise the organisation of

129 Jones & Marriot, pp. 146-60

the company and then to inject much-needed capital into new business that was about to come on-stream. Indeed, as Wilson suggested, the extent to which members of the aristocracy were able to ' initiate and finance industry, not to mention sitting on its boards of directors, should not be underestimated'.[130] Certainly Chandos's insider-knowledge of the City enable him to raise the money for expansion and his urbane, high-profile presence meant that 'he was seen at the time from outside as a strong chairman' as well as being viewed by his supporters within the Metrovicks-BTH nexus as the sort of outstanding public figure that was essential to properly represent a large-scale engineering concern.[131] Nevertheless, he made a swift return to politics in October 1951 when the Conservatives won the General Election.' He did, however, return to AEI in 1954 and then remained in office until 1963.[132] Initially, profits throughout the industry rose and the executives of Metrovick and BTH were 'brimming with confidence' whilst, as President of the Institute of Directors, Chandos's personal star rose. He had returned to AEI on a salary of £20,000 a year plus expenses. A house purchased by the company was put at his disposal and he was given a chauffeur-driven car with the numberplate LC1, though it remained unclear why a man of his patrician standing did not view this as slightly vulgar. More importantly, he was also allowed to accept outside directorships and chose to take on those of two of the biggest British companies, ICI and Alliance Assurance.[133]

---

130 J F Wilson & A Thomson, *The Making of Modern Management: British Management in Historical Perspective,* (Oxford: Oxford University Press, 2009), p. 139

131 Jones & Marriott, p. 159

132 He expected to have been given the post of Chancellor of the Exchequer. He returned to AEI having been appointed Lord Chandos of Aldershot.

133 Jones & Marriott, p. 227

Inevitably, perhaps, there was a drawback to the level of capital expenditure that Chandos had initiated on behalf of AEI and, as early as 1958, when profits began to look 'increasingly terrible', he took the decision to raise no more money in the City. He spent his final years in office 'attempting to sort out what he had already built up'.[134] Once more, there were lean times for the company. As a result of rapid expansion there was too much capacity in the system and share prices fell as profits declined. Changes in the structure then took place which resulted in the operating companies being organised into product divisions, with Metrovicks concentrating on the production of turbo-generators and being re-named AEI (Manchester) Limited whilst BTH became AEI (Rugby) Limited and focussed on the production of heavy plant equipment. In 1964 Chandos took early retirement and was succeeded by Charles Wheeler but further financial stresses resulted in management changes again taking place with Sir Joseph Latham being appointed as chief executive in 1967. In that year the government-backed Industrial Reorganisation Corporation (IRC) wanted to rationalise the industry and talks took place with executives at AEI, GEC, English Electric and Ferranti amongst others but only GEC, led by Arnold Weinstock, was able to put forward a feasible plan.[135] In September, when AEI posted a dramatic fall in profits and those of GEC rose, Weinstock made his move and the merger took place in November, 1967.[136] The Trafford Park operation continued to trade as part of GEC, but was eventually wound down and the site was finally closed.

---

134 Jones & Marriott, p. 230

135 C A Parsons, Hawker Siddeley, Bruce Peebles and Reyrolle were also approached

136 Jones & Marriott, pp. 265-288. GEC itself was later restructured into many other companies, including Marconi plc

'The aristocrats of the engineering industry': Metrovicks' position as an 'industrial giant' during the 1950s and 1960s.

Jones and Marriott used the term 'aristocrats of the engineering industry' though they did not appear to wholeheartedly subscribe to this description of either the company or of the people who worked within it.[137] Nonetheless Sir George Bailey, who stood in as Chairman for Chandos between 1951-1954, was regarded by them as an example of a leader who was 'deeply respected' because 'he belonged to the industry [and] was an engineer' with 'a high reputation'.[138] In contrast to the often cavalier attitude displayed by Chandos towards engineers, the authors believed that Bailey, 'the uncrowned king of Trafford Park', had 'a genuine concern' for the welfare of the workforce and deserved his reputation as a popular and well-respected figure.[139] Chandos, however, demonstrated his disdain for the senior engineers. Although they were the backbone of the organisation, his elitist attitude often led him to dismiss them out of hand. When, for example, Willis Jackson had to write a speech for him on a topic with which Chandos was unfamiliar the letter of thanks from the Chairman was perfunctory. Presumably Chandos was well aware of the outstanding academic career of his own Director of Research and Education, but he failed to address the distinguished professor and Fellow of the Royal Society correctly and merely called him 'Mr' Jackson.[140] The letter did, however, include the fact that Chandos had decided to alter some of the expert information that Jackson offered. In addition, Jones and Marriott quoted other

137 Jones & Marriott, p. 160
138 Dummelow, p. 76
139 Jones & Marriott, p. 157
140 Imperial College Archives (ACRU) B/JACKSON B/2 AEI and M-V Correspondence 1951-1957. The fact that Jackson was the product of Burnley Grammar School may well have led the patrician to treat him arrogantly.

occasions when the chairman failed in common courtesy. He was heard to have said to distinguished visitors 'I don't think I'll bother to introduce you to anyone here. They're all engineers and expendable', and was found 'dishing out mockery' in the executive dining room because some men had ordered soup at luncheon which he thought was 'uncouth'.[141] As Wilson pointed out, engineers 'rarely came from the upper middle class' and could 'never be described as an elite', an important factor that will be discussed later in this chapter, and a factor that was obviously not far from the chairman's mind.[142] Thus, whilst Bailey's popularity meant that he could 'walk through the factory by himself', Chandos could not command the same respect and was 'always accompanied by a retinue of sycophants'.[143] Nonetheless, despite their often critical 'take' on the way in which the higher echelons of management at AEI were known to have conducted some of their business undertakings, Jones and Marriott were not hostile to Chandos's performance as Chairman during the 1950s. They suggested that his appeal to AEI shareholders lay in the fact that he was an 'eminent public figure' who possessed the ability to understand the workings of the City and knew 'when and how to appeal to the public for more money' which enabled expansion at the firm to take place.[144] Whilst Jones and Marriott were less than enthusiastic about some of his subsequent over-exuberant and miscalculated financial dealings, they still felt Chandos to be a worthy occupant of the post and gave short shrift to the negative feelings that he engendered amongst the professional engineers,

---

141 Jones & Marriott, p. 234.The authors' attributed these outbursts to his sense of humour though some of their unnamed informants felt otherwise.
142 Wilson & Thomson, p.148
143 Jones & Marriott, p. 234
144 Jones & Marriott, pp. 228-229

especially at Metrovicks. Their bias was understandable; both men had worked as financial journalists for long periods of time, and the Eton educated Marriott had held a number of directorships in the City. This was the milieu in which they operated and with which, presumably, they most identified. As a result they appeared to display an instinctive understanding of the way in which Chandos functioned but, like him, they could not put themselves in the shoes of senior Metrovicks men. By defending his more unpleasant exchanges with engineers they opened themselves up to the suspicion that they too felt that the Metrovick staff were so far down the pecking order that they were bound to be 'frightened' of the Chairman's social standing.[145] When one of their more vocal interviewees was critical of Chandos's lack of knowledge of the industry, Jones and Marriott suggested that the man's views were exaggerated because he was 'imbued with the divine right of engineers'.[146] In saying as much they unwittingly put their fingers on an essential component of what made those who worked at Trafford Park confident that the status of the company was second to none. To put it another way, these authors too seemed to have failed to appreciate the importance to the Metrovicks employees of the belief that the organisation for whom they worked *was* the 'aristocrat of the electrical engineering industry': this was an integral part of the image that the firm fostered and encouraged over many decades. The 'kind of mystique' that seemed to attend 'Metrovick men' was one that had its roots in the desire to make the company a world leader in the provision of top quality engineering products and techniques. This was backed up by heavy investment in research and development, an enlightened attitude towards labour

145 Jones & Marriott, p. 234
146 Jones & Marriott, p. 234

relations and a belief in the primacy of top quality training programmes offered at all levels to the workforce.[147] Though critical of the firm's marketing and financial skills Keeble, for example, was happy to go along with this assessment and acknowledged that 'a fierce pride in Metro-Vicks heavy engineering skills' was entirely justified and these components became part of the corporate image that Metrovicks continued to project, especially in the challenging years after 1945.[148]

It was interesting to question how much veracity there was in Keeble's claim, which was also echoed by other commentators such as Munzenberg, that Metrovicks 'had a reputation as a forward-looking and scientific' company'.[149] Over the years it was seen as being at the 'cutting edge' of major technological advances as Whitfield suggested, and Lord Ardwick, who spoke in a debate in the House of Lords on 9 April 1989, described it as having been a 'major firm' where you felt 'one of the elect' if you had worked there.[150] Ron Foulkes, one of the pioneering computer scientists at the firm in the 1950s, gave credence to this view and suggested that 'perhaps being an engineer at Metrovick made one a little too arrogant!'[151] In addition, Tell suggested that by the 1960s Metrovick was considered a 'technological leader' in Great Britain with 'well established channels

147 Jones & Marriott, pp. 149, 234

148 S P Keeble, *The Ability to Manage. A study of British management 1890-1990,* (Manchester: Manchester University Press, 1992)

149 Munzenberg, G, 'Development of mass spectrometers from Thomson and Aston to present', *International Journal of Mass Spectrometry,* 339-350 (2013) 9-18, p. 14

150 Whitfield, 'Thrust Vector'; Lord Ardwick, 'Economic Recovery: Co-operation with Industry', HL Deb 09 April 1986, vol 473 cc202-67, hansard.millbanksystems.com/lords/1986/apr/06/economic-co-operation-with [Accessed 12 January 2014]

151 R Foulkes, 'Computers at Metrovick: the MV 950 & AEI 1010', *Resurrection: The Bulletin of the Computer Conservation Society,* No. 43, Summer 2008, pp. 14-23, (p. 17)

to markets' and, importantly 'making money'.[152] An expanding market for the Hotpoint brand of domestic appliances coupled with the demand around the world for its heavy engineering products seemed to provide sufficient evidence to confirm that the company was indeed 'an industrial giant'. In the field of education and research there was much evidence to suggest that, as Wright put it, Metrovicks was 'internationally outstanding'. When scientists of the calibre of T E Allibone, a physicist who ran the high voltage laboratory at Metrovicks, worked with Rutherford at the Cavendish Laboratory and was involved in the Manhattan Project, were members of the Research Department it would be hard to view the company in any other light. [153] There was no doubt that this was the way in which many, like Lord Ardwick, viewed the Trafford Park enterprise, not least those who were employed there.

In comparison with other important industrial concerns, Metrovicks might well have had cause to consider itself in a league of its own. Certainly it was a far larger and more complex organisation, producing a more diverse product range than the well-known and highly respected family-owned firm of Ferranti Limited based at Hollinwood. There were, however, similarities between the two organisations which had both begun production in Manchester around the turn of the twentieth-century, and it would be churlish to contest Wilson's broad argument that Ferranti 'punched

152 F Tell, 'Strategy, capabilities and corporate coherence: Exploring some dynamics of learning', p. 17. Paper submitted to the EURAM Conference, Stockholm, 9-11 May 2002. ecsocman.hse.ru/data/685/650/1219/str_cap_x26corp_coherence.pdf [accessed 12 March 2013]

153 P Wright, Obituary: T.E. Allibone', *theguardian,* Monday 15 September 2003. http://www.theguardian.com./news/2003/sep/15/guardianobituaries.nuclear [accessed 23 June 2015]

above its weight'. [154] The idea, however, that Ferranti's expertise in transformer manufacturing put the firm 'at least on a par' with the Trafford Park operation neglected to acknowledge that the rapid development of scientific knowledge, which contributed to product design, had already progressed at Metrovicks before this was brought 'on-stream' at most other companies, including Ferranti.[155] The contribution made to industrial research by the founder of the company, Sebastian de Ferranti and his successors should not be denied, and it would be remiss to minimise the contribution the firm made to the development of computer technology in the form of Manchester University's Mark I computer installed in 1951 and the Argos 200, the world's first process control computer, installed at ICI Fleetwood in 1962. It was not easy, however, for a family owned firm of the size of Ferranti to 'play catch-up' with Metrovicks. As Wilson rightly pointed out, it would have been unrealistic for a medium-sized company to have claimed to be stronger in the electrical market, even if it had carefully chosen the products in which to specialise. Kirby also pointed out the weakness of Ferranti's 'conservative managerial ethos on the part of the owning family' and shared Tweedale's scepticism about Ferranti's decision to 'place their money where it was safest – in small defense (*sic*) computing systems' that were 'spin-offs from military contracts'.[156] Whatever the case, it was clear that it was not possible to estimate the extent of Metrovicks' dominance in the field by comparing it with Ferranti: this

---

154 J F Wilson, 'Government and the Electronic Components Industry: The Case of Ferranti, 1953-1973' *University of Manchester Working Papers in Economic and Social History,* No. 7, March 1991.

155 Wilson, *Ferranti and the British Electrical Industry,* p.128

156 M W Kirby, 'Britain's “Manifest Industrial Destiny”: The Culture of High Technology and Industrial Performance in the Twentieth-century', *Business and Economic History,* Vol. 26, no. 2, Winter 1997, p.763; G Tweedale, 'Marketing in the Second Industrial Revolution: A Case Study of the Ferranti Computer Group 1949-1963', *Business History,* 24, 9 (1992), pp. 96-122

was not a like-to-like comparison.[157] It was not possible either to use as exemplars other well-known North-West manufacturers, such as Leyland Motors, Dorman and Smith, Simon Carves and so on, to bolster the claim of Metrovicks to be regarded as 'the aristocrats of the engineering industry'. Either these were much smaller industrial concerns or their engineering expertise was limited to the manufacture of one specific type of product. In surveying Leyland Motors, for example, Graham Turner suggested that, although it had a world-wide market, it was 'essentially a parochial company', trading where there was 'no indigenous competition' and relying on trade with the Commonwealth as well as focussing on markets where English was spoken.[158] Though the skill of the company's motor manufacturing engineers could hardly be called into question, like Ferranti and the other firms, this was not an archetypal 'industrial giant' and it was necessary to look elsewhere to assess the extent to which this claim might be made of Metrovicks.

Bradley certainly reckoned that Metrovicks was a 'giant' company by emphasising the fact that it possessed an 'extended network of offices and plants all over the world'.[159] He also suggested that, as far back as the 1920s, the firm had become 'a major force in the industry' and was 'a famous and well respected organisation'.[160] Some caveats must be borne in mind here. For instance, Abbott was of the opinion that it was the English Electric Company that was renowned for its world-wide reputation for 'craftsmanship and quality' and that it played an

157 J F Wilson, *Ferranti. A history:* Vols 1 and 2
158 G Turner, *The Leyland Papers,* (London: Eyre & Spottiswoode, 1971), p. 23
159 Bradley, *GEC Traction,* p. 71
160 Bradley, p. 41

important part in the history of electrical engineering in this country.[161] The company had been founded in 1918 and was based in Stafford although it had strong connections with Metrovicks. For example, in 1930 when Westinghouse of America provided it with financial backing Sir Holberry Mensforth, an ex-employee of British Westinghouse in Trafford Park, was appointed chairman with George Nelson, who had been an apprentice at Metrovicks, appointed as general manager. Broadly speaking the scale of both operations was similar, though English Electric employed 25,000 workers during the Second World War in four different factories whilst Metrovicks employed the same number on one site. As Jones and Marriott made clear, however, there was even a 'no poaching' agreement' between GEC, English Electric and Metrovicks whereby 'no company would lure executives away from each other' and 'this collaboration was made all the more easy because of their physical intimacy'.[162] In the immediate post-war period, however, English Electric experienced more severe long-term problems and found it harder than Metrovicks to benefit from the competition between engineering companies to satisfy the booming demand for engineering products. It was also hard to deny that structural differences placed English Electric in a somewhat different category of organisation to that of the Trafford Park firm. Whereas Metrovicks was run by a Chairman and Board of Directors, English Electric was a more paternalistic concern. It was overseen by George Nelson, who was described by Jones and Marriott as 'an autocratic boss' who 'never let go

161 Bradley, p. 32; R. Abbott, 'Early histories of some companies of the English Electric Group' from *English Electric and Its People, 1947-1965,* (Stafford: Engineering Research Laboratory, GEC Alsthom), n.d., p.42

162 Jones & Marriott, p. 171. The London headquarters of these companies were located near to each other.

of the reins'.[163] In 1956, however, he eventually relinquished his position as managing director in favour of his son George who, on the death of his father, became both chief executive and chairman. This was the structural problem that Jones and Marriott suggested was 'a fatal flaw, and one which prevented the younger Nelson from having the time to supervise the under-performing areas of the firm that caused difficulties.[164] Compared to the more complex and more sophisticated enterprise run by Metrovicks, the two-man operation also suffered from lack of input from the revitalising forces that the Trafford Park firm was able to summon from its pool of apprentices and young engineers eager to take on management roles.[165] Notwithstanding these factors, it was still possible to compare both companies on a 'like-to-like basis' if only because of the similarity in size of both operations.[166]

Whether or not this marked Metrovicks out as any more of an 'industrial giant' than English Electric is open to debate but what was more clear cut was the fact that Metrovicks training and nurturing of its 'young turks' bolstered the company's claim to be considered as 'the aristocrats of the engineering industry', even though this was a contested claim as far as BTH was concerned. In *BTH Reminiscences:*

---

163 Jones & Marriott, p. 175.

164 Jones & Marriott, p. 195. As a consequence English Electric, like Metrovicks, merged under the umbrella of AEI in 1968

165 Sir Alan Veale (1920-2006) was a prime example of an apprentice who had spent his career at Metrovicks, rising rapidly through the ranks. He stayed on after the merger with GEC when the new organisation made him the managing director of GEC Power Engineering and gave him a place as a director on the board.

166 Jones and Marriott classed Metrovicks and BTH as one company – AEI. Technically this was correct but the management of both organisations would have begged to differ and other commentators such as Rodgers, Abbott, Tell *et al* also regarded both companies as separate entities. Despite the eventual merger with GEC in 1968, English Electric was regarded as one of the four major electrical engineering companies in the country during the 1950s and 1960s – the other three being Metrovicks, GEC and BTH.

Sixty Years of Progress, Price-Hughes put forward the idea that the Rugby based company was 'a pioneer in the matter of organising training and educational facilities for its apprentices' although he failed to recognise that it was only in 1913 that the firm commissioned a report on apprentice training schemes 'with a view to building up a force of trained technical personnel'.[167] These schemes were fully operational by 1919, and they bore a close resemblance to those that had already been started by Fleming at Trafford Park in 1908. In such circumstances, Price-Hughes' claim for BTH to be regarded as 'a pioneer' in this field was somewhat exaggerated. Nevertheless, in the field of industrial research both Metrovicks and BTH considered themselves to be serious rivals, especially during the Second World War. The research facilities at both organisations 'were switched almost overnight to war-time problems' and both collaborated with government research establishments and with university laboratories.[168] That the BTH research department 'gained a reputation for its technical papers, lectures, and other contributions to scientific knowledge' was in no doubt, but it was always the smaller concern of the two. As a result it was home to fewer eminent scientists and engineers, although the collaboration with Whittle on jet design somewhat overshadowed Metrovicks contribution to turboprop design under the direction of Hayne Constant.[169] Nonetheless, under the influence of Fleming and his team, scientific work at the Research Department at Metrovicks was both highly regarded and was more highly developed. Where shopfloor production was

---

167 H A Price-Hughes, *BTH Reminiscences: Sixty Years of Progress,* (Rugby: The British Thomson-Houston Company Ltd., 1946), p. 151

168 Price-Hughes, pp. 135-136.

169 The Metrovick F.2 axial-flow jet engine, which began development in 1935, never entered production but the design was passed on in 1947 to Armstrong Siddeley who went on to introduce a larger and highly successful version, the *Sapphire.*

concerned there was always an overlap between the two, and both companies competed vigorously in the same markets which led to a considerable degree of frustration within the industry as a whole. The merger in 1928 that had brought Metrovicks and BTH together under the aegis of AEI had never been popular with either the management or the employees of the two firms and the organisations remained as separately quoted companies on the stock exchange. As a result, they often worked at cross purposes and intense rivalry bedevilled their operations. In 1960, when AEI made the names of both Metrovicks and BTH obsolete, sales fell dramatically. The heavy electrical industry had always been used to dealing with two 'separate' organisations and unfamiliarity with the new set-up caused dissatisfaction and no little hesitancy about the direction in which AEI seemed to be heading. Amongst other reasons, this eventually led to the buy-out by GEC in 1967. Even given this background Metrovicks, the 'aristocrats of the engineering industry', still regarded itself as more of a contender for the title of 'industrial giant' than BTH, its arch-rival. To a large extent this hinged upon the corporate identity that had been fostered at Metrovicks and this helped to explain why the company had an unshakeable belief in the idea that it was the *ne plus ultra* of the electrical engineering industry.

'The spirit of service...loyalty and comradeship...unites us all': an examination of Metrovicks' corporate identity in the post-war period.[170]

That Metrovicks wished to be seen as an 'industrial giant' hardly marked out its ambition as being any different from other large-scale undertakings such as ICI which, for much of its history, was the largest and most successful manufacturer in the country and was 'the bellwether for British industry'.[171] By 1965, by way of contrast, the Trafford Park firm was placed as 'number fifteen on the list of largest firms', a position that was only attained by being regarded as a component part of AEI alongside BTH.[172] On the face of it, then, it was difficult to regard the firm as 'an industrial giant'. This was the way in which the Company wished to be perceived, however, and which it managed to achieve with no small degree of success. There were reasons why this was the case, and the next chapter will deal with one of them, the much vaunted technical and vocational education and training programmes run by Metrovicks which played a significant part in cementing its reputation. Pettigrew suggested that when firms wished to develop their own corporate image their leaders not only created 'the rationale and tangible aspects' of their organisations such as 'structures and technology' but were also the creators of 'symbols, ideologies, language, beliefs, rituals and myths'.[173] Metrovicks was certainly at pains to promote its own corporate image in this manner, and sought to advance the idea that 'the huge plant', which was 'one of

---

170 New Year message to the company issued by Oliver Lyttleton (Lord Chandos), George Bailey, and Dr Warren, M[anchester] C[entral]L[ibrary].Q.631.AE2 *AEI News*, 21:1 (January 1951), frontispiece.

171 J Kollewe & G Wearden, 'ICI: from Perspex to paints', http://www.theguardian.com/business/2007/jun/18/2 [Accessed 12 October 2013]

172 A Sampson, *Anatomy of Britain Today,* (London: Hodder and Stoughton, 1965), p. 540

173 M Pettigrew, 'On Studying Organisational Cultures', *Administrative Science Quarterly,* 24 (1979), 570-581 (141)

the biggest in the United Kingdom', was not only solicitous of the welfare of its employees but also was a paradigm for the electrical engineering industry as a whole.[174]

In an absorbing and often challenging book, Nye examined the corporate identity of the General Electric Company in the United States, and many of his observations resonated with the way in which Metrovicks wished to promote its own image to a wide audience. He contemplated the idea that corporate history offered one type of analytical framework for the examination of a large company, whilst 'the literature on photography', and 'communication' suggested another.[175] Tempting though it might be to digress and examine this proposition in detail, there was little space in this particular study to do more than sketch over the main tenets of his argument. In parts this lingered rather long on Chandler's model of management and enterprise which Thompson and McHugh criticised as hardly applying to Britain or to other European countries.[176] That aside, Nye pointed out intriguing ways in which corporate identities were developed and 'mythologised' over time. His main contention was that the publications, literature and the publicity photographs of large corporations were 'sedulously created and maintained in order to promote positive images of the company': in other words such institutions were 'bent on controlling the past' and the 'creation and control of

174 I McIntosh, 'Ford at Trafford Park: 'an Americanised corner of old jog-trot England' ', *University of Manchester Sociology Department Occupational Papers,* No. 30, [n.d.], p. 8

175 Nye, p. xi

176 P Thompson & D McHugh, *Work Organisations,* 3rd edn (Basingstoke: Palgrave, 2002), p. 72.

such materials' was 'a metaphor for [their] cultural hegemony'.[177] As such, companies were prone to 'lay down a barrage of favourable publicity' that told 'customers and stockholder how they ought to be understood'.[178] Indeed the only full length historical study of General Electric was written by John Windthrop Hammond, a member of its own publicity department. Much like the accounts written about Metrovicks by Dummelow and Rowlinson, this was a commissioned work rather than a critical analysis. The occasional articles written by historians concentrated on very specific aspects of both businesses and, as Nye suggested, 'such piecemeal studies [could not] give a sense of the corporation as a whole'.[179] As a consequence, Nye examined the various categories of magazine produced in order to gain a sense of how the executives at the corporation 'controlled every aspect of the communication' by shaping entire magazines 'to serve General Electric's goals'.[180] The *General Electric Review*, for example, was a heavyweight 'academic' publication intended for consumption by engineers and scientists, and was produced using high quality paper akin to that used in academic journals. It included the type of photograph that distanced engineers from the industrial process in order to emphasise the idea that they belonged to the professional classes, whilst its contents encouraged them 'to think about their work as the automatic result of research and development, as something in which the rest of society responded without question'.[181] Nye further posited the idea that the *Review* reinforced class distinction and there is certainly merit in his argument that

177 Nye, p. 3.
178 Nye, p.3.
179 Nye, p.2
180 Nye, pp. 60-61
181 Nye, p. 69

this particular publication aimed at being the sole province of the learned both within the company and within the wider academic community. At the other end of the scale the *General Electric Works News* was of a lesser order altogether. Here the in-house magazine contained articles and photographs that 'concentrated on a vision of the factory as a community' and focussed on organised team sports, dances, festive celebrations and summer camps. The *Works News,* however, made hardly any reference to the work undertaken by the employees and Nye suggested this was undertaken in a deliberate attempt to displace the influence of the labour unions and focus instead on the social distractions offered by the firm.[182]

Nye was well aware of the contradictions inherent in the construction and maintenance of its corporate image by General Electric. Though somewhat unconventional, his carefully crafted approach of adopting photographs as his main archival resource and using company magazines to add weight to his arguments, allowed him to find a pathway towards an understanding of how information was disseminated to diverse groups in an effort to present a coherent image of the corporation that was understood by both those inside and outside the organisation. He did, however, rely heavily on a sociological interpretation of this material that sometimes sat uneasily with an historical explanation. In addition, his assumptions were based on an American 'industrial giant' which, in many respects, was far removed from the British experience, especially where labour relations were concerned. Ultimately these drawbacks were not so serious as to negate

182 Nye, p. 83

what he had to say but merely served to show that not every aspect of the General Electric experience could be taken as a blueprint for the development of a corporate identity, even for a firm like Metrovicks which owed more to its American antecedents than did many other British companies.

In its early and somewhat chaotic days in Trafford Park, British Westinghouse also had to learn how to promote a public image that demonstrated that the infant company was one to be reckoned with throughout the industry and beyond. Thus, like General Electric, the development of its own corporate image was vital. As early as 1902 a publishing department was set up and P A Lange, who was appointed as general manager of the firm in 1906, was credited with a new approach intended to bolster the standing of Metrovicks in the wider community. He had to break down barriers that had saddled the Trafford Park operation with the reputation for hiring and firing labour indiscriminately and being a company where the American foremen were seen as difficult taskmasters. As a result, in 1912, the first issue of *The British Westinghouse Gazette* (later the *Metropolitan-Vickers Gazette*) was brought out on a monthly basis. It was the only journal of its kind published in this country and it contained technical articles intended at first for consumption by its own employees but which soon reached a wider audience. Much like *General Electric Review,* it quickly took on the flavour of a serious, 'academic' publication promoting the image of a company that thrived on a high level of specialist ability and 'know-how'. This was the message that the company intended to foster and by 1920 Metrovicks had established a separate Publicity Department, a 'well-oiled' machine that 'churned out' all kinds of promotional

material dedicated to spelling out the corporate image that the company wished to project. Such was its importance that the first head of the department, A D du Pasquier, was designated a Senior Official of the firm and was ranked just below the level of the Board of Directors.

It was the scientific and technical expertise of the specialists in the field, as well as the high quality skills exhibited by those engaged in the engineering process, that were highlighted through these means. As in the case of General Electric, this view of Metrovicks was shaped in order to present an image of a modern, well-organized, 'cutting edge' company to multiple audiences, including its workforce, shareholders, customers and competitors alike. Metrovicks did not lack success in this operation. Certainly company publicity photographs were not as 'sanitized' as those of General Electric that had drawn criticism from Nye, and efforts were made to include many types of employees engaged in their work, as well as scenes of everyday life in the factory. It would be naïve to suggest that images were not carefully chosen in order to offer a positive view of the company but it did seem that Metrovicks tried hard to project a corporate image that was more inclusive than that of General Electric.

The company also produced a variety of magazines which, like those issued by General Electric, addressed a number of different audiences. *Rotor,* the glossy magazine written and edited by apprentices at Metrovicks, contained light-hearted student profiles, literary efforts, sporting and social postings as well as articles of

scientific and technological interest.[183] In many respects it was a publication where both contributors and readers alike, perhaps with an eye on their future prospects within the firm, seemed unwilling to 'bite the hand that fed them' and it cast an uncritical eye over company matters such as, for example, apprentice strikes. It fed in neatly with the corporate image that Metrovicks fostered and, indeed, sent out the reassuring message that, as there were few women apprentices, the *Rotor* readership were 'company men' through and through.

In the development of its corporate culture, the extent to which an organisation like Metrovicks actually needed to foster 'company men' was debatable. Although Nye made reference to Chandler on this issue, his theories on managerial hierarchies were based on observations he had made about the business structures in the United States. He considered this to be 'the seed-bed of managerial capitalism' where the 'managerial enterprise' of large corporations like General Electric and later Westinghouse offered ever more technically advanced products created by highly skilled workers and talented engineers.[184] In contrast, Chandler was critical of non-American enterprises and saw them as family firms reluctant to relinquish control to middle or top managers. As a result, he overlooked the fact that companies such as Metrovicks were neither constructed in this way, nor languished in the way that he described. Some of Chandler's more arcane arguments, therefore, missed the point. Nonetheless, he made the interesting observation that although 'class distinctions' had 'blurred' in the period after the

183 MOSI YA 1999/39/4/6 *Rotor,* 26 (Summer 1943*)* and YA 1999/39/4/7 *Rotor,* 26 (Christmas 1943), for example.

184 A D Chandler Jr, *The Visible Hand. The Managerial Revolution in American Business,* Cambridge, Mass.: Harvard University Press, 1977**)**, p.498

Second World War, European employees 'identified themselves more closely' than did their American counterparts with the firm for whom they worked because this provided the income that enabled them to 'maintain their status'.[185] By contrast, within British industry matters of status were bound up with class distinction.

Although Metrovicks had crafted a corporate identity which extolled the expertise of its own highly skilled shopfloor workers, talented professional engineers, its research capabilities and its education programmes, the notion of class distinction was never far away from that aspect of corporate culture that saw the 'company man' as the epitome of how the firm wished to be represented to its public. There is little doubt, however, that this created a dilemma that was hard for the company to resolve. It was difficult to reconcile the idea that as 'aristocrats' of the engineering industry the professional engineers themselves were not regarded as amongst the elite groups that exercised power and control in British society. British engineers were not even able to claim the 'prestigious title of *Herr Doktor Ingenieur'* which Wilson and Thomson considered gave German engineering 'an intellectual status it never achieved in Britain' though perhaps this was not important when an antithetical attitude towards intellectualism existed in this country in a way that it did not exist in France or Germany for example.[186] In addition, in marked contrast to the situation in Germany where, as they suggested, 'powerful industrial dynasties' constituted 'a separate social elite whose authority was accepted as being totally dominant', engineering concerns in this country were not so highly regarded. Wilson and Thomson further argued that three elites

185 Chandler, p. 500
186 Wilson & Thomson, pp. 92-93

existed in this country 'the financial and commercial elite centred on the City of London, the professional middle classes, and the landed aristocracy' and in comparison industry had 'low status' in regard to policy making or setting 'standards and values'.[187] In analysing the way in which British institutions and British culture 'did not accord industry the primacy and support that it had elsewhere' the authors pointed out that Britain was '*never* fundamentally an industrial and manufacturing economy' and was instead a commercial and financial based economy. [188] Importantly, they also emphasised the fact that the 'higher' professions such as law, medicine, the civil service provided a 'more appealing' career choice for the middle class than did engineering and that those working in the industry had little in common with the landed aristocracy where there was 'an enormous social gulf' between the two.[189] Wiener had already examined these issues in the 1980s and his well-known thesis was elegantly presented and, at first glance, tantalising. His insistence on promoting the idea that elites in British society were, at best, ambivalent to industrialism but that once industrialists had gained entry into the Establishment they too became imbued with an anti-industrial culture, was certainly provocative. In further declaring that this led to the waning of the industrial spirit, and thus to an 'erosion' of economic power and prestige, Wiener tapped into what Rothblatt criticised as 'a deeply familiar story' about the gentrification of the middle classes.[190] In questioning the relationship between culture and industrial decline he suggested, however, that

187 Wilson & Thomson, p. 138
188 Wilson & Thomson, p. 138
189 Wilson & Thompson, p. 139
190 M J Wiener, *English Culture and the Decline of the Industrial Spirit 1850-1980,* (Cambridge: Cambridge University Press, 1981), p. 158; Rothblatt, S., 'Ideas of Decline', *London Review of Books,* 3:14, (6 August 1981), 13-14

Wiener failed to offer a new kind of explanation for economic and industrial shortcomings but instead merely pointed out the kind of evidence that highlighted the success of anti-entrepreneurial attitudes. More critically, Baxendale argued that Wiener neglected to give either a theoretical or an empirical account of the mechanism connecting cultural values with economic behaviour.[191] By relying on describing attitudes and offering 'no real analysis of economic behaviour', Baxendale also believed that Wiener's approach and, thus, his conclusions were flawed. In addition, Edgerton was incisive in his analysis and, with almost surgical precision, cut through the 'Wiener/Barnett thesis' that 'British 'culture', specifically elite culture, caused the British decline'.[192] In *The British Industrial Decline* Dintenfass offered a different, but equally absorbing, appraisal of Wiener's argument by deliberating upon the idea that the imperative to subscribe to an ethos of duty to others and service to society 'did not withhold status and prestige from business activities'.[193] Rather, he proposed that it defined 'the dignity that attached to industry' as 'a matter of stewardship on the community's behalf' and further opined that the 'whole ethical tenor' of British culture worked against profit-seeking activity by entrepreneurs.[194] With these analyses in mind, it was interesting to speculate about the extent to which the professional engineers at Metrovicks struggled with such notions and were occupied with elitism in British society. Within the corporate culture that had been developed at the firm it seemed likely that it was recognised, however obliquely, that the engineering

---

191 J Baxendale, Reviewed work: 'English Culture and the Decline of the Industrial Spirit', *History Workshop,* 21 (Spring 1986), 171-174 (171)

192 D Edgerton, 'The Prophet Militant',pp. 360-379, (p. 364); Edgerton, 'Barnett's Audit of War: An Audit', *Contemporary Record,* 4:2 (1990), 37-39

193 M Dintenfass, *The Decline of Industrial Britain 1870-1980,* (London: Routledge, 1992), p. 185

194 Dintenfass, p. 186

industry struggled to acquire the status accorded to the 'higher' professions, hence the emphasis placed upon research and education in a bid to at least place the firm in the higher echelons of the industry, if not within Wilson and Thomson's 'three elites' that 'set standards and values'. The problem was that if, as they said, industry had 'low status' then so did the professional engineers who operated within it, the vast majority of whom were men. As the corporate culture of the firm sought to emphasise its singularity then, it is contended, it had also to attempt to enhance the status of men who were regarded as having chosen to pursue a 'second-rate' career. Since the position of women within the industry was marginal anyway, this left the female apprentices in the invidious position of being regarded as inhabiting a place that was even further down the hierarchy than that occupied by their male colleagues. Men might, at least, have the potential to be regarded as 'the right type' to make progress within the industry, even if not within the elite ranks in society but women could never be regarded as such. The ramifications of this, as far as they were concerned, will be discussed in the last chapter of this study.

According to Keeble many British corporations, such as ICI and United Steel, preferred to recruit from the public schools and from Oxbridge where they expected to find 'the right type of man' able to provide 'the type of socialisation' they preferred.[195] Indeed, companies such as Courtaulds retained the atmosphere of a 'gentleman's club' at boardroom level; it would seem, therefore, that a particular kind of social integration was a necessary prerequisite for those who

195 Keeble, pp. 13,138,144

wished to aspire to such heights.[196] Metrovicks was not entirely immune from this and the appointment of Chandos, with all his patrician conceits, was a typical manifestation of the way in which industry sought to bring members of the elite into its ranks, as Weiner's thesis has suggested. As a result, the public face of the organisation was much changed. Whether it was as a result of his appointment that the public face of the organisation was much changed is difficult to prove but, at a personal level, he set a different tone to that of his predecessor, Sir Felix Pole. More importantly there was an extent to which, as an urbane product of the public school system, he better personified the leadership qualities that Metrovicks hoped to instil into the young trainees who were expected in time to become the sort of men who would rise in the hierarchy.

A P M Fleming had been appointed as early as 1908 to centralise the training and recruitment of apprentices for the professional engineering courses at Metrovicks and was regarded as the founder of the company's education and training schemes. If this aspect of corporate culture was considered vital for the firm's well-being, then Fleming provided one of the major conduits through which this flowed. Although he did not hail from the same exclusive stratum of society as Chandos, the training schemes he initiated were careful to incorporate more than a nod to the ethos of the public schools. Thus a 'liberal' education was provided where stress was placed on particular qualities of male leadership and male bonding, and this required the selection of the kind of apprentices who would most easily fit into this mould. As a result, a proportion of the apprentice population hailed from a

196 Keeble, p. 50

public school background and 'upper-class' names such as Edward Lancelot Spooner-Lillington and Oliver Beauchamp St. John, amongst others, were to be found in the Apprentice Register. Many more entrants to the firm, however, were brought up in the robust traditions of the all boys grammar schools which, as Jackson and Marsden made clear, sought to ape public school traditions. In addition, Metrovicks was ever keen to enlist graduate trainees, and members of the Education Department regularly visited the colleges of the older universities in order to attract students. The idea that the electrical engineering industry had 'low' status, and that those who moved in elite circles and the professional middle classes did not seek to encourage their offspring to become engineers, exercised the company. Thus the task of countering such prejudice was considered to be of the utmost importance and no little effort went into ensuring that the firm was successful in this area. Metrovicks, however, did not appear to have a marked preference for recruiting Oxbridge candidates because one of the defining features of its corporate culture was that 'upward mobility' could be achieved through the kind of educational experience the firm provided for every grade of trainee. As a consequence, it did not seem to Fleming to be a contradiction in terms to commend particular aspects of the public school ethos that were useful to bolster up either the education of its 'elite' or its less academic neophytes. As he explained to the Parliamentary Sub-Committee on Technical Education in 1949, 'an ambitious and able youth can climb from the lower entrance level to attain the same ultimate position in industry as the graduate'.[197] Fleming was, therefore,

197 IEE NAEST 070/65 Box 3 A P M Fleming, 'Training in Industry', Report to The Parliamentary and Scientific Committee – Sub-Committee on Technical Education. April 1949, p.2

correct in suggesting that the likes of J S Peck who became a director after having started out in only 'the first rank' of the 'electrical engineering profession' or D B Hoseason who was a Trade Apprentice and then became a chief engineer, had been able to succeed in the same way as any graduate might have done within the firm.[198] Although Sir George Bailey, the onetime chairman of the company, began his working life as a trainee draughtsman and not as a graduate engineer, the most outstanding example of an 'ambitious youth' was Harry West who also started as a Trade (shopfloor) Apprentice at Trafford Park in 1918 and rose to become the vice-chairman of the AEI group of companies in 1964.[199] Nonetheless, as with most large-scale organisations, there was little question that a college and university-educated elite replenished itself at Metrovicks and that these men were more likely to achieve high office than the likes of Bailey and West. As a result, for the vast majority of shop floor workers, it was considered sufficient that in company mythology they were 'the aristocracy of *their* class' (my italics), in other words, the elite craftsmen of the engineering world. The idea that the 'democratic spirit' lauded by Dummelow thrived in these circumstances was yet another example of the corporate identity which the firm had chosen to forge for itself. Not even the provision of a highly regarded, top quality technical and vocational education changed either the class or, more importantly for this study, the gender dimensions of that.[200]

198 Dummelow, p. 183-184.

199 Details of this meteoric rise were contained in the 1957 edition of the Apprentice Register, as were those of Professor Harold Martin, a contemporary of West, who also started out as a Trade Apprentice at Metrovicks.

200 Dummelow, p. 33

There were other newspapers and magazines circulated by Metrovicks to its workforce that sought to broadcast ideas about the way in which the organisation hoped to convey its defining values, beliefs and attitudes. Such notions were placed at the heart of both *AEI News,* a monthly magazine that featured all the companies under the AEI umbrella, and *Topic,* a newspaper only published for employees at Trafford Park.[201] Both these in-house publications followed a broadly similar pattern to that of *General Electric Works News.* They reported the work undertaken by employees, made strenuous efforts to depict the factory and its workers as 'a community' and contained editorials which made much of 'the spirit of service which permeates the whole organisation' and of 'the loyalty and comradeship which unites us all'. Dummelow was at pains to highlight 'the spirit prevailing in the works' as being 'more intangible but no less important than technical and commercial efficiency' and stressed the idea that 'a habit of co-operation' brought 'a democratic spirit' into the organisation which was 'very unusual'.[202] In contrast to the American corporation, these periodicals were not specifically designed to re-educate blue-collar workers by replacing the 'labour unions' version of reality' with Metrovicks own construct. In British terms this would have invited trouble and part of the corporate image that Metrovicks had carefully cultivated was one of an organisation where trades union membership was welcomed. Dummelow, however, was writing a paean to Metrovicks at a particular moment in its history and his script ignored the dissenting voices of

---

201 There were other Metrovicks works that were located at sites outside Trafford Park itself, such as Sheffield, Openshaw and Wythenshawe for example, but for convenience sake it has been decided to designate these as being outreaches of Trafford Park.

202 Dummelow, pp. 34-35; K. Morgan, Obituary: Edmund Frow, *The Independent,* 23 May, 1997, http:/www.independent.co.uk., [accessed 20.1.2012].

those trades union activists who did not subscribe to the rhetoric upon which the corporate culture of the firm was based. Some workers on the shopfloor, like Eddie Frow and Benny Rothman for example, held very different views which had emerged from an early engagement in left-wing politics.[203]

A crucial re-organisation in 1917 had seen the inauguration of the Works Committee of trade unionists and shop stewards. Although common-place after 1945, this was an innovative procedure undertaken by the company and was intended, as Dummelow put it, 'to promote a close feeling between the management and all employees [...]for the mutual benefit of all'.[204] It has proved difficult to disentangle the motives behind the establishment of this powerful forum whose members often went on to take up prominent roles in the Trades Union movement, or became Members of Parliament. Detractors might sense a degree of enlightened self-interest on the part of the company eager to keep potential troublemakers 'on side'. No employer of a workforce 30,000 strong would have wished to allow militants to take over in the style of the fictitious shop steward, Fred Kite in '*I'm All Right Jack*'.[205] With media concentration on industrial strife throughout this period and public opinion divided as to the merits or otherwise of strong trade unions, Metrovicks was anxious to avoid confrontation and sought instead to emphasise the 'loyalty' which 'has developed among us – management

---

203 E Frow, & R Frow, *Manchester's Big House in Trafford Park. Class conflict and collaboration at Metro-Vicks,* (Manchester: Working Class Movement Library, 1983). The Frows founded the Working Class Movement Library.

204 [W]orking [C]lass [M]ovement [L]ibrary ORG/METVIK 1922-1967 Works Committee Minutes; Dummelow, p.53. A Staff Committee was also set up in the same year.

205 This Boulting Brothers film, starring Peter Sellers, was the most popular box-office film of 1959 and was based on Alan Hackney's satirical novel, *Private Life.*

and employees' as much of its literature indicated.[206] As far as labour relations were concerned, Metrovicks was keen to foster a corporate image that stressed its willingness to work co-operatively to ensure the well-being of all of the members of the workforce. The career of Sam Ratcliffe, an ardent trade unionist and Labour Party activist, who spent his working life on the shop-floor, gave credence to this attitude and Dummelow suggested that 'few have made a greater contribution to the smooth running of the Works'.[207] Ratcliffe's stance during the General Strike, his position as chairman of the Works Committee and his numerous activities on behalf of his fellow-workers demonstrated that both the firm and the main representative of the workers managed to maintain a rapport with each other even during difficult times.[208] Set against the broader landscape of industrial relations in the post-war period, Ratcliffe's legacy remained largely intact. Indeed, the author of Rothman's obituary in *The Guardian* commented on the fact that the Trafford Park works was 'reputedly the most highly organised factory in Britain – and the most enlightened towards its workers', and contrasted this attitude to that of the A V Roe aircraft factory (Avro) where Rothman had been dismissed for his political beliefs.[209] During the Second World War he was a senior Works Committee delegate but a dispute in November 1951 gave Metrovicks an excuse to sack him.[210] It could be argued, therefore, that the treatment of Rothman demonstrated

206 MCL.338.476213.AE2 'Welcome to Trafford Park', Associated Electrical Industries (Manchester) Ltd., [n.d. c. 1960], p. 5

207 Dummelow, p. 185

208 Dummelow, p. 75

209 J Perrin, 'Benny Rothman. Inspirational figure who led the Kinder Scout Mass Trespass in its fight for open access', *The Guardian,* Friday 25 January 2002. http://www.theguardian.com [accessed 17 January 2014].

210 B Barry, 'Benny Rothman. Not just a rambler!' http://www.wcml.org.uk,, [accessed 17 January 2014]. After this dispute, technically, a reinstatement was offered to him but it would be over-optimistic to believe that that management actually wished him to return.

that the company was no better at dealing with a thorn in its flesh than was Avro but, to some extent, this would be to miss the point. Metrovicks gave Rothman a long leash; his union activity was not curbed, he was encouraged to join important decision making bodies such as the Post-War Planning Committee and he was not reined in for selling the *Daily Worker* on the shop-floor. In terms of its corporate culture, therefore, the company believed itself to be tolerant of activists such as Rothman but this has always remained a matter of conjecture.

There were voices that pleaded otherwise. Eddie Frow, another seasoned campaigner for the rights of the shop-floor worker, also questioned the nature of 'the spirit prevailing in the works'. He, too, was critical of the way in which this was interpreted by the management as a demonstration of the cohesion between all ranks of employees. In *Manchester's Big House in Trafford Park* he cited the various apprentice strikes which took place in the period immediately after the Second World War and suggested that, apart from the training they received, the young workers were ill-served in terms of wages and conditions. He viewed as indefensible the attitude of the company in taking on workers in times of plenty, and arbitrarily sacking them when times were difficult, and agreed with Walter Greenwood's thinly veiled description in *Love on the Dole* of Metrovicks as a dystopian organisation.[211] To some extent, however, Frow harked back to the state of affairs that prevailed in the bleak years of the 1930s. During the Depression Metrovicks was one of the few large engineering works to remain open, but took

211 W Greenwood, *Love on the Dole,* new edn. (London: Vintage, 1993). Both the Frows and others have suggested that Greenwood had based Marlowes (the engineering factory where the hero Larry Meath had been employed) on Metrovicks.

on apprentices, trained them and discarded them when at the age of twenty-one they reached a man's wage. Witnesses like Frow had long memories and found it difficult to be 'sentimental' about the way in which the company had once operated. In his view this was antithetical to the corporate image projected by Metrovicks as being a place of harmony and mutual understanding.

Difficulties abounded when trying to disentangle ideas of corporate 'culture', corporate 'identity' and corporate 'image' where, on the face of it, they might all mean the same thing. Chandler remained opaque on the issue whilst Thompson and McHugh cautioned against using any of these terms lightly. As they suggested, the notion of corporate culture has been put forward as the key factor for business success, but they regarded this as 'a slippery concept' used to indicate 'social rules embodied in institutional processes more than mental constructs carried about in people's heads'.[212] On the other hand, by looking to Hofstede for inspiration, Keeble suggested that companies developed a culture or a 'personality' which was able to be distinguished from others operating in the same field by building up 'a framework of ideas, assumptions, and style of working'.[213] This analysis fitted in with the Metrovicks' model whereby the firm sought to differentiate itself from others as the founder of a leading research facility, a technical innovator, and the initiator of a unique education and training scheme. The guardian 'of the 'mystique' that was attached to 'Metrovick men' as the 'aristocracy of the electrical engineering world', the tolerance of union activity

212 Thompson & McHugh, p. 76
213 Keeble, p. 8; G Hofstede, *Culture's Consequences: International Differences in Work-Related Values,* (Sage, 1980)

with an industrial 'democracy' were also considered to be hallmarks of an organisation that a 'strong sense of its own identity'. [214] In terms of the 'constructs carried about in people's heads', there was an extent to which those who worked for the company during this period supported the idea that they were working for a singular organisation. A Technician Apprentice and one of the former employees who supplied information for this study stated that he wanted to be trained by a firm 'that was known all round the world' and he was adamant that 'the company would back you all the way' because it took a 'great interest in its employees'. The idea that Metrovicks was 'renowned' for its excellent training was a common theme expressed by those who recalled their time as apprentices with the firm. R J, a Trade Apprentice from 1956-1961, went on to work at the firm until 1974; he also agreed that Metrovicks was 'acknowledged to provide excellent training'. P B, a College Apprentice, remained at the company from 1954-1960. He was also appreciative of the 'well-organised' apprentice system directed by Willis Jackson, Fleming's successor.[215] Whilst other participants in this small sample gave due regard to a number of aspects of the corporate image that Metrovicks had been eager to convey, it was their training that they remembered as being the one that marked out the organisation as being different from other industrial concerns. It could be said, therefore, that many former employees shared the self-belief that Metrovicks revelled in and had felt that they had been part of an organisation that *was* the 'aristocrat' of the electrical engineering industry. No matter that this was a contested claim, especially by BTH, the notion was sufficiently embedded in the corporate culture as to be regarded as unassailable by those who had had an

214 Jones & Marriott, p. 149
215 Oral testimony. P F (12 April 2012); R J (17 July 2010); P B (11 February 2010)

interest in the powerhouse at Trafford Park.

The extent to which Metrovicks was the 'sprawling industrial giant' described by Jones and Marriott was underlined by the fact that the company believed that it had the 'bragging rights' to the title because it had been the largest firm to be established on the first purpose built industrial estate in Europe.[216] At the turn of the twentieth-century British- Westinghouse was able to trade on its association with its American parent company and, as a result, was regarded as an integral part of a well-established 'industrial giant'. That American companies were considered to be more modern, more efficient and more competitive than British firms had much currency at this time and there was prestige to be gained from a connection with what was considered to be a forward looking enterprise like the American Westinghouse corporation. The fact that the image of Westinghouse business efficiency quickly became tarnished in relation to its British establishment did not appear to have a profound impact on this prevailing view. Instead, as a result of its association with perceived notions of American dynamism, modernity and enterprise, Metrovicks never quite lost that standing in the electrical engineering industry, despite the many vicissitudes that the organisation experienced over the years. In addition, the corporate culture that was fostered by the company encouraged its employees to believe not only that they had inherited a distinguished tradition of engineering expertise but that their continued mastery in this area gave them a commanding presence in the industry and afforded the

216 Jones & Marriott, p.263

company a 'world-wide reputation'.[217] That this was due in no small measure to the outstanding contribution made by the scientific research and development teams at Trafford Park would be hard to contest. More especially, however, the system of technical training and vocational education inaugurated by A.P.M. Fleming was pivotal to the success that the company achieved in this field. It is to an examination of this system and of role of Fleming played in its development that the next chapter of this study will be directed.

217 Jones & Marriott, p. 277

CHAPTER 2

The education of Apprentices: the influence of A P M Fleming, Director of Education and Research, on the company and on the electrical engineering industry.

This chapter will concentrate upon the career of A P M Fleming, the architect of the technical training and vocational education programme at Metrovicks. A brief survey will show that he was appointed by British Westinghouse, the forerunner of Metrovicks, to undergo training at the American headquarters of the company in Pittsburgh in the early years of the twentieth-century. An enquiry will take place into the extent to which this schooling in American methods and techniques affected his own design and implementation of the apprenticeship scheme he was charged with delivering at Trafford Park on his return from the United States. Fleming was concerned that traditional methods of recruiting and training young people were obsolete in the context of the large scale industrial development and an examination of how he sought to change thinking on this issue will be undertaken in this chapter. In addition attention will be paid to some of the educational theories that he utilised in the pursuit of this goal and some explanation of their importance to the development of apprentice training at Metrovicks. Fleming advocated a radical approach which incorporated a liberal strand of education into technical training and the way in which his innovative methods were directed to meet the needs of three distinct categories of trainees within the company will be demonstrated. His philosophy of incorporating a 'liberal' element to their training within the technical and vocational education

programmes he initiated will be examined. Attention will also be paid to his role of Director of Research at the company. Under his guidance the provision of excellence in both the fields of technical education and industrial research became synonymous with the name of Metrovicks lending a distinctive tenor to the corporate culture that he helped to develop at the firms. An examination of the nature of the corporate culture that subsequently was embedded into the apprenticeship system will take place in order to question the extent to which women apprentices were able to benefit by its implementation. In addition, the validity of the claim that he was a pioneer of technical and vocational education, whose influence gained him and his company a world-wide reputation, will be assessed and the impact that this had upon the wider reaches of both education and industry will also be appraised. The extent to which Fleming's work in the field of education and his contribution to industrial research marked him out as a radical reformer will be considered, especially in relation to the conservative values that he felt it was necessary to uphold both within the industry and beyond. Finally some consideration will be given to the way fact that his legacy, inherited by Sir Willis Jackson, left some issues that were in pressing need of resolution.

Sir Arthur Percy Morris Fleming (1881-1960) is little remembered today but in his time he was a renowned research engineer specialising in the area of materials testing. Throughout his long career he received many accolades, including doctorates from the University of Manchester and the University of Liverpool. He sat on the Council of the University of Manchester, the Governing Body of Imperial College and was a member of the War Cabinet Engineering Advisory committee

and the Ministry of Education committee on the training of teachers and youth leaders, amongst others. Fleming also played an important part in the establishment of the Department of Scientific and Industrial Research and of the Electrical Research Association, and was President of various prestigious institutions such as the Institution of Electrical Engineers. Here he delivered the Faraday Lecture in 1937, was awarded the Faraday Medal in 1941 and given an Honorary Fellowship in 1951. In addition, he was awarded the Hawksley Medal by the Institution of Mechanical Engineers (IMechE) and was awarded both an OBE and a CBE for services to research and development and in 1945 was given a knighthood for services to education. He began his career at Finsbury Technical College, and after graduating he worked for a short time in London before he joined the British Westinghouse Corporation. In 1899 a number of young engineers were enrolled to train at its Pittsburgh headquarters preparatory to their taking up the 'less important' posts being offered at Trafford Park to non-American employees.[218] As a member of this group, the 'Holy Forty', Fleming's experience of training in the USA was much like that of his colleague Johnson, who recorded details of the daily life of what Westinghouse called the 'British Specials'. Training was arduous and overtime was demanded even after a 54-hour working week spent coping with unfamiliar American methods and techniques. The British were not particularly popular with the Americans, dysentery amongst the trainees was rife, living conditions were basic and Pittsburgh was 'a raw, ugly town' where the police 'swung useful looking clubs and carried revolvers'.[219] Fleming returned home in 1902 and his task then was to build on these American working practices

218 Dummelow, p. 13
219 Johnson, 'One of the “Holy Forty” Tells His Story' pp. 6-7.

at British-Westinghouse. He also spent time with Johnson conducting experiments with insulation and this formed the early beginnings of the industrial research facility he was to head at Metrovicks. Although he had been appointed superintendent of the transformer department, in 1908 he was also put in charge of apprentice training when, as he later recalled, 'the whole picture of training in industry' was 'a pitiable one'.[220] In response to this chronic situation, he instigated the setting-up in 1910 of the first works' training school in Britain catering for every category of apprentice and in 1912 he was given the task of organising shopfloor trainees, or Trade Apprentices as they came to be known. His initial task, however, was to increase the number of trainees being recruited. The Trafford Park organisation had started up on such a large scale that it was imperative that it quickly identified the type of employee best able to cope with the rapid development of highly technical processes, as Bradley made clear.[221] In hope of avoiding becoming mired in antiquated methods and procedures, British Westinghouse, therefore, rejected the long-established practice within the industry of employing 'premium' apprentices. This system, in their view outdated, was anathema to British Westinghouse management, ever anxious to stake a claim to be at the forefront of technological innovation and change, and it was therefore quickly banned by them. Fleming had long been aware of this old-fashioned and unfair system whereby 'a young man of education who could afford to pay upwards of two hundred guineas a year [was] admitted to a firm and provided with

220 IEE NAEST 070/106 Box 3 A P M Fleming, 'Training Within Industry', Speech given to *Cambridge University – Human Relations in Industry Group,* 22 October 1951, p. 2

221 Bradley, p. 11

some form of practical experience as a 'premium' apprentice'.[222] Indeed he co-authored *Engineering as a Profession* with R.W. Bailey in 1913 in order to encourage and enable 'those who have insufficient means' to complete their education and training at minimum expense and in his later writings and speeches he continued to stress his satisfaction at being able to replace the 'premium' system by tailor-made schemes in which apprentices were chosen on merit alone.[223] In this book the authors also set out to counter the prevailing idea that it was not possible to class engineering as a learned profession, and they went to great lengths to argue their case, albeit swimming against the tide as far as much of their professional middle-class readership was concerned. As Barnett made clear, when proposing links between education and industrial decline, the distinctions made between education and vocational training were often marked and were damaging, a factor to which he drew attention but, in any case, had long been debated in educational circles.[224] It is suggested here that Fleming being well aware of these arguments was not only prepared to open up the debate still further, but was also prepared to reconfigure vocational training in a way that challenged perceptions about the way in which the engineer ought to be viewed especially by those elite segments of society where prejudice existed. Apart from this, his archive provided few personal documents that might have hinted at his other motivations in seeking such radical changes. In *Research in Industry,* however, some of his thinking, and that of Pearce his co-author, was made more apparent. They suggested that it was imperative that the 'ill effects' of the lack of

222 Fleming, 'Training Within Industry', pp.2-3
223 A P M Fleming & R W Bailey, Engineering as a Profession, (London: J. Long, 1913), pp. vi, 14, 130-189
224 Barnett, *The Audit,p.120*

contact between 'industrial life' and 'professional life' needed to be countered and they were at pains to point out the 'more harmful' effects that could be seen in 'the general failure of those not directly engaged in productive work ' to realise the extent to which 'the well-being of the whole community depended upon industry'.[225] In further suggesting that 'the higher ideal of social development and progress' were dependent upon industrial progress and that the professional middle class as well as public institutions were 'all maintained out of the product of industry', Fleming and Pearce ignored prevailing views and instead demanded not only respect for industry but also signified its pre-eminence in maintaining 'standards of living and culture'.[226]

In the first decades of the twentieth-century, however, attitudes were slow to change and the ban on 'premium' apprenticeship quickly brought about a shortfall in recruits of the right calibre to Trafford Park. As a consequence, British-Westinghouse adopted the solution that had been employed by American corporate giants such as General Electric and the firm turned to the universities to provide postgraduate apprentices who would be chosen on merit alone.[227] Fleming then reorganised the technical and vocational education and training of these apprentices with the intention of enabling them to fill senior managerial roles within the company at a later point in their careers.[228] Inextricably linked with this system was the imperative to instil in all trainees the corporate culture that British-

225 Fleming & Pearce, *Research in Industry,* p. 1
226 Fleming & Pearce, pp. v, 2, 4
227 Nye, p. 61
228 In 1912 Fleming was given the task of organising theTrade Apprentices (shopfloor trainees).

Westinghouse, and later Metrovicks, was anxious to impart. As Dummelow stressed, his appointment was 'a step that was to have results of inestimable value', and this was a verdict with which Cooper later concurred.[229]

The way in which technical education was provided in Britain during the period under investigation has been covered in many comprehensive studies by experts in the field such as Sanderson, as well as Summerfield and Evans. Other contributors such as Esland and Venkataiah have also offered useful overviews of a topic that has been much debated over the years.[230] Fleming introduced a different concept of workplace training to the industry, and some background is needed to elucidate the problems that he faced when he was first given the task of overseeing apprentice training. Antipathy towards both applied science and entrepreneurial activity had long been expressed by those aspiring 'to the status of gentleman', as Wiener vouched.[231] It was pointed out in the last chapter that this stood in marked contrast to the position in the rest of Europe where to be an engineer was not considered to be a low status occupation. Nevertheless, in their introduction to *Technical Education and the State*, Summerfield and Evans concluded that Weiner was correct to point out that it had been considered essential to sustain an elite through the promotion of a 'liberal' education in the classics and that this was a notion that was little questioned by those whose culture and beliefs were anti-competitive. This resulted, however, in difficulties emerging when trying to sustain 'economic dynamism', as Fleming and Pearce

229 Dummelow, p. 33; Cooper, 'The early development of scientific research in industry', p. 89
230 G Esland, *Education, Training and Employment,* (Wokingham: Addison-Wesley for the Open University), 1990; S. Venkataiah, *Vocational Education,* (New Delhi: Amnol, 2002)
231 Wiener, pp. 132-135

pointed out.[232] Summerfield and Evans also noted that, from the time when the Taunton Commission reported in 1868, the lack of provision for technical education was one of the important reasons for the decline of industrial power. [233] Vlaeminke was particularly informative about the problems that bedevilled the late Victorian era as expanding employment opportunities led to 'the emergence of a new crop of sub-professions' where formal qualifications became the most important aid 'to occupational mobility', a notion to which Fleming wholeheartedly subscribed throughout his tenure as Director of Education and Research at Metrovicks.[234] Saunderson suggested, rather, that it was in the Edwardian era that the difficulties besetting industrial concerns looking to train school-leavers became widespread and this was the point at which Fleming successfully persuaded the company to set up a works school dedicated to this purpose.[235] In the face of the stifling of many local initiatives to deliver appropriate training of a high quality, Summerfield and Evans pointed out that it was hardly surprising that competition from abroad was so marked, especially from Germany and the United States where this type of instruction was already well developed. The decision taken at Trafford Park, therefore, marked a departure in the way that industrial concerns in this country began to organise workplace training. Furthermore Fleming gave much thought to the development both of his ideas and of their practical applications, with the intention of not only matching but also surpassing anything that potential rivals

---

232 Summerfield & Evans, p. 7

233 The Taunton Commission looked at secondary education and proposed a three-tier system where only the elite would be expected to go on to pursue a university education and where the rest would be prepared for entry to the minor professions or for work in small businesses and commerce.

234 M Vlaeminke, 'The subordination of technical education in secondary schooling, 1870-1914', p. 58, in Summerfield & Evans, *Technical Education.*

235 Sanderson, *Education and Economic Decline,* pp. 1-16

could offer.

The ban on 'premium' apprentices, therefore, was one of the hallmarks of the education and training programme that Fleming inaugurated but it is a moot point as to whether this was as equitable as he believed it to be. He structured his system along hierarchical lines and put into place a three-tier apprenticeship scheme. In brief, the College Apprentices, the elite trainees who were intended to provide the Company with its highest ranking professional and managerial staff, were postgraduate students recruited from the universities. Although these students had gained a high level of technical knowledge they had little experience of workplace conditions and Fleming had to design a two-year course to remedy this; one year had to be spent undergoing basic workshop training before it was possible for these apprentices to proceed to test beds and office work.[236] In addition he was adamant that the education of these potential leaders had to ensure that they were able to 'understand the working of an industrial organisation, to appreciate the relationship between labour and management, to acquire experience in the direction of labour, and to see the application in every phase of the organisation of scientific knowledge'.[237] As part of this process, Fleming wanted College Apprentices to 'appreciate the interdependence of parts of an organisation and obtain a coherent picture of the whole', and to this end he laid out a curriculum that involved the 'learner' in spending time training in the 'administrative, accounting, purchasing, commercial and research sides of the

236 MCL.Q.631.3.AE2 'A Pioneer in Research and Education', *AEI News,* 20:6 (June, 1950), p.4

237 Fleming, 'Training Within Industry', p. 5

business' as well as being schooled in engineering techniques and practices.[238] Whilst their university studies had concentrated on providing a rigorous technical training, graduate engineers were not conversant with the work undertaken by these ancillary departments. Fleming was adamant, therefore, that not only did they gain an understanding of how these sections of the company functioned but, more importantly, that they learned how to negotiate their way through the complexities of dealing with people who did not possess their level of engineering skill or technical know-how. His approach involved ensuring that College Apprentices avoided 'exclusiveness, real or apparent' and that they recognised that it was 'unfair to differentiate between one worker and another' for in their own milieu they were all 'equally capable and deserving' and 'unreserved co-operation' between all grades of workers was 'essential'.[239] These were principles that dovetailed into important aspects of the corporate culture that was fostered at Metrovicks and were the ones that Fleming referred to many times as he sought to bring his apprenticeship training schemes to the attention of a wider audience. Whether or not his combination of providing high grade tuition in the theoretical aspects of engineering alongside practical training in the workshops hastened the entry of the scions of the aristocracy or the professional middle class into the ranks of the industry was difficult to assess. Nonetheless, entries in the Apprentice Register show that this was always a popular career choice for young men. In 1902, the inaugural year for training, 28 College Apprentices joined the firm accompanied by 16 Schools Apprentices, 1 Special Trainee and 1 Trade Apprentice. These numbers grew with the peak year for College Apprentices

238 Fleming & Pearce, *Research in Industry,* p. 171
239 Fleming & Pearce, pp. 172-173

being 1950 when 144 joined the firm and began their training, as did 14 Probationary College Apprentices, 41 Schools Apprentices, 50 Special Trainees, 1 Special Apprentice, 166 Trade Apprentices and 97 Vacation Apprentices.[240] It was not possible to discover much information about the social background of these trainees from this source, or indeed from any other. There seemed to be no standard form that had to be completed for the Register and so the information that each individual provided for their short profile did not always include details of their schooling or of their university education, and few family details could be found amongst these entries that might have given further clues. Only a brief reference by Dummelow provided a hint as to their possible origins. In suggesting that many ex-College Apprentices 'have gone to leaven the lump of the non-industrial world' and that 'doctors and missionaries […] schoolmasters and barristers' as well as members of 'parliament, the churches, the civil service, the armed forces, […] the BBC and the press' were 'some by-products' of Fleming's system, he pointed to the fact that, if not members of the upper echelon in society, these engineers did at least inhabit the ranks of the professional middle class.[241]

The needs of the Schools Apprentices, who were destined to fill middle-ranking managerial and engineering posts at Metrovicks, were different from those of the graduate engineers and were complicated by the fact that they had to attend local colleges of technology, such as the Salford or Manchester Colleges of Technology (later RCAT, Salford and UMIST) in order to gain professional qualifications. Fleming suggested that this group of students might be recruited from both the

240 Metropolitan-Vickers Electrical Company Limited, *A Register of Ex-Apprentices*
241 Dummelow, p. 208

'Public Schools' and 'Grammar Schools', although it was hard to envisage that the undertaking of part-time courses in colleges of technology sited in northern cities would appeal to many public school pupils.[242] The course that was designed for Schools Apprentices was intended to build on the technical knowledge they had gained through part-time study. It also emphasised the importance of the practical training they received in the works school and in the various company divisions under the tutelage of departmental superintendents and managers. In addition, emphasis was placed on the importance of ensuring that components of a liberal education were incorporated into all the courses and training sessions that were run at Metrovicks. It was Fleming's firm belief that it was vital for engineers to be well-rounded individuals, rather than narrow specialists in their field and the provision of this type of education was extended to all apprentices as well as to members of the workforce, such as administrative staff, who were undergoing different types of training. The management at Trafford Park, however, often gave the impression that not only did the form of technical and vocational education offered to Schools Apprentices lie at the core of company thinking on industrial training but also that this category of apprentice best represented many features of the corporate image that Metrovicks wished to project. Testimonies from Fleming, Evans, Marshall and Dannatt amongst others, suggested that a visceral thinking remained about the merits of the nineteenth-century method of 'training on the job' given to the educated artisan-craftsman, and that parts of this tradition were worth preserving.[243] Thus certain elements of myth were attached to the belief that

242 IEE NAEST 070/31 Box 2 [n.d.] Fleming 'Education and Training in the AEI Group', p. 6

243 Dummelow, p. 93. Whilst Evans oversaw the training of College Apprentices, Marshall was put in charge of Schools Apprentices. Dr Dannatt was an ex-College Apprentice who rose to

those who had gained their qualifications in this way more faithfully mirrored the type of skilled apprentice that the engineering industry prized. Accordingly, Metrovicks was not slow to publicise this to boost its credentials as the premier industrial provider of this classic form of technical and vocational education and training.[244] As a result, a demanding selection process took place before candidates were able to gain entry to a Schools Apprenticeship, and then embark upon the 'long route' towards gaining professional engineering qualifications. Candidates who had completed a sixth form education to Advanced Level standard were short-listed and put before a panel consisting of senior personnel such as the Chief Engineer, Works Superintendents, the Senior Research Engineer and the Sales Manager in order to ensure that they were serious about their commitment to a lengthy training process. Prior to final selection those who had survived this process spent two days being assessed in the Trafford Park works. Fleming made it plain in a number of speeches and documents that this process should be 'rigorous', and although he did suggest that 'a few girls' might be 'taken as School and College Apprentices for training as Chemists, Physicists, Metallurgists or Engineers' his repeated use of the word 'men' suggested that he did not envisage a prominent place for women in either group.[245] In addition, he made it plain that Schools Apprentices could expect to be 'posted as junior staff

---

become the Chief Electrical Engineer and a member of the Board of Management. He was appointed Professor of Electrical Engineering at Birmingham University in 1940 but was seconded by the Admiralty to work part-time in the Research Department at Trafford Park during the war. He resigned his Chair to return to Metrovicks in 1944.

244 WCML 36001193 AG1 Gtr Manchester Box 1/A . 'Background to Metropolitan-Vickers Training Scheme', [n.d. c. late 1950s], WCML 36001193, AG1 Gtr Manchester Box 1/A amongst others.

245 Fleming 'Education and Training', pp.10-11; IEE NAEST 070/57 Box 2 Fleming, Report on the Discussion on 'The Young Worker in Industry', Section L British Association for the Advancement of Science, 13 September 1948, pp. 2-3

engineers', leading to the suspicion that members of this branch of the Apprentice Association were to occupy the 'second-rank' in his hierarchical system.[246] Directed by R.F. Marshall, from the Education Department in Trafford Park, the course was always well subscribed and during the 1940s and up to the late 1950s, 461 students had taken up Schools Apprenticeships compared with 1196 students embarking upon College Apprenticeships.[247] Metrovicks also ran a number of similar courses with a high take up in numbers for Special Trainees and Special Apprentices where elements of the training offered to Schools Apprentices, for example in draughtsmanship, were taught. The difference was that the Schools Apprentices worked towards gaining a London University external degree, or an HND which was considered to be an alternative to gaining a degree through the conventional university route in the 1950s and early 1960s.

This intention in this thesis is to examine the place occupied by female College and Schools Apprentices within the company, but it would be remiss not to mention how Fleming organised the training of Trade Apprentices, although no young women were admitted to the ranks of this section of the Apprentice Association and it remained a male-only domain during the period of time covered by this thesis. Young women who worked on the shopfloor, in insulation, coil winding or assembly work for example, were never accepted as apprentices. They were trained 'on-the-job' although they received extra tuition in the Works School where appropriate. Their exclusion may have been left over from the tradition followed by American-Westinghouse, but without archival evidence it was difficult to state with

246 Fleming 'Education and Training', p. 7
247 Metropolitan-Vickers, *Register of Ex-Apprentices*

any degree of certainty. Although both Dummelow and Rowlinson made mention of the contribution made by women in both World Wars, it may well also have been the case that the ever-present idea of 'dilution' contributed to this state of affairs.[248] Like these young women, Trade Apprentices were destined to work on the shopfloor but they were being prepared as time-served craftsmen, undertaking a six year training programme where they were taught the most up-to-date engineering techniques and acquired expertise in operating complex machinery and equipment. The technical training that took place on the shopfloor was supplemented by education in the Works School where the curriculum also provided the broad, liberal education that Fleming considered to be so important to the development of the individual and thus, as he saw it, to the prosperity of the company and the community at large, notions that he and Pearce emphasised in *The Principles of Apprentice Training.*[249] By centralising education and training under the umbrella of a purpose-built Education Department, and by adapting courses to meet the specific needs of different groups of trainees, Fleming put forward this innovatory approach to serve as a model for other organisations which might look to it for inspiration. It was certainly the case that a number of other firms had set up works schools in the aftermath of the First World War; for instance Marconi opened a Wireless Training School at Chelmsford in 1920 and Leyland Motors established a day continuation school during the same period.[250] It was equally clear, however, that Metrovicks had already gone further than any other

248 R Mackay, *The Test of War: Inside Britain 1939-1945,* (London: UCL Press 1999), p. 90; C Wightman, *More than Munitions: Women, Work and the Engineering Industries 1900-1950,* (London: Addison Wesley,1999) for a fuller picture; WCML ORG/METVIK Works Committee Minutes

249 Fleming & Pearce, *Principles of Apprentice Training,* pp. 14-18

250 Leyland Motors, *'The First Fifty Years'* (Leyland: Leyland Motors Ltd., 1948)

company, including these, in the range and sophistication of its educational provision and was at the forefront of such development.

Nonetheless, whether Fleming intended it or not, he had developed a tiered training system based on the ability of the apprentice to gain entry to university. During the period under consideration access to this level of education was often predicated on the capacity of families to provide the funding to see students through their full-time studies, or indeed the availability of university places, amongst a number of other factors. Having abolished the 'premium' apprentice system because he felt it to be divisive, Fleming went on to found a system that also ranked apprentices hierarchically and although it could be argued that they were being ranked according to academic ability, or 'merit' as he called it, this was only one aspect of the case. In the 1950s and 1960s, it was often those who were placed firmly in the ranks of the middle and upper-classes who entered full-time higher education at the age of eighteen, a factor that will be discussed in the next chapter of this thesis. This, of course, had been the very stratum of society from whence 'premium apprentices' had originated. It was clear from his writings and speeches, however, that Fleming did not look at it this way. In fact he believed that he was offering 'every encouragement' to 'a democratic cross-section of personnel' where 'the […] preliminary advantages of birth and education can be matched by […] hard work', in order to enable trainees to discover their 'natural bent'.[251] Certainly Fleming was concerned with 'upward mobility' for all apprentices as he made clear in a speech to the Engineers' Association in Pretoria

251 Fleming 'Training in Industry'. p. 3; Fleming, 'Education and Training', p. 7

in 1946.[252] Despite this, however, some hesitation remains about the ability of most of the apprentices further down the scale to be regarded in quite the same light as the College Apprentices. As it has been shown, a small number of Schools and Trade Apprentices did go on to have outstanding careers within the company. There was, however, a certain status attached to being a College Apprentice that was recognised by those who worked at Metrovicks and this did not seem to apply in the same way to the other members of the Apprentice Association, as some of the women who gave oral testimonies suggested. As P D recalled, '[…] you just knew that the CollApps were going to get ahead. In our department they were always given the good jobs to get on with and they usually did' and I B said that '[…] they always had this air about them. They were always sure of themselves. I don't know if they were clever but they always thought they knew a lot, even though they were only apprentices'.[253]

As stated earlier, the original impetus to provide training came from the need to ensure that the huge new purpose-built factory at Trafford Park was able to work to full capacity without sections having to be mothballed for want of skilled workers. It was imperative, therefore, for Fleming to provide the firm with an articulate, highly trained and technologically 'savvy' workforce because the fluctuating financial fortune of the company in the first two decades of the twentieth-century meant that its long-term survival was in jeopardy. This, however, was not the only reason why Fleming felt that it was vital to implement change in

252 IEE NAEST 070/22 Box 2 'Education of Engineers'. Speech given to the Engineers' Association, Pretoria, 15 October 1946 [n.p.]

253 Oral testimonies. P D (21 December 2013); I B (2 December 2010). CollApp was the colloquial term used at Metrovicks to describe these trainees.

an antiquated apprenticeship system. Frustrated by evidence of a lack of imagination on the part of employers to experiment with new training methods, it troubled him to think this would lead to a further decline in prestige for the British engineering industry in relation to competitors such as Germany and the United States. It was in order to stem this paralysis of thought, and indeed of action, that Fleming set about a proselytising mission to change the way in which workplace education was delivered. Already in the forefront of reform and well-placed to push for change, in 1916 Fleming turned to print and with J F Pearce wrote *Principles of Apprentice Training with Special Reference to the Engineering Industry* in order to publicise his ground-breaking ideas. Pearce had worked closely with him on a number of research projects and was instrumental in setting up the technical library in the newly established Research Department, a vital addition to the expanding importance of industrial research and development within the company. Although he later left Metrovicks to become a director of the British Cast Iron Association and thus became less involved in the promotion of apprenticeship training, in his collaboration with Fleming both men set a standard that was to be adopted extensively within the electrical engineering sector and, in time, by the wider reaches of industry. Although Fleming had discovered that several English firms such as Mather & Platt and J & J Coleman had held classes on their premises 'for the instruction of workpeople' he knew that these were undertaken on a spasmodic basis and had ceased altogether once technical schools became more organised. As a result of his investigations he felt that it was essential to encourage firms to further develop purpose-built schemes on the

lines that he and Pearce had suggested.[254] As an aside, although Wilson noted that the college that was created in 1884 to provide training for electricians in the Ferranti Hammond Company was 'one of the most prestigious training institutions in the industry up to the 1960's', this was not a forerunner of the Fleming and Pearce model and authorities such as Summerfield and Evans as well as Sanderson did not refer to it in their comprehensive surveys. [255] Whilst Fleming and Pearce's approach entailing the provision of technical skills underpinned by a broad liberal education might now seem unremarkable, this was a 'sea-change' in the ways in which vocational education and training had been viewed previously. There was, therefore a fundamental difference between Fleming's educational philosophy and the way in which much of the industry was still operating during this period. This was, therefore, a genuine attempt to engender much needed change in an outmoded and static system.

In *Principles of Apprentice Training* both authors spelt out the importance of some of the schemes that German industrial concerns, such as Ludwig Loewe & Company and Siemans and Halske in Berlin, had already implemented. Whilst they were careful to acknowledge that to take a system from another country and adapt it for home consumption was fraught with difficulties, they were impressed by German methods which they considered to be the best in Europe.[256] Here, compulsory elementary education was followed by the trade continuation school, the Fortbildungsschulen. A child could leave elementary school at 12 and go to a

254 Fleming & Pearce, *Principles of Apprentice Training,* p. 98
255 Wilson, *Ferranti and the British Electrical Industry,* pp. 20-21
256 Fleming & Pearce, *Principles* pp.103, 113

trade school full-time, or leave at 14 and attend part-time whilst working. Sanderson pointed out that it had been Kerschensteiner's reorganisation of trade continuation schools in 1900 that had focussed on 'workshops and practical work in trades' and these developments meant that the Germans had 'virtually no 'dead end' problems such as troubled England'; vocational education at all levels was, therefore, 'one of the great strengths of the German industrial economy' during this period.[257] The 'dead end' problem which Fleming also identified as affecting 'the least intelligent of the [...] community' leaving them as ' “blind-alley” ' workers who preferred 'the complete lack of responsibility which their grade of occupation affords' was one that he believed needed to be rectified as a 'lack of training compels [them] to follow work that is a probable centre of dissatisfaction, and a grave economic loss to the community'.[258] When *Principles* was eventually published in 1916 some of these workers would have been at war but this did not seem to have diminished the view of the authors that this was still a problem in urgent need of a solution. Looking to Kerschensteiner as a source of inspiration Fleming found that he had undertaken his reforms in Munich because he believed that the continuation schools were too academic and there was a need to direct the non-academic into the acquisition of productive skills. In France, similar attention was also paid to the type of education that was directed towards industry, and Bailey examined the role that the Ecoles d'Apprentissages played within the system. [259]Fleming, however, was more keen to draft in elements of the Munich Continuation School system and was particularly influenced by Kerschensteiner's

257 Sanderson, *Education and Economic Decline* p.14
258 Fleming & Pearce, *Principles,* p. 6
259 B Bailey, 'Technical education and secondary schooling' in Summerfield & Evans, *Technical Education and the State,* (p. 104)

ideas about combining industrial training with training in citizenship as a medium for cultural studies and instruction.[260] Recognising this, Fleming set about promoting training in citizenship which he felt signified a totally different approach than had hitherto been undertaken and thus it became a central plank of his initiative as he laid down plans for the curricula for trainees at Metrovicks.

Both *Principles* and *Research in Industry* give vital clues as to the way in which Fleming developed his philosophy. Though he collaborated with Pearce in the production of both books, it was difficult to avoid the conclusion that most of the ideas contained within them came from Fleming. He reiterated them on many public platforms and even referred to them in those speeches that he made to young people on occasions when he was invited to attend Speech Days. Here a curious mixture of 'fatherly' advice about 'the obligation to render the best service you can to the community', by making the 'fullest use of […] talents' and to possess 'sound judgment, honesty […] and an ability to get on with [others] and gain their respect' was combined with prescient concerns about the environment, about obligations to 'less fortunate countries' and about the 'effort' needed to produce 'weapons of destruction' which he felt that 'as far as we are personally concerned is entirely wasted'.[261] Given that this particular speech was delivered before 'the European end of the war [was] nearing its conclusion' it pointed to a stance that, it is argued, owed much to the importance that he placed on ideas of citizenship that he had gleaned from Kerschensteiner and on radical thinking

260 Kerschensteiner, pp. 104, 175
261 IEE NAEST 6 T.P. File Fleming, Speech given to Prince Henry's Grammar School, Otley, 20 November 1943, pp. 6, 8, 9

about the ways in which society might better be organised. In turn these ideas, developed in his apprenticeship training schemes, found their way into the corporate culture that he helped to develop at Metrovicks.

It was, however, interesting to speculate on the extent to which some of the emphasis that Fleming placed on the importance of citizenship in the curriculum was also embedded in ideas of Muscular Christianity and in the legacy of the Christian Socialist movement; indeed Donald Hall suggested that 'metaphors and pedagogical goals of the Christian Socialist and Muscular Christians' were 'inextricably linked'.[262] At first glance this might seem to verge on the anachronistic, but as far as Fleming was concerned there was an imperative to maintain a spirit of service within the company and it could argued that many of his ideas were influenced by principles that continued to resonate long after they were laid down in the nineteenth-century. In examining both the socio-cultural developments and the legacy of Muscular Christianity in the modern world, Watson *et al* used as an example the mission statement of Ampleforth School which they suggested was imbued with this ideal. Thus 'to work for excellence in our endeavours, academic, sporting, cultural', to be 'mature and honourable, inspired by high ideals and capable of leadership', in order to 'serve others generously' was also an accurate description of what had been Fleming's own objectives.[263] Indeed, in his conference paper to the National Movement Towards a

---

262 D E Hall, *Muscular Christianity. Embodying the Victorian Age,* (Cambridge: Cambridge University Press, 1994), p. 48.

263 N J Watson, S Weir, & S Friend, 'The Development of Muscular Christianity and Beyond', *Journal of Religion and Society,* http://moses.creighton.edu/JRS/2005/2005-2.html [Accessed 10 April 2011]

Christian Order of Industry and Commerce in January 1925, he stated that 'the highest conception of the fundamental purpose of industry is that of service to the community', and his speech to this body emphasised that it was imperative that works schools should 'inculcate' the duties of citizenship in all trainees.[264] That Fleming should interest himself in this kind of organisation and that he should take the trouble to address a conference that sought to 'base industrial activity on a clearly-understood Christian morality' suggested not only religious belief but also a deep-rooted concern to preserve the *status quo* in the midst of turbulent times for industrial leaders. During the 1920s the Movement attracted a number of prominent public figures to its ranks, including B Seebohm Rowntree and C H Northcott, and its meetings gave prominence to the Christian ideals that bound the members of the Movement together.[265] Thus there was much talk on these occasions of 'God's will for industry', or 'the essential duty incumbent on each Christian – the duty of working with God for man's salvation'.[266] The organisation was regarded with a degree of good-will, unsurprisingly by the likes of *The Spectator*, which saw the Movement as providing a *via media* between the excesses of the 'unseemly and undignified luxuries' of the rich and the 'working men who spend what they do spend on drink and on racing'. On the other hand, however, the publication did caution against some of the inflated claims of the Movement that it might better serve the community than 'all these Whitley

---

264 National Movement Towards A Christian Order In Industry. The Control of Industry, Balliol College, Oxford, 9-12 January 1925. A P M Fleming & E EWilson, 'The Responsibilities of the Management Towards the New Entrant', pp. 23-30. Miss Wilson was the Superintendent of Women Workers at Metropolitan-Vickers Electrical Company Limited.

265 C H Northcott(1880-1968), an active member of the Methodist Church, was the author of a number of well known works such as *Personnel Management* (1945) and *Christian Principles in Industry* (1958). He worked for Rowntree & Company until his retirement in 1946.

266 Fleming & Wilson 'The Responsibilities', pp. 48,62, 69.

Councils', Chambers of Commerce, Trade Unions' and that it 'might take action in times of trouble'. 'Trouble' was not defined by the Movement, but it appeared to be centred on the belief that there might be a repetition of 'what happened in 1920 in Germany with works councils' and clearly the after-effects of both the Bolshevik and the German Revolutions were still uppermost in the minds of industrialists during this period.[267] It has not been possible to discover how Fleming came to be caught up with this movement. His appearance amongst the ranks of those gathered at Balliol undoubtedly confirmed his status as a pioneering provider of industrial training, but perhaps also demonstrated an entrenched patriarchal attitude towards the workforce that encouraged his participation in the 'Christian Order of Industry'. In his address entitled 'The Responsibilities of the Management Towards the New Entrant', which he co-authored with E E Wilson, he expressed familiar ideas about citizenship that he had outlined in both *Principles* and in *Research in Industry.* He also chose to elaborate upon his belief in the importance of the scientific selection of young workers which he felt could best be effected by conducting physical, psychological and physiological tests before a candidate gained entry to a programme of training. In *Principles* he had elected to sanction a method of achieving this that relied heavily on the application of Social Darwinist theories which he explained were 'elaborated' upon by Dr Katherine Blackford and used by 'firms in America', and almost a decade after *Principles* was first published, his speech in Oxford suggested that he still appeared to support her

267 *The Spectator,* 22 July 1922, p. 103, http://www.archive.spectator,co.uk, [Accessed 15 February 2014] The Whitley Councils were formed to provide formal consultative meetings between workers and employers as a result of the work of the committee chaired by J H Whitley in 1917 which then produced the *Report on the Relations of Employers and Employees* in that year.

findings.[268] That Dr Blackford was prone to making statements, especially about the relevance of physiognomy in the selection of employees, that appeared to be racist in content and perhaps not applicable to the British experience, must have run counter to his Christian beliefs but this did not seem to have occurred to Fleming. His membership of the National Movement also presented a paradox. There was a tension between his quest for modernisation and his association with more cautious approaches to industrial change. On the one hand, Fleming set out to 'democratise' the apprenticeship system by banning 'premium' apprentices and then courted controversy by advocating a complete overhaul of the system which marked him as as being radical in his thinking. On the other hand he was happy to be associated with an organisation that sent out messages about the way in which industry as a whole should be directed that were intended to appeal to those conservative elements in society which were particularly fearful of change at that moment. Parts of his message to the National Movement, therefore, stood in contrast to the message that he delivered at Prince Henry's Grammar School. As a result, Fleming emerged as a complex character whose motives in supporting a number of contradictory issues were often difficult to disentangle.

Notwithstanding the importance to Fleming of the development of a philosophical base which would explain how apprentice training might best proceed, he was also given the practical task of putting his ideas into operation and he had to do this in short order. Although a breakdown of the Siemens & Halske Trade School curriculum was included in the appendix, little mention was made in *Principles*

---

268 Fleming & Pearce, *Principles,* pp. 81-94 (91-93).They referred to K M H Blackford & A Newcomb, *The Job, The Man, The Boss,* [n.d. no provenance]

about the American Westinghouse model of training that he experienced during his time in Pittsburgh. It was clear, however, that Fleming was keen to acknowledge the influence of the 'characteristic vigour' of the Americans in promoting industrial training.[269] During this period, as Nye pointed out, employers in the United States faced a different set of concerns to their British counterparts, especially in relation to the integration of immigrant workers into the factory as well as the lack of homogeneity in the working class population. Fleming had already identified the difficulties that had marked out the American experience from those of the British but, for the most part, he suggested that the issues that affected American companies were 'not dissimilar from those obtaining in England'.[270] It was hard to know whether or not he found every aspect of the American model of apprentice training, introduced by both Westinghouse and General Electric for example, as being appropriate for adoption at Trafford Park. As far as including citizenship in the curriculum, which was already in place at General Electric, it would be fair to surmise that Fleming *was* influenced by the way in which American companies handled this particular aspect of liberal education in the workplace.[271] On the other hand, the General Electric model of a four-year trade apprenticeship being spent in the classroom and in the training shop was not taken up, and variations on this scheme adopted by other corporations only went part way towards informing the schemes that were first put in place at Trafford Park. Although Fleming may well have been profoundly affected by the training he received during his stay in Pittsburg, for want of evidence it is impossible to state with any certainty

269 Fleming & Pearce, *Principles,* p. 101
270 Fleming & Pearce, p. 104.
271 Nye, pp. 87, 91-92

how that training was configured and how he felt about it. Johnson did report, however, that he was 'shuttled through the Works at a great rate for four months, spending little more than a fortnight in any one department' where he 'put in a lot of overtime' and collected 'masses of information to take back to Trafford Park'.[272] As George Westinghouse was adamant that the management of his new works could only be undertaken by those who had been schooled in his company's way of doing things, and given the length of time the course lasted and the fact that new American management techniques like Taylorism were in vogue and needed to be studied, it would seem likely that the programme of study offered to members of the 'Holy Forty' provided a thorough grounding in all the latest ideas. Notwithstanding the fact that it was hard to pinpoint accurately how much of what the 'British Specials' learnt at the American parent-company was the precursor of what was later brought into being at the works school in Manchester, Dummelow provided a glimmer of a clue. In stating that the two-year stay at Pittsburgh was broken down into training that consisted of a few weeks or months in the principal manufacturing and testing departments, he made mention of the fact that this was 'a model for the later College apprenticeship course at Trafford Park'.[273] Indeed Fleming and his fellow compatriots must have imbibed at least some of the aspects of corporate culture that Westinghouse was eager to introduce to his British trainees whilst they were in Pittsburgh, as well as being schooled in the new workplace methods that were revolutionising the electrical engineering industry at that time.

---

272 Johnson, p. 7
273 Dummelow, p. 13

That aspects of his philosophy of education were borrowed from German and American models, and indeed from the experiences of other European countries, hardly detracted from the fact that Fleming and Metrovicks were at the forefront of thinking about the problems associated with apprentice training and workplace education in England.[274] He recognised that there had been only spasmodic efforts to 'grasp industrial requirements from an educational standpoint', resulting in apprenticeship conditions being 'chaotic' and in need of urgent remodelling and placing on a new footing.[275] In an attempt to rationalise the systemic failure in apprentice training, therefore, Fleming wanted a 'root and branch' shake-up and a modernisation of both planning and administration to make sure that its future could be guaranteed.[276] He was critical of the fact that there was no definite standard set regarding what constituted a skilled worker, with firms leaving individual foremen to control large numbers of trainees without reference to appropriate training schemes, and that many companies failed to see the need to take on 'bound' apprentices where trainees had to serve a company for a period of years in exchange for instruction received. As one of the co-authors of *Principles,* he also recognised that it was crucial to encourage legislators to raise the status of apprenticeships in order to avoid them degenerating into a source of cheap labour. Thus a broad national policy on industrial education was needed and co-operation was called for between trade unions and employers to ensure that this was treated as a matter of priority.[277] Fleming and Pearce's analysis also suggested that once

274 He also took inspiration from French and Swiss firms.
275 Fleming & Pearce, *Principles,* pp. 98, 132. They were, however, critical of some German methods, pp. 111-113
276 He approved of some elements of the Scottish system.
277 Fleming & Pearce, p. 124

this had been put into place it was important to employ a range of techniques to publicise the newly re-vamped industrial training methods to employers, parents, and prospective trainees to ensure that there was an increased uptake in the modernised schemes.[278] Such links were forged by Metrovicks and were one of the most important aspects of the proselytising 'mission' that Fleming undertook when he established the first works school in the country and when he set the pace for those who had yet to enter the debate about the nature of workplace education and who lagged behind in embracing new methodologies.

There were aspects of some of the vocational and educational training programmes offered in countries such as Germany and the United States that were redolent of the age in which *Principles* was published and, whilst some dovetailed neatly into contemporary values and modes of thought, others now sit uneasily with the attitudes and expectations of a modern audience. It has already been pointed out that Fleming and Pearce were not averse to including ideas about heredity and environment, and the 'scientific' selection of workers in the book. Within the context of this chapter it is not necessary to dwell on the way in which elements of Social Darwinism were handled by American and German experts in the early twentieth-century.[279] What remains clear, however, was that Fleming was not afraid to 'cherry-pick' the best elements of what was on offer in order to initiate much needed change across the industry. His insistence, therefore, upon the careful selection of workers 'according to inherent suitability'

278 Fleming & Pearce, p. 125. Illustrated lectures, aided by lantern slides, took place in schools for example.
279 Fleming & Pearce, pp. 25, 29, 91

and the tailoring of their education and training 'along lines tending to produce [the] greatest economy of working' owed something to the liberal attitudes of Kerschensteiner.[280] Fleming, however, went much further by stressing that the 'upward mobility' of the workforce was of paramount importance to Metrovicks, and the idea that 'young people possessing initiative, ambition and ability can rise to the topmost ranks from the starting level' was a recurrent theme in his public utterances over the years.[281] In 1936, at one of the Summer Schools organised by the company, he gave a lecture about the work of the education and research departments and, not for the first time, stressed how important it was to 'carefully' choose trade apprentices 'on the basis of school records, physique, and general intelligence' and he estimated that 'about 15 per cent' rise from 'the bench to junior staff jobs 'some thence to senior positions'.[282] If there was the taint of Social Darwinism about an insistence on the correct physique as well as educational prowess, Fleming was probably unaware of this. Nonetheless he made it clear that it was the College Apprentices who were 'destined to become the managers of the future', so when he asserted that 'opportunities for promotion from any of the courses are equal and dependent entirely on merit,' he was being disingenuous for this was clearly not the case.[283]

The extent to which Fleming was unique in spearheading the type of training that

---

280 Fleming & Pearce, *Principles* pp. vi, 26-27.

281 MCL.Q.631.3.AE2 A P M Fleming, 'AEI Research and Education', *A.E.I. News,* 22:10 (October,1952), pp. 8-9 for example. The article stated that 27 directors of the Group had started as apprentices with the firm.

282 MOSI YA 1996.1735/MS0531/17 A P M Fleming, 'The Work of the Education and Research Departments', *Summary of the Proceedings of the Second M-V Summer School for those responsible for the training of the young engineer.,* (Manchester: Metropolitan-Vickers Electrical Co. Ltd., April 1936), p. 7

283 Fleming,'The Work of the Education and Research Departments', p. 8

would facilitate 'a rise from the ranks to professional level' is open to debate, although it was hard to find any other outspoken advocate of such a 'democratising' process amongst the leaders of the industry at this time. [284] Most employers were only engaged in taking apprentices on an *ad hoc* basis and even those firms taking on 'bound' apprentices were more concerned with ensuring that they were trained to fulfil a specific function within the organisation rather than providing them with a broader educational experience. In the first decade of the twentieth-century, when Fleming was seeking to initiate change, Sadler had investigated the status of apprentices and the education and training offered to them by a large number of firms. He found that the premium apprenticeship system was seen as 'very successful' by smaller companies, that only the larger firms, such as Brunner, Mond & Company in Nantwich, offered educational facilities to workers other than apprentices and few, aside from Hans Renold in Manchester, even mentioned young women in their provisions. In 1907, when he published his finding, most trainees attended compulsory, part-time evening courses in technical institutes. Only a few firms, such as Clayton and Shuttleworth Ltd. of Lincoln and Johnson Brothers (Dyers) Ltd. of Bootle proved to be more advanced in their thinking about workplace training and the welfare of their employees. The Lincoln firm adopted 'a new system of apprenticeship' which eschewed the 'premium' apprentices and had 'its own school in the works' and the Bootle operation seemed 'particularly solicitous of its female workers' although the training it offered did not extend much beyond offering classes in the domestic

284 Fleming, 'Education of Engineers', Pretoria speech,p. 1

arts. [285] Brief histories of the companies attached to the English Electric Group, including the British subsidiary of Siemens, yielded little extra in the way of information about vocational education and training. Indeed, Sadler reported that Siemens hoped that apprentices 'and all youths' would attend evening classes but the firm did not contribute towards their fees. Given that Siemans' German progenitors, Siemans Haske, played such an important part in providing technical education and training, it was difficult to see why reform did not take place. For want of an innovator of the stature of Fleming, it was unlikely that much in the way of educational reform took place within most industrial concerns.[286]

It could be argued that *Principles* was intended as a clarion call to the rest of the industry to make a rapid and positive response to the initiative of Fleming and Pearce. Simply by being a forceful voice operating within the industry, and drawing attention to the profound changes that needed to take place in the provision of workplace education, Fleming continued to put Metrovicks in the vanguard of change as an article published later in *Engineering* made clear.[287] There was an important debate taking place during this period about technical school education and the efficacy of the Junior Technical Schools in particular. Robert Morant (1863-1920), the senior civil servant closely associated with educational matters, was largely responsible for preparing Balfour's 1902 Education Act. Bailey covered this territory in some detail noting that, in the Morant era, work had been carried out on

---

285 M A Sadler, *Continuation Schools in England and Elsewhere. Their place in the Educational System of an Industrial and Commercial State.,* (Manchester: Manchester University Press, 1907), pp. 274-277, 284-285, 292-293, 298-299.

286 Sadler, pp. 286-287; Anon, *History of the English Electric Company,* (London: Garraway, 1951); J D Scott, *Siemens Brothers 1858-1958,* (London: Weidenfeld and Nicholson, 1958).

287 *Engineering,* 125, (1928), pp. 137-138

a large scale review though the suggestions that had been put forward for the development of further education had not been put into operation.[288] Vlaeminke offered a more trenchant analysis of the ability of Morant to deliver much needed root-and-branch reform and was particularly scathing about his elitism and his 'profound dislike of technical and vocational education'.[289] In criticising the fact that the future of British education 'lay in the hands of a small group of men' who shared a common educational and cultural background but had 'limited experience of any possible alternatives' she drew attention to some of the problems that Fleming had to overcome in establishing his system in an industrial setting.[290] Furthermore he had to ensure that this was so well-regarded that that not only did it appeal to the industry itself but that it was also drawn to the attention of the coterie occupying positions of power and influence, the group that Vlaeminke criticised for having little experience of education ways outside a public school grounding in the classics.

Whilst it was not the intention in this chapter to be drawn into further analysis of this debate, it highlights the fact that Fleming was acutely aware that many of the ideas put forward by Sadler, Dearle, Fisher, and Morant were being thrashed out and he referred to them in *Principles.*[291] It would be easy, therefore, to accuse him of merely synthesising the thoughts of a narrow group of professional educationalists but this would be a harsh judgement and, in any case, this does

288 Bailey, p. 103
289 Vlaeminke, pp. 64-65.
290 Vlaeminke, pp. 64-65
291 N H Dearle was the author of *Industrial Training* and was concerned about 'blind-alley' employment, an issue that also vexed Fleming. The 1918 Education Act (The Fisher Act) was concerned, amongst other things, with giving young workers rights of access to day release education.

not detract from what he was trying to do. In going into print it would seem that he intended, at the very least, to contribute to the on-going debate; indeed he had the added kudos of being able to speak with the authority of someone who was still actively engaged in the running of a dedicated works school. It is worth noting, as an aside, that Sanderson mistakenly presumed that Fleming had established a part-time day continuation school on the lines of those run by Boots and Cadbury and in comparing these with the Metrovicks model he misinterpreted the fundamental character of the Trafford Park enterprise.[292] Fleming, reporting to a Parliamentary Sub-Committee on Technical Education in 1949, pointed out the difference.[293]

It was difficult to estimate whether or not Fleming was determined to do any more than push the debate into the ken of those leaders of industry whose firms had yet to address this issue. His forays into print, however, placed his name in the public arena and, as his workplace education and training schemes became increasingly well-known and respected, this allowed his views to carry some weight.[294] In addition, by including a comprehensive break-down of the curriculum for Trade Apprentices in *Principles* he must have recognised that this could have been used as a model for other firms to copy, but it is difficult to say whether or not he actively promoted this as *the* blueprint for training within the industry during this period. Company literature, however, stated emphatically that this was the case, as did

---

292 Sanderson, *The Missing Stratum,* p. 28

293 Fleming, 'Training in Industry', pp. 4-5

294 He wrote a number of articles on the subject such as 'The recruitment and training of engineering craftsmen', *Journal of the Institution of Production Engineers,* 14:12 (1935), pp. 606-618; 'Training for the industrial side of engineering', *Journal of the Institution of Electrical Engineers,* 53:246 (1915), pp. 566-573; 'Planning a works research organization', *Journal of the Institution of Electrical Engineers,* 57:279 (1919), pp. 153-170.

Jones and Marriott who suggested that the scheme was followed 'by many other companies in the country'.[295] Various articles in the in-house journal *AEI News* also laid claim to the fact that Fleming's system was 'gradually copied' by other large engineering firms 'until it has become a universal practice'.[296] As the Under Secretary at the Ministry of Education remarked in September 1950, Metrovicks 'was a name to conjure with. They were the pioneers' and the Ministry was 'trying more and more to get industry to follow the M-V lead'. Indeed, Bray, speaking on behalf of the Minister, paid tribute to Fleming as '*the* pioneer' and added the Minister's thanks 'for the splendid way in which the company had provided education and training in industry'.[297] As his ideas matured, it could be argued that Fleming became more assured about the way in which Metrovicks was able to influence the provision of technical and vocational education and as Cooper pointed out, Fleming was anxious that his education and training schemes 'would carry great weight in influencing other concerns, associations and the government'.

Fleming was also active in the field of industrial research, producing a number of scientific monographs and papers during his professional life. He worked on ways of combating the submarine menace in the First World War, directed work on radar in the Second War, had been instrumental in setting up the first wireless broadcast in the north from 2ZY in the Research Department, in addition to instituting a series of highly regarded Summer Schools at Metrovicks for personnel from

295 'Welcome to Trafford Park', p. 28 for instance.
296 *AEI News, 2*0:6 **(**June 1950), p.4; *AEI News* 21:10 **(**October,1951), p. 8, for example
297 F Bray, 'The Professors Go Back To School – Tributes to M-V Training Policy at Summer School, *A.E.I. News,* 20:9 (September, 1950), p. 4.

industry, the universities, government, and professional institutions. Despite this involvement, his most prolific output was concerned with the promotion of education, training and research in an industrial setting.[298] To some extent, then, he shelved much of his technical work in order to carry out what undoubtedly he saw as a far more important 'mission'.[299] This word is not used lightly and is intended to convey the zeal with which he chose to pursue his goals of ensuring the upward mobility of Metrovicks trainees by ensuring that his liberal education system made the 'optimum use of [their] natural gifts'.[300] Cooper was informative about the part that Fleming played in the development of scientific research in industry. He pointed out that Fleming had already overseen much of the fragmented research work that had been carried out in various parts of the factory by the time that the first 'formal' research department was set up in 1916, and suggested that it was the close connection with Westinghouse in the United States, and in particular a visit made in that year, that led to the push for the establishment of a separate facility.[301] In *Research in Industry* published in 1923 Fleming and Pearce considered, however, that a wider variety of research institutions had influenced them and not only did they refer to other American companies such as General Electric and A D Little, but also Krupp A G in Germany

298 Fleming & Johnson, *Design of Electric Wirings,* (London: Longmans & Co., 1913); 'Chemical action in the windings of high-voltage machines', *Journal of the Institution of Electrical Engineers,* 47, 209, 1911, pp. 530-551; 'New materials and alloys in the field of engineering', *Journal of the Institution of Production Engineers,* 15, 12, 1936, pp. 691-703, for example.

299 Dummelow, p. 68. As late as June 1917, he was still involved in shopfloor activity as a Superintendent in the Transformer Department.

300 IEE NAEST 070/52 Box 2. Fleming, 'Report to National Advisory Council for Education in Industry and Commerce, The North West Regional Council for Education in Industry and Commerce', p. 2 (n.d. c. 1948); NAEST 070/18 Box 2 'Industrial Research and The Training of Industrial Personnel in Great Britain', Address to the Konkinklyk Instituut van Ingenieurs, 8 September 1946; NAEST 070/108, Box 3, 'Apprenticeship in Britain', BACIE Conference-Trends in Apprentice Training, 7-9 November 1951, for example.

301 Cooper, pp. 87-89

and Kynoch Limited in Birmingham, Brunton in Musselburgh and Ioco in Glasgow. The importance of seeking out College Apprentices, in particular, whom they thought might be suited to this kind of work was one that Fleming returned to in speeches and writings over a number of years and he gave prominence to this in *Research*.[302] Interestingly, the authors also felt that there was a place for women in a research department in order to undertake 'cleaning, storekeeping, and record filing' which they felt would keep the less well trained man from this kind of 'blind alley' work and enable him to become 'a semi-trained' scientific worker.[303] Although by the time that this book was published Gertrude Entwisle had managed to secure a place for herself as an engineer at the company, and had had the full backing of Fleming in this respect, it was clear that most females were viewed in terms of the supportive, and indeed menial, role that they might play in the process of helping men to achieve great strides in industrial research and development. In thus sidelining them but, more importantly, regarding them in this way a tension was created between a male perception of the kind of capabilities that young women possessed and the desire on the part of some young women to enter this masculine domain on equal terms. This will be discussed in greater detail in the final chapter of this thesis.

Cooper also explained the way in which business and research began to be intermeshed at Metrovicks in the aftermath of World War One. Importantly, he touched upon Fleming's insistence on the 'marked connection between the educational and research work', believing that by searching out 'the best brains

302 Fleming and Pearce, *Research in Industry,* pp.166-172.
303 Fleming and Pearce, p. 171

obtainable' to people the Research Department this would also 'help in the training of other classes of workers'.[304] Of greater significance, however, was the fact that the apprenticeship system produced a large number of outstanding scientists and engineers, all of whom had had the experience both of working within the universities in senior positions and of working for Metrovicks in an exchange that was the hallmark of what Cooper called the 'scientific liaison service'.[305] John Cockcroft, who had been a College Apprentice, and was awarded the Nobel Prize in Physics in 1951, as well as Cecil Dannatt and Willis Jackson, both of whom served as Directors of Education and Research after Fleming retired, as well as many eminent scientists and engineers such as T.E. Allibone whose wartime work was given public recognition in the House of Commons, were all part of the close collaboration that took place under the leadership of Fleming during his tenure as Director of Research.[306] By 1949 Dummelow was able to catalogue 'ten ex-M-V professors' amongst this number and he also cited the large number of contributions made to learned journals such as those of the Royal Society, the IEE, the IMechE, the distinctions and awards conferred on members of Metrovicks staff, and the committees and sub-committees of various committees upon which they had been invited to sit.[307]

That most of these men had served their apprenticeships with the company tied in with the emphasis that Jones and Marriott placed upon the fact that 'there was great pride in having been a Metrovick apprentice', and this opinion was echoed by

304 Cooper, pp. 91-92
305 Cooper, p. 95.
306 Dummelow, p. 165
307 Dummelow, pp. 208-209.

former employees who recalled their experience as trainees during the 1950s and 1960s.[308] All of the respondents, both male and female, stated that 'the Company was renowned for its training', that 'the standards were excellent' and that Metrovicks 'had such a high reputation for all its training courses that anyone who had learned their craft there could get a job anywhere in the world'.[309] One former apprentice felt that he could 'wax lyrical' about the years that he had spent at Metrovicks and it was clear that, from the standpoint of those on the receiving end, there was an enormous cachet in being the beneficiaries of a vocational education that they considered was second to none. Just as importantly, the knowledge that both the scientific and technical research carried out at Metrovicks also carried great weight made employees feel that they had an 'edge' over their peers as far as career prospects were concerned and that they were 'set up for life' in whatever field they later chose to pursue.[310]

It would be appropriate also to consider not only the substantial reputation for education and for research and development that were initiated and nurtured by Fleming, but also the contribution that he made towards the development of many aspects of the corporate culture that came to define the company. As a large industrial concern employing many thousands of people the firm worked hard to ensure that it was able to draw on a well-spring of support from its mainly local employee base. Thus the wealth of publicity material produced played on the idea

308 Jones & Marriott, p. 149

309 Oral testimony A B [12 September 2012]. Twenty-five people replied in answer to an advertisement placed in 2010 in LifeTimesLink, a magazine published by Salford City Council. The circulation area covered those localities in which employees of Metrovicks were most likely to have lived. The replies, however, came from many parts of Great Britain.

310 Oral testimony E L[3 November, 2011]

of an 'indefinable 'something' that permeated the works' and such sentiments were constantly repeated for consumption both by Metrovicks employees through the medium of works journals, and for a wider audience outside the factory gates.[311] As has been noted, the virtues of loyalty and democracy were etched into the corporate image in which the company sought to invest and, as it has been shown, loomed large in Fleming's writings and speeches. The promotion of this sense of identity as a mainstay of the company offered some important clues to the way in which he upheld the 'character and heritage' of the firm.[312] Addressing a phalanx of directors and managers at an all-male Annual Dinner for College and Schools Apprentices in January 1950, Fleming followed a well-trodden path by lauding the Metrovicks training schemes as offering a major contribution to this heritage. In reply, the Chairman of the Apprentice Association echoed another familiar tenet of the corporate culture of firm by stressing that it was necessary to 'put our backs into our work with the same enthusiams as a Revue is organised, a *Rotor* published or a Rugger game won'. Such gung-ho expressions of male solidarity fitted neatly into the corporate culture that was developed at Metrovicks, and which littered the pages of works' publications, the statements from the chairman of the board and those of the chairmen of the works' committee. In also emphasising that apprentices should 'make every effort' to take part in games of football, rugby and cricket as being 'beneficial' to [their] health and well-being, there was a sense in which female apprentices found it more difficult to bring their own attributes to the attention of this audience.[313] There was an extent,

311 'Welcome to Trafford Park', p. 5
312 MCL.Q.631.3.AE2 *AEI News,* 20:1 (January 1950), pp. 21-22
313 IEE NAEST 070/99 Box 3 'The Education and Training of Electrical Technicians', *M-V*

therefore, in which 'fostering the spirit of belonging to a team' or to 'the great M-V family' seemed to highlight the exclusivity of gatherings where young men were being nurtured as future leaders.[314] The small numbers of women apprentices taken on by the firm were not always in evidence on occasions such as these, either because there were no women students in a particular year group, or perhaps because the women themselves recognised that, being in a minority, there was little place for them in this kind of social setting. Future leaders were presumed to be men, and were always encouraged to aim for high office; the necessity of giving more than a nod from the company hierarchy in the direction of the career aspirations of young women apprentices was less easy to discern. Given that Fleming had taken a radical stance by offering parity within the Apprentice Association as a whole to Trade Apprentices when he stated that 'if any capable young *fellow* (my italics) wants to become a craftsman' or 'a manager or director, the obvious thing is to join up as a trainee or apprentice' as,' from these beginnings *fellows* do end up on the Board', there was little to suggest that the company itself was radical enough to arrest or even modify the 'masculine' culture to which it continued to subscribe during this period.[315] Indeed, it could be argued that it could hardly have been otherwise when the engineering industry, especially the heavy engineering sector, was perceived to be such an aggressively masculine environment. In 1949, Metrovicks' Golden Jubilee year, Dummelow could only list 'close on a dozen women' who had had 'a regular apprenticeship

---

Gazette, 25 May 1951, p. 5. The College and Schools section of the Apprentice Association organised an Annual Revue that owed something to the tradition of the Scout 'Gang Shows' of the period.

314 MCL.Q.631.3.AE2 T Dicken, *AEI News*, 23:5 (May 1953), p. 20.

315 MCL 338.47613 AE2 'Bringing up the Family', *AEI News*, 20:3 (March 1950), p. 13

training', in stark contrast to the typical *yearly* intake of over four-hundred men.[316] The dominance of a masculine corporate culture was thus seen in the way in which all members of the Apprentice Association were urged on by their mentors, ever anxious to inculcate into the rising generation the largely unquestioned notion of Metrovicks being the acme of the engineering industry and the importance of the privileged place of the apprentice within its stellar orbit. As Fleming reminded them, 'Our Company is of world-wide fame' and 'its engineering achievements are of outstanding merit'.[317] Accordingly apprentices were invited to view themselves as the bullish inheritors and future upholders of a corporate identity that had already taken on 'mythical' status by the time he delivered this encomium. Grenville Atherton, who took up a Schools Apprenticeship at the end of the Second World War, was typical of the kind of middle-class young trainee from a comfortable background who fitted into this mould; his obvious pride in working for a company 'which was internationally famous for its experimentation in the fields of physics, chemistry, industry and electronics' was only matched by his obvious pride in the breadth of his own extra-curricular community, intellectual and sporting activities.[318] The place that young women might claim for themselves within this kind of environment was fraught with difficulties, as the following chapters will demonstrate.

The idea that the pursuit of 'manliness' was 'an appropriate vehicle for advancing

316 Dummelow, p. 94
317 IEE NAEST 070/12 Box 2 A.P.M. Fleming, Speech to Twentieth Annual Dinner, College and School Section, Apprentice Association, 22 February 1946
318 J G Atherton, *Home to Stay,* (Manchester: Neil Richardson, 1991), pp. 56-57.

British imperialism' was another area of great importance to Fleming.[319] The company was by no means parochial and much was made of the ties between Metrovicks and the numerous subsidiary companies which had been set up round the world, especially those located in the former British Empire.[320] Mirroring the construct of Britain as the 'Mother Country', Metrovicks was keen to position itself as the epicentre of a nexus of industrial concerns that were still, in varying degrees, 'dependent' on its support.[321] As well as hard-nosed business acumen, it could be argued that there was a degree of imperial nostalgia in the way in which the firm went about ensuring that these bonds continued to thrive. The graduate apprenticeships it offered to students from the former Colonies and Dominions, therefore, were an integral part of this process as papers in Fleming's archive suggested.[322] As members both of the Apprentice Association and also the influential Overseas Association these trainees were placed in an especially privileged position. The Overseas Association had been founded in 1925 and was not only open to nationals of the countries that sent apprentices to the United Kingdom but was also extended to 'all M-V men who had spent two years abroad in the service of the company'.[323] As a result this became a mutually profitable system; obvious economic benefits flowed from increased trade between the

---

319 N J Watson, *et al*, p.2

320 MCL 338.476213.AE2 Overseas Association News, *AEI News,* 25: 6 (June 1955), p. 36, for example. Australia, New Zealand, India, Ceylon (Sri Lanka), Hong Kong, Canada, former British territories in Africa and Malaysia, Argentina and the United States were the countries where most of the subsidiary companies were located.

321 'Great Britain: Mother England', *Time Magazine,* 1 May, 1944. www.time.com/time/magazine/article/0.971.774892.00.html [Accessed 30 March 2014]

322 IEE NAEST 070/33 Box 2 'Metropolitan-Vickers report on a visit to India. Exchange of apprentices, 31 December 1946-9 February 1947; IEE NAEST 070/77 Box 3 Report of a visit to Canada and the USA to discuss exchange of overseas students as apprentices at AEI, 15 March-17 May 1950; IEE NAEST 070/11/42 Box 4 Correspondence: 'Athlone Fellowships' for Canadian engineering graduates

323 Dummelow, p. 83

various subsidiary and associated companies around the globe, drummed up as a result of the personal contacts made during the two-year College Apprenticeship course and continued long afterwards through membership of the Overseas Association. Not only was this scheme firmly rooted in British engineering practices and traditions but it was also based on a set of cultural norms that owed much to the public school ethos upon which it was built. In view of the fact that this was a period of gradual disentanglement with Empire and Commonwealth by successive governments, and some disenchantment amongst former colonies with the speed of this process, it was notable that overseas government agencies and business concerns were still anxious to send students to be trained at Trafford Park.

Ironically, from the mid 1960s onwards the idea that the cultivation of a public school persona should be part of the preparation for a top-flight career in the engineering industry was beginning to look increasingly anachronistic to many British trainees, but to their peers from overseas this was not the case. The 'great imperial university' was directed towards an exclusively male audience, and it has not been possible to trace through the Apprentice Registers any placements that were offered to female Overseas Apprentices.[324] The scheme, therefore, stood in contrast to the College and Schools Apprentice section where women were accepted, albeit in very small numbers. Perhaps the fact that contingents of Overseas Apprentices were not leavened by the inclusion of females in their ranks

324 IEE NAEST 92A/2.3 I H Hardwich, 'Women Professional Engineers in British AEI'. It has not been possible to locate any female Overseas Apprentice during the period, though Isabel Hardwich noted that four trainees had spent some time with the firm in the early 1960s.

meant that they were more closely defined by an emphasis on 'manliness' than their 'home-grown' counterparts. A J Shackleton, a New Zealander, demonstrated that that it was considered essential to participate in the activities of the Overseas Association, where 'identity' was important.[325] In addition, especially after the Second World War, there was an extent to which the often conservative outlook of these overseas trainees meant that they did not question the traditional mores and attitudes held by their elders living in expatriate communities in far-flung corners of the former Empire. The hallmark of this group of trainees, therefore, was a conservatism that was at odds with the burgeoning 'youth culture' and the 'anti-establishment' attitudes of many young people in Britain that authorities like Kynaston and Hennessey surveyed in some detail, and which will be discussed in the next chapters of this study.[326] There was, nevertheless, an extent to which *all* apprentice engineers were encouraged to define themselves in terms of 'manliness' and it would not be too far-fetched to say that this was steeped in the corporate culture of all industrial undertakings during this period. How far notions of 'manliness' could be directly attributed to Muscular Christianity is a matter of conjecture, but by noting that 'shared beliefs about robust masculine strength, skill, steady perseverance and stoic acceptance' abounded by the late nineteenth-century, Huggins most succinctly summed up what 'manliness' might have meant to Fleming who was a product of that era.[327] The type of men, therefore, that best personified public school attitudes and traditions rooted in Christian endeavour

---

325 A J Shackleton, 'The Passing Years', pp. 144-163 museum.timaru.gov.nz/data/assets/pdf_file/0008/32687/THE_PASSING_YEARS-Nov-2014-Part-Two.pdf [Accessed 7 January 2015]

326 Kynaston, *Modernity Britain,* (Part 2, pp. 61-201); *Family Britain 1951-57,* (pp. 379-381, 438-439): Hennessy, *Having it so Good*, (pp. 63-132, pp. 133-185, pp. 312-356).

327 M Huggins, *The Victorians and Sport,* (London: Hambledon & London, 2004), p. 74

were to be found in the ranks of the Overseas Apprentices and, as such, they served as the paradigm for all apprentices.[328]

Fleming retired in 1954 by which time shifts in society, variously described and analysed not only by Kynaston and Hennessy but by Sampson, Clarke, and Marwick amongst others, had begun to take shape.[329] The post-war 'baby boom', for instance, began to make an impact in the early 1960s and the education and training of this segment of the population occupied the minds of the great and the good. A paper written in 1960 by Margaret Croft for the Fabian Society on the vexed subject of apprenticeships and the 'Bulge' recognised, however, that the company was one of the few firms in the country able to cope with this eventuality.[330] Under Fleming's leadership Metrovicks had already had the foresight to anticipate the consequences of the post-war 'baby boom' and, as early as 1949, had once more invested in the training programmes interrupted by the war. As a result the foundation stone for a new £100,000 apprentice training school was laid down and at the ceremony the firm was congratulated on behalf of the government by H J Shelley who made it clear that 'the education world has learned so much in industrial education from M-V'.[331]

---

328 Hall, *Muscular Christianity,* pp. 46-65

329 Sampson, *Anatomy*; Kynaston, *Family Britain; Modernity Britain;* Hennessy, *Never Again*; *Having It So Good*; P Clarke, *Hope and Glory: Britain 1900-1990,* (London: Allen Lane, 1996); A. Marwick, *The Sixties: Cultural Revolution in Britain, France, Italy and the United States c. 1958-1974,* (Oxford: Oxford University Press, 1998)

330 WCML Fabian research. M Croft, 'Apprenticeship and the 'Bulge' ', *Fabian Society,* September, 1960, pp. 6-7.

331 MCL 338.476213.AE2 'M-V Company's New £100,000 Apprentice Training School', *AEI News,* 19:11 (November 1949), pp. 4-5; TNA ED149/37 Y.10/49 'Metropolitan-Vickers Works School 1946-1940'. Ministry of Education Report by H M Inspectors on Metropolitan-Vickers Electrical Engineering Company Limited, 17, 18, 19, 20 and 21 January 1949.

Despite the efforts by industrial concerns like Metrovicks, the often fractious debates about the nature and delivery of technical education within both the secondary school system and tertiary education that had rumbled on since the beginning of the century, had not been resolved. Davis was particularly eloquent about short-comings of various government committee reports, from the 1945 Percy Committee to the 1956 White Paper *'Technical Education',* but also placed blame for a lack of innovation squarely at the feet of the universities who were keen to preserve their status in relation to technical colleges, and the professional engineering institutions led by the IEE who were anxious to avoid the prestige and status of engineering in British society being further diminished.[332] Metrovicks operated largely outside this wider debate and continued to plough its own furrow, ensuring that the head of the Education Department, K R Evans (and later, R F Marshall), maintained the long-established contacts with universities, technical institutions, and the grammar and secondary modern schools and by this means recruited, educated and trained their future workforce. Keeble's warning that the strategies employed by business organisations were liable to become resistant to change over time perhaps explained the reasons why Fleming's blueprint for apprentice training had been little amended by the 1960s, but clearly the company recognised the need for industry to increase the numbers of skilled workers and continued to act accordingly.[333] The Carr Report (1958) and the Industrial Training White Paper (1962) suggested that the problems of both training and education were 'very complex', and certainly information found in TNA files from this period

---

332 M Davis, 'Technology, institutions and status: technological education, debate and policy, 1944-1956', pp. 120-143, in Summerfield & Evans, *Technical Education and the State*

333 Keeble, p. 8

pointed to a great deal of activity by mandarins anxious to ensure that industrial training was improved, but more anxious to ensure that the economic burden did not fall on the shoulders of the government.[334] Thus the Conservative Party was keen to make certain that each individual industry be made responsible for ensuring the adequacy of its own training and, more importantly, was eager to see that firms who were unable to do this made some other contributions towards the cost of training skilled workers. The problem that occupied government and industry alike was not just one of economics, nor was it just one of suitable training, but rather it hinged on the fact that it had been estimated that by 1970 another 1.5 million skilled workers would be required in the workforce and in this respect Metrovicks was 'ahead of the game'.[335] The debate in the House of Lords on 6 February 1964 saw Lord Bowden delivering high praise to the firm, which he said had 'quite an extraordinary influence on engineering education for electrical engineers for the whole of this country' and went on to give thanks 'to the genius of that very great man, Sir Alexander (sic) Fleming […] a man whose name should be revered in educational circles, but I am afraid has all too soon been forgotten by most' - indeed so quickly forgotten by Bowden himself who had made the unforgivable error of muddling up the discoverer of penicillin with the man from Metrovicks.[336] This was, presumably, a slip of the tongue by Bowdon, as during his

334 TNA LAB 18/333 Industrial Training White Paper 1962-3. Comment by J G Stewart. Industrial Training: Government Proposals, HMSO cmnd.1892, Press Notices Ministry of Labour 21/11/62 and 5/12/62

335 Lord Bowden of Chesterfield speaking in the House of Lords, 6 February 1964. Bowden was appointed Principal of Manchester Municipal College of Technology in 1953 and transformed it into one of the leading technological universities, UMIST, founded in 1965. He was appointed Minister for Education and Science by Harold Wilson in 1964 but returned to UMIST the following year where he remained until his retirement in 1976.

336 In suggesting that Fleming had quickly slipped from public recognition, Bowden had a case.

tenure at UMIST the institution worked hand in hand with Metrovicks in the training and education of College and Schools Apprentices and he was well-acquainted with Fleming. Bowden's speech, therefore, supported the argument that when the Metrovicks apprentice system was first laid down it was so radical a departure from what had gone before that it was bound to survive intact for years to come. Indeed Fleming's successor, Sir Willis Jackson, did not overhaul apprentice training substantially; even with the passage of time the system appeared to have remained undiminished.

The long sustained network of contacts within universities, colleges of advanced technology, and government agencies insured against the danger of Metrovicks becoming too hidebound to adopt advances in technological training or the latest thinking on technical education.[337] Former apprentices often took their expertise into academia and one of the most notable amongst them was Willis Jackson D Sc, FRS (1904-1970), a graduate of the University of Manchester, whose distinguished career at Oxford University was followed by professorships at both the University of Manchester and at Imperial College. He re-joined the Company in 1953 as Director of Research and Education after the brief interregnum of Dr Cecil Dannett. An article in *Nature* which commented on his appointment extolled 'the high standard ' set by Fleming whose work at Metrovicks 'has won the admiration and respect of the whole engineering profession' but assured readers that this legacy would be 'in safe keeping' under Jackson's leadership whose 'wide

337 He served from 1953-1961 as Director of Research and Education but then returned to Imperial College where he was Pro Rector at the time of his death.

experience in both education and research augurs well for his success'.[338] This proved to be the case and the new Director maintained the links forged by the company with the universities where he was able to wield influence, as exemplified by the case of the appointment of the chair of the governing body at RCAT, Salford, in 1962.[339] To all intents and purposes, Jackson followed closely in the footsteps of Fleming. His involvement in the Apprentice Association echoed that of his predecessor and his many messages to parents repeated those rendered by Fleming. By saying 'we regard them [the apprentices] as very important members of our extremely large family' and adding that 'in addition to wanting your *son* [my italics] to do well in their studies' Metrovicks also encouraged them to participate in 'the corporate activities of the works', Jackson signalled that he had inherited a system that initially he appeared to believe needed little change.[340]

That being said, there was one crucial area in which the new Director of Research and Education needed to pay urgent attention. Although Fleming had not entirely neglected the issue, it had not occupied a commanding position in his overview of apprentice training and this left Jackson having to face the perennial problem of trying to recruit young women to take up professional apprenticeships within the firm. This was no easy task. Four years later he was still grappling with the

---

338 'Willis Jackson – Professor of Electrical Engineering at Imperial College', *Nature,* 17:4345, (1953), p. 242

339 Imperial College Archives (ACRU) B/JACKSON FO/2 General Correspondence, Kathleen Mary Ollerenshaw. A number of letters passed between Jackson and Ollerenshaw on this subject. Ollerenshaw, the author of *Education for Girls*, and a local educational expert, attempted to embroil him in the machinations surrounding the appointment of the person whom she thought to be the most suitable candidate. She did not get all her own way and had to be content with the success of her second choice but thanked Jackson by saying 'It was good that you did so much' in a letter dated 26 June 1962.

340 Imperial College Archives (ACRU) B/JACKSON B/11 Parent's Day 1955-1959 Programmes and Speeches, C & S Section, Apprentice Association, 23 June 1956, p. 1, p. 6.

problem, as demonstrated in an address in 1957 when he admitted that 'we at Metropolitan-Vickers, with nearly 2,500 apprentices of all grades, have no girl graduate apprentices at present'.[341] Attempts by the company to identify and then attempt to rectify the problems surrounding the entry of young women into the electrical engineering profession were not easy to resolve and were complicated by a number of different issues. The place of young women in society in the post-war period, for example, was under scrutiny and a re-evaluation of their position was often the subject of lively debate. Bound up in this discussion was a particular concern about the aims and objectives of the education offered to girls in the wake of the 1944 Education Act. The grammar schools were intended to provide an education that would prepare their pupils for a professional career but, alongside the pressures that came from wider cultural and societal changes, girls faced particular challenges that affected their ability to gain access to such careers. The efficacy of the teaching offered to them as well as the composition of the curriculum did not always encourage an interest in science and technology and the engineering industry, in particular, was seen to be a male-dominated profession that was not welcoming to young women. All the attendant gender implications that were involved in attempting to break into the profession served to alert parents and teachers, as well as girls themselves, to the hazards they would face. Amongst many other authorities who voiced their concerns, Willis Jackson was aware of these problems and was keen to provide a means by which Metrovicks might motivate grammar school girls to 'buck the trend' in this respect. Powerful mechanisms, however, sought to define the role that young girls should play in

341 W Jackson, 'Opportunities for Girls in Electrical Engineering', p. 16

society. The ethos of the grammar school often ran counter to the way in which its pupils wished to fulfil their ambitions. Their choice of career, however, was dependent upon their ability to access higher education and the gender implications of this state of affairs coalesced during the years that they spent within this system. The girls who wished to become professional engineers had additional hurdles placed in their way which affected the transition of female College and Schools Apprentices into workplace training.

The following chapter of this thesis will examine these issues in the light of problems faced by grammar school girls as they attempted to balance the expectations place on them by society with their own hopes of pursuing a professional career.

CHAPTER 3

Tensions in society during the 'long 1950s': the ethos of the girls' grammar schools, and the implications of class and gender for the transition into workplace training of female apprentices.

This chapter provides a vital link between the understanding of how the corporate culture developed by Metrovicks helped to establish the firm as an 'outstanding' provider of apprenticeship training and an examination of both how Fleming's scheme operated within the company and an analysis of wider issues relating to the way in which women engineers were perceived and were able to prosper within the industry. To train to become an engineer was a highly unusual choice for a young woman during this period and this chapter will offer a critical examination of some cultural and institutional changes that took place in the two decades following the end of the Second World War in order to seek explanations as to why this was the case. Particular attention, therefore, will be paid to the way in which young people were viewed by the wider population, especially those who attended girls' grammar schools after the re-organisation of secondary education in 1945. These pupils were expected to gain access to the universities or institutes of higher education in order to develop their professional careers, and the female apprentices who were employed by Metrovicks emerged from this background. The chapter starts by setting out the context in which a changing social and cultural landscape affected these young girls where anxieties about the impact that 'youth culture' might have had on the role that they were expected to play in society were frequently expressed. The impact that the ethos of the grammar

school had on its female population will be scrutinised, especially when great emphasis was placed on academic achievement and high expectations, which was often at odds with broader, antithetical cultural messages. The fact that only a small percentage of eighteen-year old girls, 2.5% in 1962 for example, were offered places at university impeded their ability to enter many of the professions and this chapter will examine the impact that this had upon both their aspirations and their choice of career.[342] Despite the provisions made by the 1944 Education Act, there was still an on-going debate about the extent to which girls were able to benefit from its implementation and, indeed, about the purpose of girls' education and these issues will be given due attention. The complex relationship between class and gender that gave rise to tensions in the 'long' 1950s will be surveyed and the oral contributions given by participants in this study will be reviewed. Finally, thought will be given to how these factors affected the transition into workplace training, especially for those 'exceptional' young women who had decided to pursue careers that fell outside the conventional expectations of the times, like the female College and Schools apprentices at Metrovicks.

The nature of post-war youth culture and its affect on girls' grammar school pupils

The growing 'visibility' of youth after 1945 was enhanced by demographic shifts, the expansion of secondary education and, importantly, by long-term economic trends which allowed young people mobility within the job market as Todd and

342 M.Sanderson, *Educational Opportunity and Social Change in England,* p. 133.

Young, amongst others, made clear.[343] Discussing the idea of youth as a social construct, both Osgerby and Spencer were keen to stress, however, that young women in post-war Britain were 'hidden from history' and thus became a 'forgotten generation'.[344] This was explained by Carmondy's assessment of the television documentary '*Living For Kicks',* made by Daniel Farson in 1960, which concurred with Osgerby, that it was 'spectacular male subcultures and masculine activity' that defined the era.[345] Indeed both Kynaston and Hennessy followed this pattern and gave precious little space to detailing the role young women played in society at this time.[346] If, however, Osgerby was sympathetic to the idea that the teenage girl within 'post war ideologies of classless prosperity' deserved to be investigated, then he was often wide of the mark in his analysis both of aspects of the sub-culture and also of the idea that this was a 'classless' phenomenon.[347] By taking a 1957 *Picture Post* article entitled 'Those Wild, Wild Girls' to support his claim that the teenage girl 'most fully encapsulated the ideologies of energetic hedonism', which he described as a 'characteristic of Britain during the period', he failed to recognise that this was far from the case.[348] In an era when the behaviour of most young girls was still heavily monitored both by parents and by adults in the wider community, 'energetic hedonism' was a concept whose moment had yet to arrive. Although many of them made forays into the sub-culture, visiting the cinema, listening to Radio Luxemburg, or attending 'hops' at the church youth club, it was

343 S.Todd & H. Young, 'Baby-Boomers to 'Beanstalkers'. Making The Modern Teenager in Post-War Britain', *Cultural and Social History,* 9:3, (2012), pp. 451-467; B. Osgerby, *Youth in Britain Since 1945,* (Oxford: Blackwell, 1998), pp. 50-52

344 Spencer, *Gender, Work, and Education;* Osgerby, p. 50

345 Osgerby, p. 50; R. Carmody, *Daniel Farson, The Outsider,* 1 October 2006 http://www.transdiffusion.org/tv/tvheroes/daniel_farson [Accessed 11 October 2013]

346 Kynaston, *Family Britain 1951-57* and *Modernity Britain ;* Hennessy, *Having It So Good*

347 Osgerby, p. 50

348 Osgerby, p. 54

always recognised that this was carried out in the face of adult disapproval. Girls also recognised that as grammar school pupils there was 'supposed to be a better way and we were expected to spend our free time reading Dickens or Trollope and listening to the Third Programme, or going to see John Barbirolli conducting the Halle Orchestra' as one of the women who contributed to this study suggested.[349] Aspects of the sub-culture, therefore, such as 'pop' music, coffee bars, teenage fashion, and so on were difficult to reconcile with an education that highlighted the importance of 'high culture', 'respectability' and 'ladylike behaviour' over other forms of expression. There was, thus, a tension between being free to choose to be part of a sub-culture that seemed to be enjoyed by contemporaries who had been educated elsewhere in the tripartite system, and the grammar school girls' realisation that such a choice was somehow unacceptable within the 'class' terms upon which their education was predicated. Being denied access to the sub-culture by adults, especially schoolmistresses whose contact with all things modern seemed slight and uncomprehending, meant that grammar school girls abided by the ethos of the school with its often narrow social and cultural confines. As a result it was not until the mid-1960s that many hidebound notions began to be challenged. Attitudes towards teenage culture then began to change both in society at large and amongst the young themselves, but during the 'long 1950s' a more conservative set of values dominated the way that most of them felt that they had to both think and act.

Anxieties about the status of girls and young women in a world that was still

349 Oral testimony J C [4 December 2012]

dealing with the fractures caused by the Second World War had a profound effect on the way that they were treated during this period. If Hennessy and Kynaston had failed to analyse the way in which they were regarded, it was necessary to look elsewhere in order to tease out the reasons why the aspirations of young women, especially those who wished to enter masculine dominated professions, were often considered to be controversial and why their lives were frequently circumscribed and subjected to prolonged debate and no small degree of challenge. M B had wanted to go to medical school but had been 'put off it by almost everyone in the family because they thought I wouldn't manage the workload if I got married and I suppose I agreed [with them] then'.[350] Spencer looked at these issues and concentrated this part of her research on the training and on the workplace experiences of a relatively small cohort of girls within a limited geographical area, whilst Dyhouse drew on a much larger canvas. In *Girl Trouble* she gave much thought to the social changes that typified the immediate post-war period, and examined both the 'extraordinary contradictions' of the 1950s and the controversies bound up with the 'permissive society' in the 1960s.[351] In so doing she pointed out some important matters relating to the cultural shifts in ways in which these young women were regarded. Influenced by anxieties about a burgeoning 'generation gap', adults were ever vigilant to ensure that young women were shielded from elements that might have a negative affect on their education even, as it often appeared, they had an incomplete understanding of where such an education might eventually lead. This was nothing new, but in the post-war period greater spending power, greater mobility and the overweening

350 Oral testimony M B [29 November 2011]
351 Dyhouse, *Girl Trouble*

influence of the mass media ensured that behaviour was more difficult to monitor than ever before. Discussing the anxiety displayed by 'Middle England' in relation to these 'new forces in society with the potential to lead girls astray and turn them into rebels', Dyhouse suggested that there was some foundation to parental apprehensions. The impact of films like *A Taste of Honey* and *The L-Shaped Room* and the worries engendered about places where the police thought girls were being put in moral danger, like *The Jungfrau* and *The Twisted Wheel* in Manchester, were quickly capitalised upon by the red-top press.[352] On the other hand, women who had been at girls' grammar schools and attended these coffee bars and who gave oral testimonies for this thesis countered the notion that they had been unsafe.[353] *The Twisted Wheel,* as described by P D, had an 'edgy feel [where] 'beatniks smoked reefers and girls older than us were trying to look like Juliette Greco so they wore black and looked serious, actually I think they were trying to look intense because that was important, and they always had big CND badges. I think I was influenced by them and as they were student-types, it made me want to be a student but I'm not sure that it was school that made me want to be a student'. J C said 'You could have taken your grannie to *The Jungfrau'* [and] most people's mums only 'tut-tutted' about *The Twisted Wheel,* [but that was] probably because they knew nothing about what it was like and listened to what other people, who hadn't been there either, told them'. Indeed, Todd and Young assertion that the 'disjuncture' between the 'literature on moral panic' and the

352 Dyhouse, pp. 115, 120, 126-127, 135-136, 151-152, 245. L Jackson ' “The Coffee Club Menace”: Policing Youth, Leisure and Sexuality in Post War Manchester', *Cultural and Social History,* 5:3 (2008), pp. 298-308. The British Board of Film Censors introduced the X certificate in 1951, following the recommendations of the Wheare Committee report, and only those over the age of sixteen were allowed to view such films.

353 Oral testimonies. J C [4 December 2012]; P D [21 December 2013].

'widespread evidence of intergenerational co-operation' held true in cases like this.[354] Nevertheless the tension between youthful experimentation and adult alarm fuelled by the mass media was often marked.

Kynaston also investigated this phenomenon and he considered that 'the question of the moral state of the nation' was 'on its way to becoming a hardy perennial' quoting a House of Lords speech by Lord Denning who declared that the 'disease is in the body politic itself. It is a loosening of moral standards, a decay of religion'.[355] The idea that a growing teenage culture threatened to 'exclude parents altogether from any supervision of courtship', where daughters were 'increasingly perceived as out of control' and 'bad boys with raw sex appeal gave middle class fathers headaches', appeared to have some currency, as *Living for Kicks* demonstrated. [356] The subsequent 'moral panic' after the broadcast further exacerbated the unease with which the older generation viewed these societal upheavals. The extent to which this 'panic' applied to pupils in girls grammar schools, however, was debatable. Four years before *Living for Kicks* was broadcast, Veness had investigated the aspirations and expectations of school leavers. She concluded that 'the powerful interest in the affairs and 'problems' of teenagers resulted in the mass media 'building up a picture of the teenager rampant', which was a description she felt might well have been applied to the few, but not to the many.[357] Marwick agreed with this view, and went further by suggesting that the 'forces of parochialism and conformity were strong', that many

354 Todd & Young, pp. 451-467, (451-452)
355 Kynaston, *Modernity Britain,* pp. 298-299.
356 WCML AG-Z Labour Party Youth Commission, 1959. *The Younger Generation,* p.7
357 Veness, p. 9

aspects of the sub-culture were, in any case, 'very conservative', and that much unwarranted hyperbole attended the activities of young people during this period.[358] Nonetheless, the prevailing view seemed to be that problems did exist and the Labour Party too was exercised about 'The Younger Generation'. A 1959 report had members of its Youth Commission, such as Humphrey Lyttleton, adding their voice to the concerns affecting not only the 15-20 year age group but also the 'Bulge' generation following hard on its heels.[359] Four million 'war babies' had been born between 1939-1944 and the Party was concerned about their further education, their position in the job market and about the social changes that were affecting them as they turned fifteen years of age; the Report also considered the issues that would face the 'Baby Boomer' generation born after the end of the Second World War. This was a survey that focussed on the idea that 'the relationship between young people and the adult society is not good' and that some features of this relationship involved a 'passive' rejection of the standards and values of the adult world.[360] In addition the Albermarle Report, which reported in 1960, also pointed the finger at what seemed to be troublesome issues in relation to 'changing social and industrial conditions', and the findings suggested that 'several aspects of national life' were 'causing widespread and acute concern'.[361] These included 'much more complex and continuous elements of

---

358 Veness, p. 6; Marwick, *The Sixties,* p. 42

359 Labour Party Youth Commission, pp. 4, 41. Humphrey Lyttleton was the nephew of Oliver Lyttleton, Lord Chandos, the chairman of AEI, but their political persuasions were somewhat different.

360 Labour Party Youth Commission*,* p. 5

361 *The Albemarle Report,* Cmnd. 929*,* (London: HMSO, 1960)*,* p. 1. See also http://www.hansard.millbanksystems.com/lords/1960/may/18 HL Deb 18 May 1960 vol 223 cc 935-1052 [Accessed 9 February 2013]; Marwick, *The Sixties,* p. 41. He suggested that 1957 was the year when the notion of high spending teenagers as 'new and influential players in the market place' created 'a distinct and separate sub-culture', a factor that the Labour Party Youth

social change' to which it was felt that 'adolescents are responding sharply and often in ways which adults find puzzling or shocking'.

Dyhouse recognised this and, importantly, stated that within schools 'issues around institutional regulations and personal autonomy became particularly vexed in a context where there was so much ambiguity around being grown up'.[362] She quoted the well-know writer on educational matters, Kathleen Ollerenshaw, who stated that 'increasingly' girls stepped 'from the school choir to the church altar' discarding the 'prefect's badge for a wedding ring', a factor also highlighted by the Labour Party Youth Commission findings which had pointed out that there was 'a new revolution in marrying habits' which meant that '1 in 4 of all young women marry at nineteen or earlier'.[363] This 'revolution' did not necessarily apply directly to girls who had attended grammar schools, many of whom were still in full-time education or training at this age but it was apparent even to them that girls of their generation were expected to marry within a few years of completing their studies. As a result, young women were encouraged to learn 'a femininity acceptable to post-war society which was necessary for the ultimate formation of a family unit of male breadwinner and non-working wife', as Spencer suggested, and this resulted in girls often viewing jobs as short-term or stop-gap experiences.[364] The findings of the Labour Party Youth Commission were not necessarily directed at every grammar school educated girl and were, in any case, somewhat dichotomous. On

---

Commission report also considered, p.6

362 Dyhouse, pp. 24-24, 125

363 Ollerenshaw, p. 38; Youth Commission, pp. 35-36

364 S.Spencer, " 'Be Yourself'*: Girl* and the Business of Growing Up in Late 1950s England", pp.141-158 (pp. 146-147)

the one hand its report bemoaned the fact that 'the latent abilities of a large number of women' were 'never given a chance to develop' but on the other it stressed the importance of homecraft as an important part of the curriculum, and the placing of the main burden of childcare in the hands of young women. [365] Even the highly educated and articulate grammar school girl found it difficult to escape the gendered implications of this particular state of affairs.

Veness, ever optimistic about the school leavers she surveyed in the mid-1950s told a somewhat different story. She reported that 'a devotion to work is by no means rare' and suggested that grammar school girls recognised that 'training for their jobs' demanded considerable time and effort' which was 'not lightly to be given up' on marriage'.[366] Todd, too, emphasised the fact that a changing labour market meant that 'the expanding clerical and technical jobs open to girls demanded formal qualifications that could only be taken at the age of sixteen'; not every young person, therefore, rushed into a 'dead-end' occupation. [367] Tebbutt confirmed this fact by pointing out that 'the expansion of the service sector in the 1950s opened up white-collar opportunities in areas like banking and the civil service for better qualified school-leavers'.[368] In addition, Todd and Young suggested that teenagers were no longer seen as '*important* breadwinners for the family' and parents were anxious to support their aspirations, reflecting 'both a desire for stability that economic security could offer and a willingness to embrace

365 Labour Party Youth Commission, pp. 35-36.
366 Veness, pp. 53, 58
367 Todd, *The People,* p. 221
368 M. Tebbutt, *Making Youth: A History of Youth in Modern Britain,* (London: Palgrave Macmillan, forthcoming), p.9. Tebbutt quoting C. Cregan, *Young People in the Workplace: Job, Union and Mobility Patterns,* (London: Mansell, 1999), p. 12

the potential for social transformation that it promised'.[369] I B, one of the women who made an oral contribution to this thesis, provided an example that supported their contention. She described the encouragement given to her by her working-class parents and 'was so grateful that they let me stay on and go to study shorthand-typing at Metrovicks when I could have left [school] at fifteen like most of the girls in my class […] they always said that what I did was 'a step-up' from where they had come from. That was what they did for all of us [her siblings] in whatever we wanted to do'.[370]

Thus moral indignation stirred up by mass media was often misplaced, and concerns about 'the teenager rampant' hardly applied to the vast majority of those attending girls' grammar schools. In his informative, but frustratingly ill-referenced, book Everett charted the progress of youth culture from the end of the Second World War and showed that until the mid-1960s 'the middle-class grammar-school-and-university tradition was not only located outside commercial pop sub-culture but was deeply suspicious of it'. His interesting survey pointed out the way in which this group of young people began to straddle two 'cultures' and he used as one example of this the fact that many of them included 'L Ps by Bob Dylan in their (mostly) classical record collection' as he was the 'new, intellectually respectable brand of rock 'n' roll'.[371] Similarly, the importance of modern jazz to this section of young people, which was categorised by them as neither 'high' nor 'low' brow music, was another example of the way in which their version of the

369 Todd & Young, p.463.
370 Oral testimony I.B. [2 December 2010]
371 P. Everett, *you'll never be 16 again*, pp. 70-71.

'sub-culture' stood outside that which disturbed the strident elements of the media but still disturbed parents and teachers anxious to preserve in them what they deemed to be middle-class cultural mores. Thus P D pointed out that 'there was one time in my life when I seemed to go to Halle concerts every week' but she also mentioned that playing her 'collection of Bob Dylan [records] drove my mother mad. She used to shout upstairs and tell me to turn it down because he sounded *so miserable',* experiences echoed by J C and D B1.[372] In ways like this, grammar school girls during the 'long 1950s' recognised that they were expected to conform to adult expectations about the way in which they should conduct themselves but tended to display their own discomfitures in a passive rejection of such controlling influences, as the Labour Party Youth Commission reported.[373] As a result, much of what was described by the mass media as teenage 'rebellion' did not form part of the life of these girls. Instead, as Veness found, many girls amongst the 'forgotten generation' paid attention to more serious matters with world affairs and 'the Bomb' being major preoccupations. [374] Jeff Nuttall's *Bomb Culture* graphically described the unease felt about 'living with the Bomb' with which he said 'the post-Hiroshima teenager' had to grapple, and Peter Watkins' seminal work, 'The War Game', made for the BBC in 1965 but withdrawn before it was broadcast, further pointed to the fears that the 'forgotten generation' faced. Little has been written, however, about the extent to which Cold War events had an impact upon young girls during this period; historians might consider this to be an area in which some

372 Oral testimonies P D; J C; D B1 [15 July 2011]
373 Labour Party Youth Commission, p. 5
374 Veness, pp. 99-100

fruitful research might be conducted.[375] Certainly oral testimony from those who contributed to this thesis supported the notion that they were also preoccupied with the same concerns as those young women found amongst Veness' cohort. That these women felt that their 'tentative foothold into the adult world' started with these concerns and required them to 'push against the conformity of what the school expected' and the 'conservative beliefs' of their parents indicated that 'rebellion' took many forms during this period and that youth culture was, indeed, multi-faceted.[376] As such it was described by Everett as being part of a 'transitional period' having 'a certain period charm when set alongside the 'sex and drugs and rock 'n' roll formula of a decade later' but, as he suggested, 'in 1961 sex wasn't discussed, drugs hadn't arrived and rock 'n' roll was finished'. [377] Thus, the place that 'youth culture' occupied in the lives of the grammar school girls who would later go on to take up apprenticeships at Metrovicks remained largely undetermined. To take Dame Margaret Beckett as an example it would seem that, much like the other grammar school interviewees in this study, she spent much of her time studying and said that her contact with the popular sub-culture was limited, although she did stress that she 'made up for it' when she left school and became an apprentice at Trafford Park. [378] If rebelling at all, it would seem that

375 J. Nuttall, *Bomb Culture,* (London: MacGibbon & Kee, 1968). pp. 12, 45, (39-71). This is now seen as a 'period piece' but was regarded by many at the time as a controversial account of events that shaped their lives. Watkins wrote and directed 'The War Game' for *The Wednesday Play* series for the BBC. It depicted the aftermath of a nuclear war and was considered so shocking that it was withdrawn before it was broadcast. It won an Oscar for the Best Documentary Feature in 1967.

376 Oral testimony. J C; P D ; D B1. Mention was made about the affect upon them of films such as *Dr. Strangelove* and *The War Game,* and the importance of membership of protest groups such as the Campaign for Nuclear Disarmament which became the focus of their burgeoning political and social lives.

377 Everett, p. 30. It is unclear which version of 'rock 'n' roll' he felt was finished in 1961 but then reincarnated a decade later.

378 Interview with Dame Margaret Beckett, 20 January 2015.

many grammar school girls were confining 'rebellion' to those elements of their education that they felt were limiting and frustrating.

Girls' grammar schools in post-war Britain: issues surrounding parity of esteem, aspiration and youthful rebellion

Before embarking upon the discussion that is to take place in this section of the chapter, it is necessary to explain that Metropolitan-Vickers only sought to recruit its female College and Schools Apprentices from the grammar school sector. The firm also offered training to grammar school girls who wished to pursue other careers such as laboratory assistants, technical librarians, draughtswomen or senior secretaries. It was necessary for all these categories of employees to have gained passes in five or more subjects at GCE Ordinary Level and the grammar schools provided this level of educational opportunity. It has to be stressed, however, that the grammar schools did not adequately prepare most of their female students to meet the qualifications that Metrovicks sought for entry onto its College and Student apprenticeship schemes. Many girls attended single-sex schools that lacked qualified staff to teach physics, chemistry or mathematics, or gave these subjects a lower priority than classics and the arts. In addition, pupils who expressed an interest in science or engineering were ill-served by schoolmistresses who had little experience of working outside the grammar school milieu and were unable to offer considered advice on such career opportunities. These factors made it particularly difficult for Metrovicks to attract significant numbers of female candidates of the required calibre to its ranks.

It would also be worthwhile looking at the make-up of the different types of grammar school brought into being under the tripartite educational system by the 1944 Education Act. This type of school was organised in different ways but there was a tendency to favour single-sex education.[379] 1180 grammar schools had already been established by 1955, and a decade later a further increase in numbers led to a total of 1285 grammar schools in all.[380] 179 direct grant grammar schools were also created by the 1944 Act and these varied in size and composition, from the large and well-known establishments such as Manchester Grammar School to much smaller foundations such as Dr. Williams' School for girls in Dolgellau.[381] Although there was much variation, Sampson found that most pupils were middle-class in origin with only 7% being children of semi-skilled or unskilled workers.[382] The Donnison Report (1970) also found that, taking the direct grant schools as a whole, 'the achievements of their pupils appear to be similar' to those of pupils in 'other grammar schools', even though the Roman Catholic schools provided 'an academic education' for children of 'a fairly wide range of abilities'.[383] Indeed, by 1966, 3.1% of the grammar school population was educated in direct grant schools, including those who were pupils at 56 Roman

379 Schools under the auspices of the Local Education Authority numbered 1200

380 By comparison, in 1955 there were 3350 secondary modern schools, 302 technical schools and 16 comprehensive schools. By 1965 both the numbers of secondary modern and of technical schools dropped to 3727 and 172 respectively, but the number of comprehensive schools had increased to 262 http://www.researchbriefings.files.parliament.uk. p. 1 [Accessed 30 July 2015]. These figures were based on government information figures from England and Wales including Ministry of Education, *Education 1900-1950. The report of the Ministry of Education and the statistics of public education for England and Wales, 1950*

381 Dr Williams' School Old Girls' Association, *Dr Williams' School, Dolgellau,1878-1975,* http://www/dwsoga.org.uk.[Accessed 11 July 2015]

382 A Sampson, *The New Anatomy of Britain*, (London: Hodder & Stoughton, 1971), p 141

383 D Donnison, The Donnison Report. The Public Schools Commission, Vols. I and II, (London: HMSO,1970, pp. 5, 51, 57

Catholic, 14 Church of England and 6 Methodist establishments.[384] On average, a quarter of the places in direct grant grammar schools were funded by central government with the remainder being funded by the Local Education Authorities and by some fee-paying pupils. In all, around 20% of children attended grammar schools, but there were severe regional imbalances.[385] Tebbutt noted that the 'anomalies in the eleven-plus system' meant that 'the number of children who passed the exam was based on number of places rather than ability' and the chances of gaining a place varied from 'five to thirty per cent' according to region. In 1963, for example, there were grammar school places for 33% of pupils in Wales and only 22% of children in the Eastern region. In Huntingdonshire a cap was placed on the number of girls being given places at grammar schools, allowing boys with lower scores in the 11+ examination to proceed in their stead. There were more grammar school places available in the south of England than in the north and there were fewer places available for girls even though, as she made plain, 'more girls than boys passed, but more grammar schools were reserved for boys'. [386]

Although it was considered to be a transformation in the education system, Thom suggested that the 1944 Act merely 'refined an existing, highly meritocratic system', and there was much to be said for this stance.[387] The accusation was

384 TNA ED 267 'Independent Schools 1975', subseries CRDA/13/DS/4 (National Digital Archive of Datasets), retrieved; TNA ED 278 Department of Education and Science and successors: Statistics Branch: Schools' Census (Form 7) Datasets. Grant Maintained Schools Database

385 A Elliott, *State Schools Since The 1950s: the good news,* (Stoke-on-Trent: Trentham, 2007)

386 Tebbutt, *Making Youth*, p. 22

387 D Thom, 'The 1944 Education Act: the 'art of the possible'?' in *War and Social Change:*

hard to ignore that the Act promised much but failed to deliver the degree of change necessary to ensure that girls were able to benefit fully from its implementation. As Hunt put it, the principle of 'parity of esteem did not really exist' even though it was upon this provision that the tripartite system was touted during the construction of the Bill.[388] Writing in 1985, Tessa Blackstone picked up on these points, making it clear that girls' education and their ability to achieve their potential was an issue that, even by that date, still needed urgent attention.[389] In contrast, in the 1950s and 1960s worries about the majority of grammar school girls achieving their potential had neither been the subject of much debate nor the subject of much concern. This was despite the fact that, as Byrne pointed out, Ernest Bevin had already spoken about 'poverty of aspiration' and had suggested that 'nowhere' was this 'more true than of girls' expectations in aiming at jobs or careers after leaving school'.[390] It is important therefore to seek some explanations as to why many grammar school girls were ill-served by their educational experience, lacked confidence in their ability, and accepted as their lot what Blackstone called 'depressed aspirations'.[391] By examining their experience it should be possible to identify some of the reasons why only a minority were able to prosper within this system, as well as to assess the extent to which even they were not encouraged to aspire to careers that were considered to be outside the norm for grammar school girls during this period.

British Society in the Second World War, H L Smith (ed.), (Manchester: Manchester University Press, 1986), pp. 101-128, (p.101)

388 F Hunt, (ed.), *Lessons for Life*, p. xix; M Barber, *The Making of the 1944 Education Act,* (London: Cassell, 1994).

389 T Blackstone, in J Whyte et al, *Girl Friendly Schooling*, pp. xi.

390 E M Byrne, *Women and Education,* (London: Tavistock Publications, 1978), p. 137

391 Blackstone, p. xiv

Very little has been written about those girls who passed the 11+ examination but were then consigned to following an academic curriculum that left many of them unable to gain the necessary matriculation qualifications for entry to university. Some of the women who offered oral testimonies mentioned the fact that they had been relegated to lower streams within their year group and were then unable to study Latin as a result. As it was necessary to pass a GCE Ordinary Level examination in this subject in order to matriculate they had no hope of gaining entrance to university and D B2, Z B and P D, who had all attended different schools, made this point.[392] In addition, as P N pointed out, 'It didn't matter if you passed the 13+ you couldn't go to uni either because you were always put in the lower streams'.[393] 'Streaming' decisions were usually based on examination results at the end of the first year at grammar school, with a crude cut-off point being made without reference to performance in individual subjects, or age differentials, and so on. Z B explained that she was 'rotten at maths, even though I always got top marks in English and Art and I wasn't awful at other things, but I just got put down anyway, just because of maths' and D B2 pointed out that she was 'one of the youngest in the year group and I struggled because of that so I found myself in the middle stream after the long holidays and that was it'.[394] As Evans put it, girls such as these were 'the educational successes that the grammar schools *failed* to produce'.[395] In addition, little examination has taken place into the reasons why these girls, identified by Todd as 'leaping the hurdle' of the 11+, and with it an

392 Oral testimony. D B2 [3 March 2014]; P D and Z B were amongst those who were required to 'drop' Latin at the end of their first year at Grammar School.
393 Oral testimony. P N [7 February 2012]
394 Oral testimony. D B2; Z B
395 Evans, p. 3

entry to what 'initially appeared to be the promised land,' were so quickly marked out as 'failures'.[396] Their inability to harness their academic potential suggested that factors existed that were hard to tease out and subtleties that were not easy to capture. Elliott surveyed this situation by analysing 300 HMI Reports for the period 1955-1961 and by interviewing women who had attended secondary schools during this period.[397] He found that the main areas of criticism focussed on 'low expectations', 'unduly harsh treatment by teachers', and 'poor guidance'.[398] Women who contributed to his study by recollecting their time at various types of grammar school also mentioned common factors that they felt militated against their ability to cope successfully.[399] They too spoke about the attitudes of teachers towards 'B stream' pupils, the unqualified staff who were sent 'to mind' classes for long periods of time, and the narrow confines of a curriculum that laid heavy emphasis on needlework and domestic science and failed to prepare pupils adequately in mathematics, foreign languages and the sciences. These contributors all attended grammar schools in different areas but also felt, like Elliott's sample which was gathered from contributions from across the United Kingdom, that factors like age in relation to the class cohort, maturation, social anxiety and bullying were problems that had been ignored.

Along with these reasons there existed a *de facto,* if not *de jure,* state of affairs which prevented all but a minority of girls fulfilling their potential within the

---

396 Todd, *The People*, p. 227

397 Elliott's cohort were self-selecting and answered an advertisement he placed in *Saga Magazine* asking for women to recount their experiences of their secondary education during this period.

398 Elliott, p. 23

399 Oral testimony D B2; Z B; D B1; D B2; J C; T E [19 July 2010]

grammar school system. Spender pointed out that in 1959, for example, out of a total population of 271,778 only 3310 girls went to university.[400] Of major significance was the paucity of university places offered to girls. This fact alone ensured that the majority were sifted out of the running at the first opportunity and although, as Byrne pointed out, girls who were not 'high flyers' were not 'by any means, all deprived of intellect [or] ambition'.[401] To underline further failings within the system, the women in Elliott's survey 'condemned with one voice' the 'lack of career choices offered other than teaching and nursing'.[402] Thus, as the grammar schools were unable to hold out the hope of a university place for most of their pupils, many felt that the best they could hope to encourage their pupils to achieve in terms of higher education was a place at a teacher training college; those who did not want to follow this career option had little to gain and so most either entered the workplace at the age of sixteen, or continued with some other form of vocational training such as nursing. It could, therefore, be argued that they were the 'victims' of 'depressed aspirations' finding that there were few opportunities available to them to advance a career outside the traditional occupations that were considered to be suitable for young women during this period. Whether or not all those who stayed on into the sixth form avoided being categorised as having 'depressed aspirations' is, however, debatable. To support this proposition would fail to take into account the fact that some girls who were capable of gaining a

---

400 D Spender, *Invisible Women. The Schooling Scandal,* (London: The Women's Press, 1989), pp. 90-92

401 Byrne, p. 73; Elliott, p. 27; C. Lacey, *Hightown Grammar: the school as a social system,* (Manchester: Manchester University Press, 1970). Lacey has more to say about this, but it must be stressed that more boys than girls were offered university places during this period. Jackson & Marsden, p.26 estimated that 87% of pupils had left grammar school by the age of sixteen.

402 Elliott, p. 2

place at university chose instead to attend training colleges or to take up the kind of semi-professional jobs described by Tebbutt that had long been considered to be 'suitable' for girls with 'A' Level qualifications. J C, A T and D B1 all spoke of their lack of enthusiasm about going to teacher training college but as D B1 said 'I wasn't sure I would get into university so I didn't even try […] and no-one told me what else there was […] so there wasn't really an alternative', A T said ' My aunts were teachers, so it was decided that if it was good enough for them [...]so that's why I ended up at college' and J C also questioned 'what else there was to do' and was also 'scared of trying for university in case I failed, so I didn't bother […] Teachers only seemed to want to encourage the ones who were really dedicated and knew what they wanted to do in life and I wasn't one of them'.[403] Gay Doyle, interviewed as part of an oral history project in Saddleworth, was also a case in point.[404] She turned down a place at Durham University in favour of attending a teacher training college. She defended her choice by recalling that 'you didn't have to go to university, and most didn't. There was no pressure to get a career; the idea never really occurred to me. You just pottered about for a few years and then got married'. In examples like this 'depressed aspirations' played their part and both Blackstone's concerns, and her exasperation, made sense against this background. It was clear that girls of the 'forgotten generation' were rarely given adequate career guidance and few examples were presented to them of women who had taken up professional careers, apart from their schoolmistresses. Although J C remembered that 'our family doctor was a woman and she had small children who were the same age as us, but it never once occurred to me to do

403 Oral testimonies. D B1; J C; A T [16 July 2015]
404 North West Sound Archive SADVOI 2013.0487. G Doyle [12 February 2015]

something like that […] and a couple of women who lived nearby went out to work carrying brief cases and […] they were businesswomen', many of the women who gave statements during the course of this research struggled to find examples of older women whom they knew and whom they would have liked to have emulated. None of them mentioned that they had considered taking up a career that might differ from those considered to be 'acceptable' occupations for young women and they did not know of any girls of their acquaintance who had stepped outside this narrow range of options. As Spencer pointed out, they were hardly helped by the 'career novels' of the period that cast young men in roles such as *Sam Dykes, Marine Engineer, Tim Baker, Motor Mechanic* or *Keith in Electricity* whilst the majority of the books written for young women offered equally stereotypical reading where *Judith Teaches, Jean Becomes a Nurse* or there was *A Library Life for Deborah.* Only one book, *Anne in Electronics,* written in 1960 by Louise Cochrane, contemplated the idea that young women might involve themselves in work where they would be seen as 'pioneers'.[405] The Metrovicks College and Schools Apprentices who had decided to become professional engineers during their time at grammar school were, therefore, amongst such 'exceptional' young women. The certainty with which they pursued their aim stood in sharp contrast to the evidence presented here of indecision on the part of many young girls about how their future careers might evolve, especially when they were embarking upon pathways that they recognised were limiting and were not necessarily made out of choice. Where choice seemed to be circumscribed, as P D stated 'it was hard to know what to do […] none of the teachers seemed to suggest anything, so I drifted

405 Spencer, pp. 108-109, 126-127

and it took me years to find my vocation', and this oral testimony chimed in with that given by others who contributed to this study, as well as tying in with the information provided by Elliott who gathered together a larger sample from his cohort of *Saga* members.[406]

If there was a degree of confusion on the part of grammar school girls as to where their education might lead, there had long existed uncertainties about the *purpose* of girls' education which the 1944 Education Act did not adequately address. Summerfield offered compelling evidence to suggest that this posed an ever-present dilemma to both teachers and pupils alike. Her study of girls in two Lancashire towns confirmed that girls were encouraged to pursue the path of academic excellence, but also confirmed the maintenance of an unspoken assumption that most ought to be prepared for their ultimate destination – bourgeois wife and mother.[407] Indeed, Clements argued that grammar schools 'persisted' in presenting motherhood as the 'primary' career for girls during the 'long 1950s' so it was not surprising that such a dichotomy contributed to an often fragile understanding of what exactly girls' grammar schools were *for.*[408] How the idea of 'having children, being married and becoming part of the universal Janet and John world', as Evans put it, became part of the system of ideologies and attitudes lodged within the grammar school tradition and then transmitted to

406 Oral testimony. P D; Elliott, *State Schools since the 1950s.*

407 P Summerfield 'Cultural Reproduction in the Education of Girls: a Study of Girls' Secondary Schooling in Two Lancashire Towns, 1900-1950, in F Hunt, *Lessons for Life,* pp. 149-170.

408 S Clements, *Feminism, citizenship and social activity: The role and importance of local women's organisations, Nottingham 1918-1969,* (Unpublished PhD thesis, University of Nottingham, 2008), p. 241

impressionable adolescents, was not easy to capture.[409] Arnot *et al* suggested that part of the explanation lay in the adherence to the doctrinaire principles of childcare that were prevalent during this period, especially Bowlby's theory of 'maternal deprivation' where 'motherhood became increasingly extolled and codified'.[410] These were ideas that were transmitted by women's magazines that had an avid readership peaking between 1956 and 1960 when it was estimated 'that five out of every six women in Britain read at least one magazine a week'.[411] In investigating the idea that the 'preoccupation […] with all things female created a sense that 'being a woman' was a full-time career in itself that demanded training and expertise,' Spencer pointed out that these publications sought to influence a large female audience who were given a 'clearly defined […] role to play as citizens of a post-war world' and 'marginalised those who did not fit their model'.[412] Thus a contradictory message was forged within the grammar schools; the upholding of this construct of femininity was somehow made to coalesce with the professed aim of providing a high class academic education that led to a university degree and entry to a professional career.

As a renowned mathematician and a leading expert in her field, Kathleen Ollerenshaw gave some thought to these ambiguities and her views were both a product of the times and of the Conservative Party politics in which she was immersed. As Chair of Manchester Education Committee, later the Lord Mayor,

---

409 Evans, p. 58.
410 M Arnot, M David & G Weiner, *Closing the Gender Gap: Postwar Education and Social Change,* (Cambridge: Polity Press, 1999), p. 40;
411 Spencer, pp. 129-130
412 Spencer, pp. 130-131

Ollerenshaw was a determined campaigner on the issue of the provision of technical and scientific education for girls. She made much of her ability to combine her role as wife and mother with both her academic career and her formidable public service duties. When she was appointed Pro-Chancellor of Salford University she began to forge important links with Willis Jackson at Metrovicks at a time when he was anxious to recruit young women as apprentices on 'Sandwich Courses' run in conjunction with the university and she was supportive of his stance.[413] When she wrote *Education for Girls,* however, she was keen to examine the secondary curriculum in the light of the negotiations she considered that girls would have to make in order to pursue a career whilst looking after a family. Whilst she promoted the idea that 'it is in the national interest that a *reasonable* (my italics) proportion of girls should choose to study physics and chemistry' she suggested that 'but a few' were capable of rising to the challenge and felt instead that the rest should be given 'all that is best in the education of boys, but with a different slant'.[414] In *The Education of Girls*, Newsom also extolled the virtues of a curriculum focused on 'the vital interests of the majority who will marry', and insisted that it was important that schools did not 'spoil their pupils for married life' by making them 'despise domestic occupation'.[415] As an influential educator during this period, he represented a pedagogical conservativism that seemed to consider that there had been a 'golden age' of Victorian tutelage that prepared girls for their 'true' vocation as wives and mothers and that to replicate old 'certainties' was in the best interests of modern-day

413 Imperial College Archives (ACRU) B/JACKSON FO/2 Correspondence: Kathleen Ollerenshaw
414 Ollerenshaw, p.87
415 Newsom, pp. 48, 148.

schoolgirls.[416] His views now seem breathtaking in their assumptions about girls' aspirations and, although Kamm generally spoke of him in positive terms and Tinkler suggested that his controversial approach was 'tongue-in-cheek', unsurprisingly he has been much criticised both by feminist historians and by his more liberal-minded contemporaries.[417] It could be argued, however, that many of his views were not too far out of kilter with popular opinion in a society adjusting to the pressures and confusions of the post-war world. Indeed, Ollerenshaw agreed with Newsom in believing that one of the main functions of girls' education was to instil in them the virtues of good citizenship, mirroring the ideas that Fleming had already incorporated into the apprenticeship schemes at Metrovicks. Set against contemporary concerns about a breakdown in family life, both authors suggested that the burden of responsibility for dealing with these issues would fall on the shoulders of the mothers of the next generation, an idea that had already been expressed in the Youth Commission Report of the Labour Party. Furthermore, in stating that 'the incentive for girls to equip themselves for marriage and homemaking is *genetic*' (my italics), but the 'incentive for girls to study to give their best' so that they might endeavour to gain access to a 'future career' was 'not so clear cut', Ollerenshaw was perhaps only reflecting on the climate of the times.[418]

To compound matters, the grammar schools themselves were ever anxious to be

---

416 J. Robinson, *Bluestockings.* See also D. Parker, *John Newsom: A Hertfordshire Educationalist,* (Hertfordshire: University of Hertfordshire Press, 2005)

417 P. Tinkler, 'Girlhood in Transition? Preparing English Girls for Adulthood in a Reconstructed Britain' in *When The War Was Over: Women, War and Peace in Europe 1940-1956,* (ed.) C. Duchen & I. Bandhauer-Schoffmann, (Leicester: Leicester University Press, 2000) p. 61. Tinkler suggests that R A Butler implied this in his introduction to Newsom's book. J Kamm, *Hope Deferred: girls' education in English history,* (London: Methuen, 1965), p. 297

418 Ollerenshaw, p. 186

seen to preserve a Victorian construct of 'gentility' based on the idea that to encourage and promote 'ladylike' behaviour was a laudable educational objective in itself. In an interview with Dame Margaret Beckett in January 2015, she was critical of the way in which staff at her small convent grammar school felt that 'social aspirations' were important. Many girls, having failed the 11+, 'were fee-paying pupils' and in her estimation were less concerned with academic prowess than might be expected at a grammar school. Both her sisters, however, had attended a large, urban, convent grammar school where great emphasis was placed on intellectual development and where girls were encouraged to become high achievers. In contrast, her own school placed an emphasis on ensuring that 'pupils were well mannered' and 'gave service to the community'; Dame Margaret further suggested that the 'teaching was variable' and that she had 'no feeling' that other goals played an important part in her education. She also commented on the lack of science teachers at the school, where only biology was taught and where only one student in her year group, apart from herself, had managed to pass Ordinary Level mathematics. As a result, she was forced to attend a local technical college to study Advanced Level physics, but felt that this enabled her to experience other methods of teaching that she had not found within the narrow confines of the grammar school. 'Ghetto-ization' was her word for what she considered to be the way in which convent grammar schools stood outside the mainstream and where the maintenance of religious conformity was given priority over the need to ensure that all teachers were able to deliver the kind of academic education that was deemed to be the hallmark of the grammar school system. Such sentiments were echoed by Sheila Dewsbury and Gay Doyle who also said 'I

don't think I learned very much. The nuns were more concerned with turning out good wives and Catholic mothers', although the emphasis placed on marriage and motherhood was not just to be found in the Catholic system .[419] Oral testimonies given to this study also reported that similar attitudes prevailed in their local authority schools. Some made mention of a lack of qualified staff in important subjects, and to the fact that there were 'always fee-payers in the lowest stream', but one women suggested that 'they probably only missed passing the 11+ by a whisker' and 'most of them […] I was friendly with managed to pass 'O' Levels and I know some of them went to [the local] teacher training college'.[420] Dame Margaret was the exception to the rule that attendance at a training college was often viewed as the most suitable career destination for a young girl and, like the handful of young girls who wished to enter the engineering industry, she found that the path towards achieving her goal was not always easy to follow

If the grammar schools appeared to be ambivalent about the kind of education that ought to be offered to young girls during this period, then parents also sent out mixed messages to their daughters. Whilst Todd and Young argued that much hard earned cash was expended in providing leisure activities for their offspring, they focussed their attention on working class parents rather than on the parents of most grammar school pupils. That being said, they noted that most 'teenagers were told to be ordinary' whilst simultaneously being encouraged 'to believe that 'the sky's the limit' ' and these 'contradictory messages were never entirely

419 North West Sound Archive. 2010.02 8.3.2012S. Dewsberry [Accessed 12 February 2015]; Doyle, SADVOI; Oral testimony. A T

420 Oral testimonies. D B2; J W [29 July 2015] and R G [29 July 2015] made similar comments.

reconciled'.[421] Many women had faced problems as workers during the Second World War and, though ambitious for their children, believed that similar limitations might be placed on their daughters as they tried to force a career for themselves. Amongst others Braybon and Summerfield, Lewis, Goodman, and Myrdal and Klein, have analysed the reasons why so many of these war-time workers returned so quickly to full-time work in the home.[422] Whilst the relief felt by women who were able to relinquish the struggle of balancing work with the demands of family life in difficult circumstances was obvious, contributors to Mass Observation such as Edie Rutherford and Maggie Joy Blunt also gave a flavour of the frustration they felt when their talents were being under-utilised. Having been discouraged from trying to advance their careers when war-time conditions applied, when matters did not improve in the immediate post-war period, they both decided to give up the attempt.[423] Marwick's claim that war 'altered the consciousness' of women like them looked a little thin in relation to this kind of experience and Smith pointed out that, if this was the case, such women would have had 'a strong desire to remain in paid employment' when the conflict ended; most women did not do so.[424] Whether they believed that their daughters, the members of the 'forgotten generation' would fare a great deal better was debatable. That being said, a grammar school curriculum that promised a good general education enabling girls

---

421 Todd & Young, p. 460

422 G Braybon & P Summerfield, *Out of the Cage: Women's Experiences in Two World Wars,* (London: Pandora, 1987); J Lewis, *Women in Britain since 1945: Women, Family, Work and the State in the Post-War Years,* (Oxford: Blackwell, 1992); P Goodman, *Women, Sexuality and War,* (Basingstoke: Palgrave, 2002); A R Myrdal & V Klein, *Women's Two Roles: home and work,* (London: Routledge, 1998)

423 S Garfield, (ed.), *Our Hidden Lives,* (London: Ebury Press, 2005).

424 H L Smith, 'The effect of war on the status of women' in *War and social change,* pp. 208-209, 217-220; A Marwick, *War and Social Change in the Twentieth Century,* (London: Macmillan, 1974)

to find a short-term 'respectable' job and a companionate marriage that was economically and socially superior to their own was the option that many parents preferred.[425] Indeed The Taking Liberties Collective suggested that parents 'wanted it both ways hoping that girls did well at school but not at the expense of [their] sexual destiny'.[426] In other words, females profited from attendance at grammar school only inasmuch as it prepared them for 'a dual role in life' that always had to 'make the personal adjustments to match [their] husband's career' as Ollerenshaw pointed out, even if it was difficult to see just how far she followed her own advice.[427]

These were the dilemmas faced by grammar school teachers who could only hope to promote what they best understood. As Summerfield perceptively pointed out, few schoolmistresses were wives and mothers themselves and most were members of a generation that had been obliged to make a stark choice between marriage and a university education.[428] As she saw it, the shaping of femininity within this corpus was seen as a preparation for 'professional spinsterhood' rather than for bourgeois marriage. This is a moot point; what remained clear, however, was that teacher identification with girls who were perceived to be capable of achieving scholastic excellence sometimes led to a summary dismissal of the aspirations of the rest. This was a matter that remained unresolved during the period, as Newsom and Ollerenshaw clearly demonstrated. Whilst both stated that

---

425 Spencer, p. 51

426 Taking Liberties Collective, *Learning The Hard Way. Women's Oppression in Men's Education,* (Basingstoke: Macmillan Education, 1989), pp. 45-46

427 Ollerenshaw, p. 124. Gay Doyle describes how this happened to her in the 1960s.

428 Summerfield, 'Cultural Reproduction', pp 162, 166; Evans, p. 58

only a minority of 'exceptional' girls had the potential to be able to benefit from a university education, both remained less secure about the potential of the rest. Ollerenshaw fudged the issue. She berated most girls for taking little interest in mathematics and failing to have an 'insatiable curiosity about mechanical contrivances'; by her insistence upon preparation for bourgeois wife and motherhood, however, she fell into the trap of suggesting that this was a laudable aspiration, equivalent to high academic achievement and entry to a professional career.[429] It could be said with some justification, therefore, that most grammar school girls experienced a fallow period in the understanding of their situation and, hence, in the advancement of their education. Indeed, one of the women engineers who contributed to this study remarked that 'I left grammar school without having had any help or encouragement and it was just by luck that I managed to choose the right subjects [whilst I was there] and that eventually got me onto an engineering course, but that was a long time afterwards'.[430]

Both Summerfield and Mary Evans examined the issue of cultural reproduction, though from somewhat different chronological and geographical perspectives. In essence they said the same thing: the transmission of ideologies, values and attitudes by girls' grammar schools maintained and perpetuated a view of 'refinement' that often clashed with adolescent needs and wants and was incompatible with their perceived view of the world. Evans, in particular, offered a trenchant analysis of this 'culture clash' in her examination of the embargoes that were placed on 'the experimentation of adolescence' which directly contradicted

429 Ollerenshaw, pp. 82, 86-88
430 Oral testimony. M B

'the ethos and practices of the school' during this period.[431] To rebel, however, was no easy matter. As it has already been pointed out, members of the 'forgotten generation' were often wary of many aspects of 'youth culture', but nevertheless the transmission of 'appropriate' feminine ideologies was crucial in the grammar schools where the wider anxieties of society about the status of these young girls was brought into sharp relief.

In *Convent Girls* a number of well-known women, such as Germaine Greer, spoke of the kind of restrictions and the kind of punishments meted out to 'bold girls' who stepped out of line and their responses were typical of those reported in oral testimonies given in this thesis.[432] To be thought of as 'bold' was a source of shame rather than of pride. 'Bold' behaviour, such as eating on the street, copying homework or being untidy, was amongst a panoply of 'failings' that irked schoolmistresses and was intended by girls themselves to be markers of disaffection with their schools. The most obvious way of expressing dissent was in relation to the 'creative' ways in which a uniform was worn and all the women included in my survey made mention of this. Evans, however, posited the idea that the whole function of the uniform was to concentrate the mind on school work and to keep girls from thinking about their appearance, an occupation far too frivolous to be thought worthy of the grammar school pupil. [433] Whilst the wearing of 'correct' shoes and uniform enforced a particular set of bourgeois values based on smartness and respectability, Payne also placed this within the context of a

---

431 Evans, pp. 54-56, 74-98 (p. 92)

432 Bennett & Forgan, *Convent Girls* ; Evans, pp. 24-49; Oral testimonies J W; R G; R W [29 January 2012]. They were a decade younger, but they still reported in the same way.

433 Evans, pp. 29-33.

'process of destroying individual identity'.[434] Further, she suggested that the 'gender-uniform' of sensible shoes, shirt and tie, gabardine, blazer and hat presented a masculine image ' and thus femininity was being symbolically sacrificed in the pursuit of knowledge'. [435] Within such parameters it was unsurprising that most girls rebelled in one way or another.

Another of the defining features of rebellion was to be thought of as 'common', and covert smoking or taking on a Saturday job at Woolworth, for example, was considered to be 'beyond the pale'.[436] There was, perhaps, only one 'crime' more heinous and that was to acquire a boyfriend. The headmistress of the local grammar school attended by I S said that she 'felt physically sick' on seeing one of her sixth form pupils 'walking hand in hand in the street' with a boy from the neighbouring grammar school; this behaviour marked out girls who were thought to be advanced beyond their years.[437] Indeed, one of Jackson and Marsden's interviewees spoke of her fear of mature girls who wore make-up and high-heeled shoes and it was the fear of the burgeoning sexuality of the girls in their charge that informed the way in which the grammar schools dealt with what they considered to be deviant behaviour.[438] Boyfriends were taboo, and Summerfield's analysis of the idea that class was at the root of such a prohibition tied in with both Payne and Evans's views that grammar school girls were being prepared for

---

434 I Payne, 'A Working-Class Girl in a Grammar School', p.14 in D Spender & E Sarah (eds.), *Learning to Lose*

435 Payne, p. 14

436 Payne, p. 16; Summerfield, 'Cultural Reproduction', p. 16.

437 Oral testimony I S

438 Jackson & Marsden, p. 45

middle-class status and so had to preserve their sexual 'purity' for marriage.[439] In other words, as Evans pointed out, 'the culture was prepared to tacitly maintain conventional sexuality' in order to ensure that 'middle-class girls should remain in a middle-class world'.[440] During the 'long 1950s' a 'middle-class world' did not see engineering as an appropriate choice of career for a grammar school girl. It could be argued that pursuing such an ambition was seen as transgressing those societal expectations that were gender based and thus was a form of rebellion in itself. In saying, '[...] so I swapped my first choice [medicine] and ended up being an air-hostess which made everyone happy, but I wished that I had had the guts to be a rebel and stuck to what I wanted to do', M B made this point.[441]

'Staying On': The impact of class and gender on the ability of the grammar school girl to access higher education and a professional career

It was difficult to state with any certainty that 'class' had a bearing on the decision of girls to stay on at grammar school after age of sixteen, though it had long been a conventional explanation favoured by authorities such as Jackson and Marsden. In their seminal study of grammar school pupils of this era, they considered the reasons why middle-class children stayed until the age of eighteen and why so few with a working-class background did so.[442] What they failed to calculate, and this is unsurprising given the nature and scope of their work, was that many lower-middle and middle-class pupils did not stay on at school either. Though the authors had worked with a small sample and focussed much of their attention on

439 Summerfield, 'Cultural Reproduction', p. 165.
440 Evans, pp. 38-39
441 Oral testimony. M B
442 Jackson & Marsden, p. 28

boys rather than girls, their findings brought the problems faced by early leavers into sharp definition. Whilst their survey gave economic imperatives and parental opposition to further education as the obvious reasons why work was chosen over school, other issues had a long-term effect on the decision to leave at the age of sixteen, but Jackson and Marsden failed to recognise that these were not necessarily 'working-class' issues at all.

There was oral testimony collected for this thesis that suggested that girls placed in lower streams in their grammar schools performed well in their 'O' Level examinations but still decided to leave school at sixteen. Others, however, who had been placed in the 'top' stream but had failed to reach their potential, tended to carry on into the sixth-form irrespective of their class origins. Obviously, a much larger investigation would be needed to corroborate their evidence. Indeed, the information gleaned from this very small sample may well have been atypical. Most of the women who participated in this study, however, kept in touch with school friends, via Old Girls' Associations for instance, and so were acquainted with a much wider group of former grammar school pupils. In discussing this idea with them, the participants in this survey could identify many instances where this was the case. In an interview with D B2, who came from a comfortable middle-class background where parental expectations were high, she recalled the 'shock' she experienced in being placed in the 'lowest stream' when she first entered grammar school and this made her determined to 'leave at the first opportunity […] because I felt that I was so stupid that there was no point [in staying on]'.[443] Like

443 Oral testimony D B2

J C and A T, she passed her 'O' Level examinations but they stayed on into the sixth form. As A T remembered, '[…] that was what people in the top stream generally did […] but I knew one or two where it must have been a bit of a struggle for their families', and J C recalled '[…] I can't remember anyone leaving at that stage, except a girl called A N who went off to a finishing school'.[444] It would seem that once the grammar schools had decided on investing in girls in the 'top' stream, and had imbued them with the confidence to see themselves as academically successful, then early leaving was a much rarer occurrence whatever the 'class' origins of the pupils.

This was borne out by examining school publications of the period. There was evidence to suggest that schools such as Altrincham Grammar School for Girls, situated in a leafy suburb and catering for an almost exclusively lower-middle to middle-class population, still included many 'early leavers' in its cohort.[445] Adelphi House Grammar School was located in a deprived industrial setting and served a wide catchment area but the social background of a small number of pupils was similar to that of the girls in the Altrincham school.[446] Many of these girls had the qualifications to enter the sixth form but still chose to leave school at sixteen whereas a healthy population of the mainly working-class girls at Adelphi House stayed on regardless of the difficulties that they faced in doing so. I S attended a different school but also recalled that 'the idea that the school was aiming to give

444 Oral testimony J C and A T

445 M Kendrick, *Altrincham County Grammar School for Girls,* **(**Altrincham: unknown publisher, 1974).

446 F Heaton, *Adelphi House Convent: The School by the Irwell 1852-1981,* (Salford: The Centre for the Study of Religion and Education, 1982)

us intellectual and social advantages' meant that in her year (1962) 'out of 103 girls, 24 of us stayed on' despite the financial hardship incurred by many of the parents. [447] In cases like these 'class' was not the issue at stake; what seemed to play a crucial part in the decision to leave school at the age of sixteen was the fact that those who were unable to gain access to the 'top stream' at the age of eleven become academic 'also-rans'. That they entered the workplace as soon as they were able may have been the product of 'depressed aspirations', but it did provide an escape from the sense of failure that had dogged them throughout their school career, as D B2 suggested.[448] Where there was no great discrepancy in examination results at the age of sixteen it could be argued that it was neither 'class' nor was it 'ability' that marked out the girls who chose to stay on into the sixth form. Those who did take this route were the girls who had been encouraged to think of themselves as 'successful', even 'exceptional', and their membership of the 'top stream' was instrumental in reinforcing this notion. As a result, when examining the aspirations of those women who were part of this small sample, the idea of using 'class' as the main indicator of their ability to fulfil their ambitions during the time that they spent at their grammar school seemed to be less appropriate than authorities such as Jackson and Marsden had suggested. It has also been shown that using 'ability' as a guide presented difficulties when girls, admittedly later in life, went on to university and took up professional careers, often under the auspices of The Open University as Rosemary Reynolds testified.[449] Admittedly this small survey, which was not subject to rigorous

447 Oral testimony. I S
448 D B2 and Z B made this point.
449 Oral testimony. P D and D B2 were notable examples; Rosemary Anne Reynolds, 'My

methods of testing, was only able to examine anecdotal evidence. The fact, however, that different types of grammar school from across the country seemed to operate in a remarkably similar way was also confirmed in the literature, especially by Mary Evans, Payne, Rowbotham and Spencer, and this lent credence to the views expressed here.

As fewer places were offered to young women than to young men the issue of gender was the significant factor in the ability of grammar school girls to access a university education during this period. Out of a total 17,337 students who obtained a first degree in 1950, 3939 were women and 13,398 were men. A decade later, out of a total of 22,426 students, 5575 women were awarded a degree in contrast to 16,861 men. [450] It was not the case that all young girls who were members of the 'forgotten' generation had 'depressed aspirations' and preferred to marry at an early age, as the Labour Party Youth Commission reported and as Ollerenshaw seemed to believe, although some like Gay Doyle eschewed a university education and followed this route. There were other reasons, and two of the male College and Schools Apprentices who made contributions to this thesis summed up the type of gendered attitude towards women students that were prevalent during this period. Whilst S A described the ease with which he progressed through grammar school 'in the top stream' where he had been given 'a great deal of encouragement from the chemistry master' and

---

academic journey 1965 to 2011'.http://www.open.ac.uk [9 October 2014]. Of the 42,000 applications to study at the OU when it first opened in 1971, however, only 25% came from women.

450 House of Commons Library SN/SG/4252 27 November 2012. P Bolton, Social and General Statistics. Education: Historical statistics, p. 20. http://www.researchbriefings.files.parliament.uk [15 April 2015]

so 'it was never even considered' that he would do other than take up a university place, he also suggested that '[…] most of the girls that I knew went to training college. It wasn't the thing to go to university like it is these days'.[451] P B focussed his attention on a career as an engineer 'from the time when staff from the Research Department at Metrovicks visited the school and they made an impression'. He found that few obstacles were put in his way, he was 'encouraged' by his physics and mathematics teachers and he 'couldn't think of a reason' why he would not continue his studies at university' [but he] 'didn't think girls would have been inspired by the Metrovicks talks, no not at all'. [452] Their contributions stood in contrast to those of P N, I S and J W who all gained coveted places at university during this period and then became successful professional career women. They were more self-deprecating and talked of being uncertain about their capabilities and their chances of success. J W suggested that 'It was luck more than anything. I don't think I was clever, not in the way that an Oxbridge girl was clever', I S also made a similar comment and P N believed that she was 'not exactly in the top league'.[453] In contrast, male Schools Apprentices, such as T W and P F, gave oral testimonies in which they did not question their ability to succeed, even though they had had to opt to attend colleges of technology rather than embark on degree courses at university as a result of 'disappointing' Advanced Level results.[454] Women however, described how they worked hard to avoid disappointing examination results suggesting that they would have been, as D B1 said, 'really devastated if I had done badly. I wouldn't have known what to

451 Oral testimony. S A (3 November 2010)
452 Oral testimony. P B [This took place at MOSI]
453 Oral testimony. J W; I S; P N
454 Oral testimony. P F; T W [5 November 2010]

do, apart from re-sitting and trying not to think I was a total failure'.[455] Whether or not men were more insouciant about accepting 'failure' was difficult to gauge but T W and P F, at least, were confident that being accepted onto the Schools Apprenticeship course offered them the same opportunities as those who had embarked on a degree course. They felt that they had other choices too, and that their grammar school education '[…] wouldn't have been wasted. There was always the chance of a good career in the industry. You could work your way up if you needed to'.[456] When discussing career choices, P D made the important point that many grammar school girls lacked confidence and 'were afraid of failure [and] didn't dare to do something different in case it all went wrong' and she suggested that fear of adult disapproval played a part in shaping such attitudes.[457] There were gender differences to be found in the statements that these women and men offered. T F, who completed his apprentice training and later went on to become a teacher, said that he 'messed around quite a bit at school' so that he 'didn't do really well' but he felt that he was liked by his teachers because he was 'sporty' and 'a bit cheeky' and so they 'encouraged me all the way, and when I left to go to college they still kept in touch and spurred me on, really'.[458] It might be said that T F was given some lee-way by his grammar school to push boundaries and find his feet and, as a consequence, his 'cheeky' behaviour did not need to be reined in. Other male contributors spoke in similar vein about the way in which they were allowed some latitude by their schools when they were 'flexing our adolescent

455 Oral testimony D B1. Most of the women who contributed oral testimonies spoke of their fear of failure,

456 Oral testimony T W [17 February 2011. This was a continuation of conversation of 5 November 2010]

457 Oral testimonies. J C; P D; A T; D B1

458 Oral testimony. P F

muscles' as T W explained, and R J felt that 'it was generally accepted that all boys would be a bit bolshie from time to time but as long as you got your head down [to work] when you needed to it was usually OK'.[459] These types of statement stood in contrast to the way in which J C had referred to 'obedience' to authority within girls' grammar schools. In saying that 'if you were a girl you were expected to be obedient and do what you were told, and there was no room for negotiation', she echoed the statements that other women contributors had made. Whereas boys were being prepared for a life in an often competitive working environment where they had to learn to 'hold their own', it was not at all certain that this was the case as far as girls were concerned. One way of understanding how young women during this period found it much harder than men to think about forging a professional career for themselves lay in the fact that it was not so clear-cut that this was theirs for the taking. Their lives both inside and outside the grammar school system were more circumscribed, especially when behaviour was heavily monitored, when entry to higher education was limited, and when career aspirations were less well articulated than those of their male counterparts. Young women, therefore, were impeded by these factors and gender differences were marked during the 'long 1950s'.

'Exceptional' young women: An assessment of the extent to which societal pressures and cultural shifts affected the transition from grammar school to apprenticeship training of the 'forgotten generation' during the 'long 1950s'

It was clear that, despite being differently grouped according to ability, pupils at

459 Oral testimonies. T W; R J [1 December2011]

girls' grammar schools during this period shared common experiences. It has already been shown that these related to the pressure to conform to expectations about their future role in society, about their adherence to the ethos of the grammar school, and about the extent to which they identified with 'youth culture'. Thus a well-established and 'strongly imposed system of values' which orientated each individual 'towards academic achievement and a characteristically middle-class value complex', as Lacey put it, characterised both home and school life for members of the 'forgotten generation'.[460] The remaining part of this chapter, however, takes close account of the small group who were determined to gain access to university and then to forge a professional career for themselves. Even amongst the girls who inhabited the 'top stream', there were 'exceptional' girls. These were the young women who were encouraged by their teachers to aim for the 'glittering prizes' offered in the form of County Bursaries, State Scholarships and places at Oxbridge colleges. Both P N and P J attended the same 'excellent' High School and both remembered the way in which their Headmistress encouraged them to work hard and pursue a career. P N, in particular, recalled 'being taken aside when I was not working hard enough and told to pull my socks up' because she was considered to have 'academic potential', although 'it was never openly expressed as such' to her.[461] I S was another high-achiever at a different grammar school who recalled that top stream girls 'felt a bit superior to the others' and 'were encouraged to think of the world as an adventure and that we could go on to higher education', and though she did not remember that 'it was mentioned to us that Oxbridge was a possibility', she felt that the school believed

460 Lacey, p. 192
461 Oral testimony P J [10 June 2010]; P N

in 'developing our intellect and making sure we went to a good university'. The French teacher whom 'all the girls were terrified of decided that I was good at French and would go to study it at university, so I said 'Yes Miss Bennett!' and did'. Although when eventually interviewed for a place at Durham University I S admitted that, 'I could hardly say a word, because I wasn't trained in expressing an opinion or talking freely to adults'.[462] Despite this she, like the others in this survey who were academic 'high-flyers', felt that they had benefited from being so regarded and were grateful to have been encouraged to strive towards the academic prizes upon which the grammar schools set such store. Alongside the promotion of high academic achievement there was, however, an ever-present injunction to be 'watchful' where such achievement was concerned. The schoolmistresses at the grammar school attended by J.R. 'were forever' reminding their pupils that they were 'the cream of the country' but she said that they used this phrase 'sarcastically', as a reminder that 'we were not always up to scratch and needed to do better' and not 'as an indication that we might be quite bright'.[463]

If there was one drawback to being amongst the favoured few, it was the fact that even 'exceptional' girls shrank from being compared to their teachers. Newsom, in his own inimitable style, described the 'celibate staff' as 'a bunch of failures'.[464] All the women in this study also agreed with Rowbotham's description of schoolmistresses as 'the shadowy figures in long old fashioned clothes', frightening creatures dressed 'in tweed suits and hornrimmed glasses with stern

462 Oral testimony I S
463 Oral testimony J C
464 Newsom, p. 147

buns at the back of their heads', and this was congruent with Evans' view of 'the valiant spinsters' who 'biked to school, wore flat, sensible shoes and white ankle socks'.[465] There was, therefore, an element of dread amongst many clever girls that they too might turn out to be equally desiccated and have to endure 'a drab and depressing spinsterhood' unless they took steps to avoid this at all costs.[466] Nicholson also made much of the preoccupation with marriage and the home during this period and suggested that 'if getting a good education meant isolation from men and frumpy clothes, who would embrace it?', a view shared by most of the women who were contributors to this study.[467] She made no claim to having written an academic study, but she gathered together an impressive array of interviewees. Amongst these women it was hard to find any who had not had to face challenges when trying to channel their often formidable education into a profession. In quoting one graduate, who suggested that 'brains are a distinct handicap to a woman's prospects of happiness and contentment', Nicholson pinpointed the problems that even those who were exceptionally able had to face in order to comply with the social mores of the period. The idea that 'if you were clever', but 'didn't want to be dismissed as 'a 'blue-stocking' or a 'sexless woman intellectual', there was little option but to 'play the feminine game', had a firm hold over impressionable minds.[468] Both Payne and Macdonald pursued this idea further and in examining the concept of femininity, posited the idea that girls judged academic success 'as unfeminine on the assumption that 'bluestockings'

---

465 S Rowbotham, *Women's Consciousness, Man's World,* (Harmondsworth: Pelican Books, 1973), p. 12; Evans, p. 58

466 Newsom, p. 148

467 Nicholson, *Perfect Wives,* pp. 157-197 (p.160)

468 Nicholson, pp. 171, 192. She quoted J. Hubback, *Wives Who Went to College,* (London: Heinemann, 1957); Sewill, p. 217. For a sympathetic view see Robinson.

do not find husbands or boyfriends and therefore will fail as women'.[469] Egged on by what they read in the media, and certainly influenced by family and friends, this was what many of the girls of the 'forgotten generation' assumed would be their fate if they did not carefully balance academic prowess and social acceptability. Despite the fact that campaigning women had prompted a clause in the Crowther Report allowing able girls to be exempt from 'education for motherhood', as Clements pointed out, there still seemed to be an imperative for girls to position themselves in such a way as to make it plain that they too embraced marriage and children.[470] Nicholson, for example, quoted an article by 'agony-aunt' Marjorie Proops in the *Daily Mirror,* entitled 'Love Life of a Female Egg Head!' which concluded that it was 'intelligent girls who spend their youth getting themselves highly educated and have little time to devote to the art of making themselves delectable for the opposite sex'.[471] This was the sort of message that was regularly meted out in the press and was not always challenged by young girls themselves where peer-pressure helped to reinforce a belief in notions such as these. Indeed, Evans made the interesting point that grammar schools were not adept at encouraging a love of learning and suggested that 'well-mannered, academically competent semi-philistinism provided the identikit features of the perfect pupil' however they had been 'streamed'.[472] Even 'exceptional' young women were cast in this mould and one of them, who was a graduate apprentice at Metrovicks, summed up such attitudes well. When interviewed about her training as a professional engineer for *Topic*, the in-house magazine, she was careful to stress

469 Payne, p. 17; Macdonald, p. 24
470 Clements, p. 242
471 Nicholson, pp. 193-194
472 Evans, p. 22

that her abilities as a good cook and housekeeper were of 'great importance' to her. [473] Amongst the pages of *AEI News, Rotor* and *Topic* itself examined in the course of this study it was not possible to find an example of a male apprentice extolling skills other than those that marked him out as 'good' engineer. The old Victorian saw of 'be good sweet maid and let who will be clever' still resonated during this period, and was not always challenged by many inexperienced young women anxious to 'fit in' with what they believed was expected of them.[474]

Spencer offered a detailed account of the 'transitional' period during the 1950s when these ideas held sway. Described by Hennessy as 'social churning', the 'real shift' which 'established normative cultural values and social behaviour' could still be located well into the 1960s and it would be pedantic to argue otherwise.[475] Nonetheless, Spencer's perceptive look at the transition from school to work during the 1950s suggested there were salutary lessons to be learnt from the 'not always coherent expectation of employers' magazines, teaching associations and the state itself' about the direction that the lives of young women should take.[476] Her examination of the tensions that faced young women as they entered the workplace, therefore, took note of 'the multi-faceted, complex and above all, gendered nature of career choice where their desires and aspirations did not always coincide with 'the prevailing notions of a universal 'woman' '.[477] Exploring the ways in which English society during the period was 'clearly marked' along

473 IEE NAEST 92A/8.8 Interview with A Bainbridge. *Topic,* June, 1965, p. 11

474 In the 1920s when my aunt won the prize for being the pupil with the highest marks in the school the headteacher inscribed this aphorism on the flyleaf of the bound volume presented to her, presumably as a warning about where her future priorities should lie.

475 Hennessy, *Having It So Good,* p. 492

476 Spencer*,* p. 3

477 Spencer, p. 3

'gender lines' which affected the employment choices that its pupils felt able to make, she noted that even girls who attended university could be expected to marry within six years of graduation.[478] Like Byrne and Tebbutt, amongst others, she argued that as education was a resource that was distributed unequally, so the educational outcomes of boys and girls were necessarily unequal, with prestigious future careers being the province of men rather than women.[479] To step outside these boundaries was rarely considered, partly due to peer pressure and partly due to societal pressure and, as a result, some 'exceptional' young women who had been given coveted places at university did not always take up these offers, as demonstrated earlier in this chapter. C B, for example, described how she met an older girl 'quite by chance and she talked me out of going to university and persuaded me to go to secretarial college instead'. She used her training as a starting point, had a highly successful career in the City, and did not regret giving up her university place. She recognised that she had fewer options than men within the job market, accepted that 'demarcations existed', but said that, like many of her contemporaries, she was given little idea 'how to advance a career', so took the advice of someone she thought was 'successful at work'.[480] It was hardly surprising, therefore, that most girls opted to work within the traditional framework of restrictive and restricted employment opportunities. In addition, although the role of wife and mother, so central to the iconography of the period, was a projection into the future that few girls contemplated at this stage of their lives, there was an unspoken assumption that this was what eventually would be

478 Spencer, pp. 2, 186
479 Spencer, Chapter 7 (pp 90-92)
480 Oral testimony C B [8 August 2014]; A B [30 September 2010] and T E also reported similar experiences.

expected of them. Even many of the 'exceptional' young women who were trying to make progress in a 'challenging' career such as engineering, seemed to subscribe to this view. Evidence from these women, examined in the following chapter, will testify to this fact.

To train to become an engineer was a highly unusual choice for a pupil at a girls' grammar school. Whilst Metrovicks engaged a sizeable number of grammar school leavers in its ranks the vast majority were young men or were young women who took the opportunity of being trained in administrative or other semi-professional roles. As it has already been amply demonstrated, the apprentice system attracted few young women. The uptake in science and mathematics by girls was an inhibiting factor. At the time the Crowther Report was published, as Elliott made clear, less than half of the cohort of 16 year-olds who attended grammar school managed to achieve five or more O-Level passes.[481] As a consequence those girls who went on to study mathematics, biology, chemistry and physics at A-Level were few in number and although it was not necessary for girls who wanted to study engineering to have gained a pass in biology it was crucial that they gained good marks in the other subjects. In 1958, for example, the Joint Matriculation Board recorded that in all only 3138 candidates passed the mathematics examination and 10,669 passed biology, chemistry, and physics. As Elliott noted, 'the aggregate number of passes for the three latter subjects was 'still less than in English (3862) and barely more than in mathematics', which

481 Elliott, p. 50. He quoted *The Crowther Report*, Vol. II, p. 208 and also used the Joint Matriculation Board Annual Report, 1958 figures of 22,976 candidates passing O-Level mathematics and 25,887 candidates passing biology, chemistry, and physics.

indicated that 'the numbers passing all three sciences must have been very much a minority'.[482] Indeed. Dame Margarett Beckett reported that very few girls at her grammar school cared to sit examinations in these subjects and, in any case, educators like Ollerenshaw doubted the latent ability of most girls to succeed in these areas. Women who gave oral testimony for this thesis also pointed to the ambivalent attitudes of their contemporaries towards girls who studied mathematics, physics and chemistry at their schools. J C having been placed 'in the top science set' struggled to 'keep up the pace' and believed that 'there were only one or two of the really 'geeky types' who were any good and they were far ahead of the rest of us'. D B1 and A T both described their 'problems with maths and physics' and A T said she was 'absolutely amazed' that she managed to pass her School Certificate examination because she was 'rather poor at understanding the basic concepts'. Some of these women enjoyed studying science. J W studied mathematics and the three sciences in the sixth form and went on to do a Masters degree but was 'in a minority' amongst girls at her grammar school where 'most of my classmates went on to take arts subjects at 'A' Level'; P N , who became a physicist, described her 'fascination' with 'all things scientific' and wondered 'where I got it from as no-one in my family was the least bit interested so I plodded on with a great deal of support from my friends and teachers in the science classes at school'.[483] These women commented on the fact that 'the science girls' were often perceived as 'a bit intense' and others suggested that they were 'far brighter than the Arts lot' and were sometimes viewed with 'quite a bit of awe' because they

---

482 Elliott, p. 53. He also used the Joint Matriculation Board Annual Report, 1958, when quoting these figures. There was not a breakdown of numbers of male and female candidates.

483 Oral testimonies J.C; D.B1; A T; J W; P N

were 'studying things I just couldn't handle'.[484] In an attempt to explain this, Payne put forward the idea that mathematics and the sciences were regarded as 'male' knowledge, which occupied 'the higher rungs' of the hierarchy of knowledge, and the academic ethos of the grammar schools determined that such knowledge 'remained the goal to be achieved'.[485] These ideas will be developed further in the last chapter of this thesis. Whilst Elliott reported that the grammar schools educated the brightest 20% of the cohort in 1959, he also pointed out that nearly 40% of these students 'failed to achieve more than three 'O' Levels' so a significant number of girls would not have been able to gain access sixth form studies even if they had wanted to do so.[486] Taking these factors into consideration, it was not difficult to see that many girls were 'frightened off' studying these subjects at GCE Advanced Level and instead turned to the arts side where they felt better able to cope.[487] Attitudes such as these prevented many grammar school girls from taking their studies beyond the basic scientific knowledge acquired at GCE Ordinary Level. In addition, the idea that to become a woman engineer was seen as 'a contradiction in terms' was one that had currency for 'the forgotten generation'.[488] Careers advice did not point them in that direction, nor did most come into contact with female professional engineers who might have influenced them. Although some grammar school girls had had female family members who had been involved in the engineering industry during the Second World War, these relations did not enter the work as graduates and often told 'off-putting' stories

---

484 Oral testimonies P D; R W
485 Payne, p. 18
486 Elliott, p. 50
487 Oral testimony. J C was a case in point. She switched from mathematics and the sciences after a year in the sixth form and went on to study English.
488 Oral testimony. Both P N and J C used this phrase

about conditions that applied for women during this time. P D, for example, related how her mother and aunts were employed in various capacities as shopfloor workers but warned her 'never, ever go and work in a factory', as a 'dire warning' that she had to work hard at grammar school.[489] Even a famous female like Amy Johnson, whose exploits were presented to grammar school girls as an example of an 'exceptional' women, was never described as an 'engineer' despite the considerable skills she possessed in that field and despite her membership of the Women's Engineering Society. Other notable members of the Society, such as Lady Parsons, were unknown even to a wider public. As a consequence, most grammar school girls displayed little inclination to step outside 'traditional' career paths such as teaching or perhaps medicine, which was regarded as a profession that was somewhat more accepting of women amongst its ranks. These factors played an important part in the difficulties that Metrovicks faced in recruiting 'exceptional' young women with suitable qualifications to the professional apprenticeship courses. As it was pointed out in the last chapter, it was not until Professor Willis Jackson took over as Director of Education and Research at the company in 1953 that this appeared to be a pressing issue. Up to that time, a small number of young women had put themselves forward for membership of the College and Schools section of the Apprentice Association and had been accepted for training. In the post-war period, however, Isabel Hardwich and other doyennes of the Women's Engineering Society made it their mission to educate and to recruit young girls into the industry as professional engineers. The ambitions of this distinct group of 'exceptional' young women who went on to take up

489 Oral testimony. P D

apprenticeships with Metrovicks will be examined in the final chapter of this thesis.

CHAPTER 4

'Exceptional' women: Metrovicks' female College and Schools Apprentices, their technical education and training and their place in a male dominated engineering industry.

The last chapter of this thesis continues to use Metrovicks as a case study in order to consider the position of young women who had chosen to undertake training as engineers. They entered a 'gendered' world where there were few professional women with whom to identify. In addition, concerns about their 'appropriate' place in a male dominated industry highlighted other thorny issues that were difficult to resolve. Women engineers themselves often expressed ambivalence about their ability to 'fit in' and find their place in such an environment.

The first part of this chapter gives some historical context to the issues under discussion by examining the work of some important pioneering women in the field in the nineteenth and early twentieth centuries. The intention is to show how they were viewed by audiences who were unused to seeing females engaged in science and engineering, and to examine their legacy in relation to the women who followed in their footsteps. Attention will also be paid to the trailblazers at Metrovicks who paved the way for women to access technical and vocational education at the firm. The difficulties that young women faced in gaining acceptance as professional engineers in these early years will be reviewed and attention will be paid to the establishment of the Women's Engineering Society and

the role that its founder members played in this process.

The second part of the chapter examines the College and Schools Apprenticeship scheme set up by Fleming at Metrovicks and looks at the way in which both the 'exceptional' graduate College Apprentices and the Schools Apprentices, or 'Sandwich Girls', sought to come to terms with the fact that their choice of career ran counter to societal expectations. Archival evidence and evidence from women who were apprentices during the 'long 1950s' will be used in order to examine the extent to which the 'cutting edge' technical and vocational education and training provided by the firm offered equal benefits and opportunities to both female apprentices and young women engineers and their male counterparts.

The debate will also focus on the ways in which the Women's Engineering Society supported its fledgling members as they tried to secure a place for themselves in the industry. A number of women engineers and scientists, including Isabel Hardwich at Metrovicks, were also instrumental in encouraging an interest in engineering and her work in this field is central to the discussion. Young women faced many pressures and there were many inhibiting factors that made this difficult for them to find a place within the industry. In addition to archival material, oral testimonies have provided valuable insights into the way in which these factors affected young women.

The chapter moves on to examine the ways in which female skills and competencies were viewed by a profession that was dominated by men. The

extent to which the skills that they brought to their job were adequately recognised will be examined. Some attention will also be paid to gender inequality where tensions emerged that were difficult to resolve. An examination of the work of a number of authorities on the subject will take place in order to add a theoretical base to this investigation.

Few young women entered the profession, and many who had taken a career break found it hard to return to the work for which they had been trained. Despite the work carried out by individuals such as Hardwich and organisations such as the Women's Engineering Society it was difficult to find a way to boost the number of female apprentices and young wome engineers. The last part of the chapter looks at the attempts made during this period to rectify this situation and the responses of Metrovicks, the Women's Engineering Society, government and other agencies will be scrutinised.

The pioneers, the early history of The Women's Engineering Society and Metrovicks' own trailblazers.

In 1811 Sarah Guppy patented a method of making the piling of bridges safe. Her name and her work remain hidden from history. Indeed Hertha Marks Ayrton (1854-1923), the first woman to be elected to the IEE in 1899, still commands little attention despite her formidable skills and her distinguished career in engineering. Marks came from a poor immigrant background but managed to pass the Cambridge University Examination for Women in 1874 with honours in English and mathematics. As a protegee of Barbara Bodichon, one of the founders of Girton

College, she entered the university in 1876 and completed the Cambridge Tripos in 1881. Three years later she began her studies at Finsbury Technical College under the aegis of the professor of physics and electrical engineering, William Edward Ayrton. After their marriage in 1885, and the birth of her daughter, ill-health and her domestic commitments forced her to abandon her research work but a legacy left to her by Bodichon meant that she could afford to hire a housekeeper and was then able to resume work on her husband's ongoing experiments on the electric arc. Her award of a prize by the IEE for her own work on the hissing arc sealed her reputation and she went on to concentrate on research in hydrodynamics. Although the Royal Society awarded her the Hughes Medal in 1906 it refused to admit her as a fellow on the grounds that, as a married woman, she did not qualify for election. Like her friend Marie Curie she was often accused of riding on her husband's scientific coat tails, and once she had to defend Curie by stating that 'an error that ascribes to a man what was actually the work of a woman has more lives than a cat'.[490] In 1915 she invented the Ayrton fan to dispel poisonous gases from the trenches and developed this for industrial use after the war, and she continued her work on air vortices, on searchlight carbons and a number of other projects. As Malley pointed out, however, 'her work was firmly rooted in the engineering tradition' and she was not 'guided by theoretical physical models' and, in any case, her 'concrete approach and analytical style' was

490 M Malley, 'Hertha Marks Ayrton (1854-1923)',in *Women in Chemistry and Physics,* (eds.) L S Grinstein, R K Rose & M H Rafailovich, (Westport, CT: Greenwood Press, 1993). Available on line at 'Contributions of Women in Physics, UCLA. http://www.cwp.library.ucla.edu [13 June 2015]; J Tattersall & S McMurran, 'Hertha Ayrton: A Persistent Experimenter', *Journal of Women's History,* 7:2 (Summer 1995), pp. 86-112. Ayrton was an active member of the suffragette movement and made large financial contributions to the WSPU and served as vice-president of the National Union of Women's Suffrage Societies. She was also a founder member of the International Federation of University Women and the National Union of Scientific Workers

'appropriate for an engineer of her time'.[491]

The idea that women might involve themselves in scientific and technological work only because of their ability to 'ride on the coat tails' of a man was not new. Ada Lovelace (1815-1856) had been schooled in mathematics by her mother from an early age but marriage, motherhood and domestic duties had interrupted her studies.[492] Her chance to collaborate with Charles Babbage on the development of his Analytical Engine led her to produce 'Notes' containing an algorithm designed to be carried out by the machine, and this was considered to be the first computer programme. Although Babbage himself was supportive of her, describing her as the 'Enchantress of Number', subsequently her contributions became the subject of much dispute. Collier, for example, suggested that 'it is no exaggeration to say that she [had] the most amazing delusions about her own talents, and a rather shallow understanding of […] the Analytical Machine, a view with which Swade agreed.[493] Controversy has surrounded her work, and as Charman-Anderson suggested 'there are still people who seek to discredit her achievement'. Speaking in 2013, she added that 'it is something that many women working in technology are only too familiar with'.[494]

Ayrton, Curie and Lovelace all had to contend with the demands of marriage and

---

491 Malley, 'Hertha Ayrton'

492 Lovelace was the only legitimate child of Lord Byron, but was abandoned by him. She had a turbulent upbringing, alleviated by becoming absorbed in the study of science and mathematics

493 B Collier, *The Little Engines That Could've: The Calculating Machines of Charles Babbage,* (London: Garland, 1990), p. 4; D. Swade, *The Difference Engine: Charles Babbage And The Quest To Build The First Computer,* (London: Viking, 2001)

494 S Charman-Anderson interviewed for an article by B Morais, 'Ada Lovelace, the first tech visionary', 15 October, 2013, www.newyorker.com [12 December 2014]

domestic responsibilities which kept them from their work for long periods of time and there were occasions when results of their research were only grudgingly received by the scientific community, a male preserve. Goff offered one explanation for this state of affairs, and suggested that women working in science 'were often married to notable men […] so it was unclear whether [the women] became 'visible' because of their husband's visibility because [the men] somehow facilitated their wives' careers or because women campaigned for recognition'.[495] Despite their achievements, others also struggled to become 'visible' in the first years of the twentieth-century. These included Alice Perry (1885-1969), who gained a First Class Honours degree in civil engineering from Queen's College, Galway in 1906, and was the first woman graduate in engineering in the British Isles, Victoria Drummond (1894-1978) who was the first female marine engineer to become a member of the Institution of Marine Engineers and Dorothy Donaldson Buchanan (1899-1985) who was the first female member of the Institution of Civil Engineers. The outbreak of war in 1914 that drew many women into factory work did not bring opportunities to trained engineers either and, as Goff suggested, women had to campaign for recognition. The Women's Engineering Society (WES) set out to do this. It was founded on 29 June 1919 by an influential committee drawn from the National Council of Women, a body created during the First World War with the aim of getting women into work so that men could be released into the armed forces. Investigating the position of women engineers drafted into the factories during this period Birkett found that although many were well received by their employers they were regarded as 'more like technicians or skilled artisans'

495 A C Goff, 'Women Can Be Engineers' in (ed.) M E Layne, *Women in Engineering: Pioneers and Trailblazers,* (Reston, Va.: ASCE Press, 2009)

and as a result made little progress and had few career prospects.[496] At the end of the conflict pressure was being applied to force women to leave the workplace. In the face of opposition from government, industry and the unions, this was contested by a coterie of women led by Lady Katharine Parsons, her daughter Rachel, Margaret Partridge, Verena Holmes and Lady Margaret Moir.

Katharine Parsons (1859-1933), who was married to Sir Charles Parsons the inventor of the steam turbine, possessed considerable scientific and engineering skills herself and when appointed a member of the North East Coast Institution of Engineers and Shipbuilders became the first woman to be elected as honorary member of any British engineering society. Nevertheless she was seen only as a respected 'amateur' and the insinuation that her career was 'facilitated' by her husband, as in the case of Ayrton, was often difficult to dismiss. Their daughter, however, attended Newnham College and was one of the first women to study Mechanical Sciences at Cambridge, qualifying in 1911. She became a director of the Parsons Works, joined the Ministry of Munitions in order to oversee the recruitment and training of women during the war and by 1920 had set up her own all-women engineering company, Atalanta.[497] As a leading member of the National Council of Women, she was well-placed to apply her skills in committee to the role of first President of the WES.[498] Other notable founder members like Dorothee Pullinger, who introduced a female apprenticeship scheme into the Vickers

496 D Birkett 'Women Engineers in the First World War', E&T Engineering and Technology magazine, 9:6 (2014) http://eandt,theiet.org/magazine/2014/06/wartime-women-at-work.cfm

497 Her early promise was blighted by poor relations with her family, financial difficulties and by her increasingly haphazard lifestyle. She was bludgeoned to death at her Newmarket racing stable in 1956.

498 Caroline Haslett, Verena Holmes, Margaret Partridge, Margaret Moir and Katharine Parsons all served as President in the following years.

shipyards during the First World War, Verena Holmes who also set up an engineering firm that only employed women, and Claudia Parsons who made an epic motoring trip around the world and became a member of the Factory Inspectorate, had been amongst the first women to gain engineering degrees from universities and technical colleges. They, too, remain largely hidden from history perhaps because 'although they had broken the ice of convention that held women down to certain jobs but denied them others' they were too 'self-deprecating' to wish their achievements to be the centre of attention, as the author of Claudia Parsons' obituary suggested. [499] Baker has also reviewed this situation in 'Early Women Engineering Graduates from Scottish Universities', and some of the first members of the WES were to be found amongst their number. Her research found that, whilst female medical and science students from this period were 'generally better documented', 'none of the universities' published histories mention women in engineering'.[500] Her paper, therefore, demonstrated the fact that it was not easy to retrieve information about the few women who worked in 'very male-dominated', non-traditional working environments and the ability to make their history 'visible' was attended by difficulties such as these.

When the Society was first set up its main aim was 'to promote the study and practice of engineering among women' which in practical terms meant providing access to a network of fellow engineers with the ability to give advice on technical matters. In addition it was felt necessary to alert members about job opportunities,

499 Obituary. Claudia Parsons 1900-1998 www.independent.co.uk/arts.../obituary-claudia-parsons-1167736html [11 August 2015]. She was not related to the Parsons family.

500 N Baker, pp 21-23. She surveyed records from the 'older' Universities of Edinburgh, Glasgow, Strathclyde, Dundee and Aberdeen

to monitor and address discrimination and to correct misconceptions about the nature of the work that was entailed in being a practising engineer.[501] As a result of their efforts, the WES anticipated that the image of the woman engineer would move from that of a semi-skilled tradeswoman to that of a professional engineer. To this end, Caroline Haslett (1895-1957) was appointed as Secretary, and although the working relationship between her and Lady Parsons broke down, in the 1920s the Society made rapid progress.[502] The WES journal, *The Woman Engineer,* was first published in 1919, six branches had been set up in London, Manchester and elsewhere by 1920, and the first Annual Conference of the WES took place in Birmingham in 1923. Most importantly the WES offered a space outside the usual male cabals in which women could meet and exchange ideas and this was one of the main priorities of the organisation. The idea that exclusion from male social networks in science contributed to the domination of men's interests and contributed to poorer performances from women was investigated by Kelly as well as by Saraga and Griffiths, and matters were no different in the engineering industry. [503] As a result WES members were encouraged to take part in a wide range of projects that aimed at finding a way of tackling this persistent problem. The recruitment, education and mentoring of younger colleagues, therefore, took on a special significance to a Society that had already positioned itself as the only body able to represent women in the industry. After the Second World War it continued to ensure that its membership worked to 'open up new

501 IEE NAEST 92A/3.4.2 Isabel Hardwich to Emlyn Stephens, 15 January 1953.

502 Haslett became president of the WES in 1941 and was the founder and first director of the Electrical Association for Women

503 A Kelly, 'Where have all the women gone?', *Physics Bulletin,* 30 (1979), 108; E Saraga & D Griffiths, 'Would more women change science?', *Physics Bulletin,* 31 (1980), 166-167

avenues of training' and to study 'the condition and value of women's work'.[504] During the 1950s and 1960s a number of activists, like Isabel Hardwich at Metrovicks, were instrumental in furthering this process and the significance of the contribution that was made will be assessed at a later point in this chapter.

The long tradition at Metrovicks of accepting young women engineers onto its programme of technical and vocational education and training was commented upon in 1963 by V J Mills who said that 'the intake of girls as students is now history', albeit a 'hidden history'.[505] She was referring to the fact that, forty years earlier, Pearl Swann had become the first woman to be designated as a College Apprentice and admitted to the training scheme organised by Fleming at Trafford Park. Swann, however, soon disappeared from the record. Whilst it might have been anticipated that Metrovicks would have wanted to publicise her presence amongst their graduate trainees, if only to boost its credentials as an organisation that offered parity of esteem to every apprentice, this did not seem to be the case. It has not been possible to trace information about her apart from a brief entry in the 1957 Apprentice Register that recorded her death, but gave no date. Until her appointment in 1915 the company had not opened up to female professional engineers, but Gertrude Entwisle (1892-1961), joined the Motor Department in that year. She was the only woman on the technical staff at Metrovicks, and although she later went on to become a Plant engineer she spent her working life with the company. Mid-way through her Physics degree at Manchester University the

504 The Women's Engineering Society, Thirty-First Annual Report, *The Woman Engineer,* VI:2 (Winter 1950-51), pp. 391-397.

505 V J Mills, 'A Practical Scheme of Training for the Female Engineer', *The Woman Engineer,* 9:11 (Winter 1963), pp. 10-12.

engineering faculty opened up classes to women and she took up the opportunity which later enabled her to gain entry into the profession at a time when she reported that 'women rarely worked outside a home and were looked upon as freaks if they [did so]'.[506] Notwithstanding the fact she was a graduate, she was not enrolled as an official College Apprentice and as a consequence was trained in piecemeal fashion. She was, nonetheless, highly regarded. In contrast to Swan, much was made of Entwisle's undoubted talents by the company, and she was given every opportunity to advance her career. Although Bix suggested that Westinghouse gave no encouragement to women engineers, this was hardly the case with Entwisle.[507] When she addressed a Conference in Portsmouth in 1955 she was adamant that it was only because the Americans at British Westinghouse, especially J S Peck, the Chief Engineer, were 'brave enough to take me on' that women trainees found this foothold within the Company. She did suggest, however, that he employed her because the outbreak of war had led to a shortage of male engineers, 'hence Mr. Peck's decision to try a girl'.[508] Indeed, Kata suggested that American Westinghouse was supportive of women and in researching the career of Emma Barth, who worked in the Turbine-Generator department, demonstrated the 'open-door' policy at the firm.[509] Dorothy Smith also went to work in the Motor Department and Dummelow suggested that her career 'closely paralleled' that of Entwisle as 'a pioneer for women's place in the

506 IG L Entwisle, p.1; Entwisle's views were confirmed by Hardwich, 'Women Professional Engineers in British AEI', p. 2.

507 A S Bix, 'From “Engineeresses” to “Girl Engineers” to “Good Engineers”: A History of Women's U.S. Engineering Education', *NWSA Journal,* 16:1 (Spring 2004), pp-27-49, p. 3

508 G L Entwisle, p. 1

509 L Kata, 'Spotlight on Emma Barth A Typical Woman Engineer' in (ed.) M E Layne, *Women in Engineering,* p. 211

engineering industry'.[510] Evelyn Roxburgh became a College Apprentice during this early period and on completion of her training in 1926 went to work in the Switchgear Department and afterwards moved to BTH. Her career was somewhat chequered and did not show the stability of that experienced by Entwisle and Smith. The Apprentice Register noted several changes in circumstance; after a period as an H M Factory Inspector she went to work as the chief radiographer at Surbiton General Hospital. The reasons for these moves were unclear but may have been symptomatic of the way in which some female engineers found it difficult to secure a place for themselves within the industry, and this will be a factor that will be addressed in this chapter. On the other hand, Anne Shaw, sometime chief supervisor of women at Trafford Park who then went to work with Lillian and Frank Gilbreth (1878-1972), the renowned American pioneers in the field of motion study, was one of the few women who were able to establish a career on the same footing as men within the company. On her return from the United States she set up a motion study department at Metrovicks in 1930 which was copied by many other firms in the late 1930s and 1940s. She became an expert in the field, established a renowned consultancy group and was seconded to a number of government agencies during the war, including being sent by Stafford Cripps to the Ministry of Aircraft Production in 1943. Unlike most women engineers she was 'visible' both within the industry and to a wider public, possibly because the area in which she specialised did not conform to traditional expectations of what was entailed in being an engineer. As a result her work was seen as more 'acceptable' for a woman to undertake and it was possible to portray

510 Dummelow, p. 94; MOSI 1996 2338, Box 1, *AEI News,* 15:7 (July 1945), p.105

her working in an environment where she did not appear to be challenging masculine power and authority. During this period, Madeline Nott, Morag Macdonald and Charlotte Long worked as professional engineers in the Motor, Transformer and Mechanical departments respectively. It could be argued that these early female 'trailblazers' owed something to the legacy that Metrovicks inherited from its American antecedents.[511] The influence of the innovatory outlook of the American parent company had had a strong bearing on the provision of vocational education and training in the early years, even though there was no evidence to suggest that the elite training opportunities that were provided for the 'Holy Forty' were extended to any women. Progress was slow and even by the mid-twentieth century, as Dummelow reported, only 'a dozen women have had a regular apprenticeship training'.[512]

Graduate College Apprentices and Schools Apprentice 'Sandwich Girls'

As far as College and Schools Apprentice training was concerned, there had always been a degree of latitude as to how 'engineering' was defined by the firm. It was clear that Trade Apprentices on the shopfloor studied 'engineering', as did most male College and Schools Apprentices who took degrees in electrical or mechanical engineering. This was not usually the case with young women.[513] Gertrude Entwisle suggested that 'when I speak of engineers, I mean those on

511 M R Weatherburn *'Scientific Management at Work; the Bedaux System, Management Consulting, and Worker Efficiency in British Industry, 1914-48'* , (Unpublished PhD thesis, Imperial College, 2014).

512 Dummelow, p. 94. It was unclear how he collated these numbers, or what he meant by 'regular' apprenticeship training.

513 There were only five women who had graduated in engineering who were listed in the Apprentice Register, although these figures may not be accurate as some entries did not include the degree course that had been undertaken. No other figures have been found in archival material

technical work' and pointed out that 'in this country we use the same term to refer to technicians or to manual workers' whereas 'on the continent, the two have distinctive designations'.[514] When he became Director of Research and Engineering, Willis Jackson clarified the matter still further by stating that 'those who attain qualifications in the intimately related subjects of mathematics, physics, chemistry and metallurgy' should be included in 'the broad scientific and technological field of engineering'.[515] In making this statement he was addressing one of the main issues that concerned the provision of apprentice training for young women and was acknowledging the fact that one of the many inhibiting factors that determined entry into the industry was that so few of them chose to study either electrical or mechanical engineering. As a result, Jackson believed that this might have discouraged candidates with potential from applying for apprenticeships and he was seeking to 'open the door' to them. That being the case, only a small number of women became College Apprentices. According to the official Apprentice Register, in the period 1902-1957, only 112 placements in total were offered to females. Of these, only 16 were categorised as College and Schools Apprentices (6 engineers and 10 scientists). 35 trainees were designated as Special Apprentices and remained with the firm for varying lengths of time. This group was comprised of 2 engineers, 3 scientists, 15 personnel management trainees and 15 apprentices who were engaged in a variety of areas from canteen management to laboratory technician. Archival material, however, suggested that a total of 230 women had taken up 'full-time industrial training and experience' with the firm since 1923, but it was unclear how these figures were computed.

514 G L Entwisle, 'Engineering As A Career For Girls'
515 W Jackson, 'Opportunities for Girls in Electrical Engineering' p. 15

Although it was suggested in this source that some information had been compiled from the Apprentice Register, the information also drew on other unspecified data that appeared to access figures up to 1961 which went some way towards explained numerical discrepancies [516] By far the largest number of female apprentices listed in the Apprentice Register were classified as Vacation Apprentices who, as the name suggested, spent little time at Metrovicks but wished to widen their experience within industry. Some were university students (7), others were engineers (6) or scientists (5) but most were personnel management trainees (14).[517] In contrast to the paucity in numbers of female apprentices, there had never been a shortage of male apprentices entering the Company as College and Schools Apprentices. In 1951 alone, a total of 251 young men was engaged in various categories of professional training by the firm. In addition to 40 Schools Apprentices and 10 Special Apprentices, 87 were Special Trainees, 106 were College Apprentices and 8 more were designated as Probationary College Apprentices who went on to enter university after training for a year at Trafford Park. It was only in 1958, when the RCAT, Salford, first introduced sandwich courses in chemistry and physics, that an increase in the numbers of female apprentices began to take place. Documentation compiled by Isabel Hardwich in 1961 suggested that there were twelve girls on sandwich courses across the AEI Group of companies, with five of them undertaking training

516 IEE NAEST 92A/2.5 Associated Electrical Industries (Manchester) Limited. Overall Record of the Company's Experience of Full-Time Training Schemes For Women, 15 September 1961

517 These figures come from the 4th and final edition of the Apprentice Register, dated 1957. Entries did not always include work-related details. As a result, it was not possible to categorise a small number of women

at Metrovicks that year.[518] Metrovicks worked closely with both UMIST and RCAT, and Willis Jackson was keen to see this course prosper and to encourage young women to become Schools Apprentices. He was also keen to engage more graduate trainees as College Apprentices but bemoaned the fact that 'so few girls' with the 'right aptitude' were available for recruitment. The stress that he placed on the fact that although initially female trainees 'might have to wear overalls and get dirty' during training, […] once their careers were established they would spend most of their time 'thinking, planning, writing and talking' was indicative of the way in which he seemed to believe that women were put off by an old-fashioned image of what engineering entailed and had to be reassured that the reality of working within the industry was very different.[519]

With this in mind, Metrovicks was as active in canvassing sixth-formers bound for university and recent female graduates as it was in seeking out their male counterparts. Oxford and Cambridge were amongst a number of universities that proved to be fertile recruiting grounds, and a small number of high calibre female candidates eager to become College Apprentices came from Girton and from Newnham Colleges. Nonetheless, the overall numbers of graduates who wished to take up apprenticeships were low. [520] The reputation of the firm for being, at one and the same time, both a top-class research institution and a renowned provider of technical and vocational education, however, attracted a number of apprentices

518 I H Hardwich, 'Women Professional Engineers in British AEI'. One of these girls had been a pupil at Adelphi House Convent Grammar School. Hardwich did not list Dame Margaret Beckett who was a Schools Apprentice at this time.

519 W Jackson, p. 17.

520 The Apprentice Register did not always list the universities attended by this women and so it was difficult to gauge with any accuracy whether particular colleges or universities provided more candidates than others for training at Metrovicks.

from disciplines other than the sciences and engineering. These young women were keen to associate themselves, however vicariously, with a level of prestige that most other firms found hard to match, especially in the area of scientific research. It was the case, therefore, that a large number of the young women classed by the company as College Apprentices had neither the requisite qualifications nor the intention of becoming professional engineers or scientists. Instead they went to Trafford Park to gain work experience in an industrial setting and to benefit from the sought-after status of being granted membership of the Apprentice Association at Metrovicks. Many were arts or social sciences graduates who intended to further their careers in diverse areas such as pharmacy, teaching, lecturing, or as employment or welfare officers and the time they spent at the firm varied from a summer vacation session to a full year of training. Whilst this boosted the number of female apprentices as a whole, the reality was that women *engineers,* however broadly defined*,* were still under-represented within this cohort as both Dummelow and the Apprentice Register figures indicated. The practice of designating all women as apprentices, whatever their discipline, was a way of enhancing overall numbers. This method of enumeration, however, only served to underscore the fact still further the fact that few young female trainees seemed eager to become fully-fledged engineers and the reasons why girls were reluctant to do so will be examined later in this chapter.

It would be hard to fault Metrovicks for the quality and level of technical and vocational education and training it offered to female College Apprentices. Archival material stressed that there was no difference between them and the male

apprentices as far as the selection process and the training offered at this early stage of their respective careers.[521] The programme of study for the two-year course was carefully organised and was divided between periods of postgraduate instruction in the purpose-built Apprentice Training School, described by Fleming as 'the hub of the universe', and time spent in the Drawing Office, Manufacturing, Testing, and Assembly Departments in order to 'get a wide acquaintance with the company's products and methods of production'.[522] In his organisation of the course, however, Fleming placed particular emphasis on training in 'the organisation and handling of men'.[523] As this played such a prominent part in the curriculum it meant that young women who wished to become professional engineers were put at a distinct disadvantage; the ramifications of being put in charge of men was well-understood by senior management who ensured that such opportunities were not offered to women either during their training or once their training was over. Indeed, as Willis Jackson pointed out, 'parts of their training' would 'appropriately differ in character' to take account for this fact.[524] As a consequence progression by women to senior positions within the company was limited from the outset, even though the rest of the curriculum had been designed to enable them to build on their own individual aptitudes and skills so that they might become experts in the field of their own choosing.[525] There was, therefore,

---

521 I H Hardwich, 'Women Professional Engineers in British AEI', p. 2

522 IEE NAEST 070/118 Box 3 A P M Fleming, British Association for Commercial and Industrial Education (BACIE), Birmingham, 4 December 1953, p. 8.

523 IEE NAEST 070/18 Box 2 A P M Fleming, 'Industrial Research & The Training of Industrial Personnel in Great Britain'. Address to the Koninklyk van Ingenieurs, 3 September 1946, p. 11

524 Jackson, 'Opportunities for Girls', p. 17

525 Metrovick funded a number of scholarships for College Apprentices to work in prestigious institutions both at home and abroad so that students could refine their skills and concentrate on aspects of engineering that most interested them.

a gap between the promise of a high-flying career that most students must have presumed was theirs for the taking, and the reality of struggling to gain recognition on a par with men within a large organisation like Metrovicks.

In 1937, as one of few women who *did* become an engineer, Joyce Sewill faced this difficulty. She found that gaining acceptance was hard when long hours were spent both studying and working, and later found that 'sheer stamina' was needed to cope with the pressure of operating under war-time conditions.[526] As only the second female engineering apprentice to be engaged by the firm she was mentored by K R Evans, the head of the College Apprentice scheme, by 'the renowned Sir Arthur Fleming' ,as well as by luminaries of the Research Department such as Max Kaufmann who supported her in her postgraduate studies and Cecil Dennett who 'never refused [...] assistance or backing'.[527] Indeed, she said that Fleming 'strongly supported' her when she sought and gained membership of the IEE. It would appear from her evidence that Sewill suffered no discrimination both during her training and in her early days working at the company. Whilst Entwisle's career was an unqualified success, spending her working life at Metrovicks designing electrical machines and achieving the distinction of becoming the first woman Associate Member of the Institution of Electrical Engineers (AMIEE), Sewill, however, began to experience set-backs and, ultimately, made less progress. Feeling that her 'qualifications and

526 MOSI A1996.1735/MS0531/208 J Sewill, pp. 215-217; 'She Designed Power Station Plant', *AEI News,* August, 1954, pp. 4-5

527 Sewill, p. 215-216. Sewill was uncertain as to whether she was the first or the second woman engineer to be granted College Apprentice status and clearly had no knowledge of Pearl Swann.

membership of the IEE did not alter my status in any way', she left the company in 1946 and went to work for ICI Manchester where she was the 'first female engineer that they had ever employed'.[528] The time she spent at ICI again was marred by the fact that , despite her credentials, 'in the eyes of the company I did not exist as an electrical engineer'. Moving on, she joined the Scientific Civil Service, but the expertise she gained as 'a combination of electronics engineer, physicist and chemist' left her with the feeling that she was undervalued and that her work 'was not given 'sufficient credit'.[529] From Sewill's point of view it was not just in the inter-war period where difficulties were put in the way of most women who wanted to become professional engineers. Her career, which stretched until 1968, spoke of numerous incidents of 'hidden' discrimination ranging from recognising that 'it was always the male who was sent on interesting visits abroad or even put forward for promotion' to knowing that 'the most humdrum routine jobs were always given to any female staff, regardless of experience'.[530]

Her case was not an isolated one. WES1 who was interviewed for this study also spoke of 'hidden discrimination' and of the way in which she felt that it had affected her career. As an apprentice with BTH in the early 1950s, she recalled being 'up against it a bit' when 'the wiring department refused to have me just because I was a woman', and the test department was 'not very pleased to have me either', attitudes which she believed helped to put the whole of her training in jeopardy. After much effort trying to negotiate a place for herself she did 'eventually manage'

528 Sewill, p. 216. Unlike Entwisle, she was only a Corporate Member of IEE.
529 Sewill, p. 217
530 Sewill, p. 217

to find a position within the firm but felt that this was unlikely to further her career. 'Ambitious to move ahead', she went to work for Lucas in 1958 and here she experienced remarkably similar kinds of setbacks to those described by Sewill more than a decade before. Like the older woman, WES1 described how she felt that she was treated as ' a dogsbody', being 'sidelined to take on translation work in the legal department', offered poor pay and few opportunities and was prevented from being able to use her 'expertise as a qualified engineer'. She was unable to say 'with any real certainty' that this was a case of discrimination although she felt that there were 'subtle' ways in which she was made to feel that she was 'not quite cut out for certain jobs' and that it was 'really hard to challenge things that were not put in an open way'. By the late 1960s she considered that hers was 'a very thin career' despite her Law Society qualifications and her status as a MIEE (Member of the Institution of Electrical Engineers) and felt overwhelmed by the sheer hard work involved in maintaining her position. Like Sewill, she took early retirement and like her she felt that she would not be missed saying that 'they [Lucas]were quite pleased' when she left. [531] Both women seemed to have had to have acquired skills in a number of areas aside from engineering and they worked extremely hard to gain these qualifications. In addition, WES1 had to contend with a particularly difficult set of domestic circumstances. Her interview reflected the stress that was placed upon her to do both these jobs successfully, a situation that affected other women trying to make their way in the industry and one that Kelan discussed in relation to the fact that 'the carer role was gendered feminine and the

531 Oral testimony WES1 [27 November 2014] .

assumption was that women have to juggle paid and care work'.[532]

WES1 had trained as an illuminating engineer but felt that this was not classed as a 'full engineering apprenticeship' by BTH. Having been unable to gain a place at university she recognised that she was not among 'those girls who really stood out, the one or two who won state scholarships', the 'exceptional' young women who featured so heavily in the writings of Ollerenshaw and Newsom. Like her counterparts at Metrovicks, WES1 was destined to become a Schools rather than a College Apprentice, though they were also few in number. Diana Goth was one of this small band of young women who were accepted by the company to became a Schools Apprentice. She found that this route 'exactly suited her needs' as Metrovicks enabled her to attend RCAT, Salford and also paid her fees whilst she was a student. As a 'Sandwich Girl' she reported to *The Woman Engineer* that she had been given 'every opportunity and lots of encouragement' to complete her apprenticeship and to gain an HND.[533] Although a typical example of a Schools Apprentice, spending half the time as a full-time student and half the time training in the works, her career outcome was rather different to that of her fellow male apprentices; her destination in Plant Applications Engineering was mainly office-based and involved little contact with the shopfloor. Female training, as Jackson said, often needed to be 'appropriately different', but it also seemed to be that their career paths were 'appropriately different'.[534] Ever since Entwisle entered the firm, objections had been raised about the possibility of professional women engineers

532 Kelan, pp 100-101
533 'Sandwich Girl – Diana Goth', *The Woman Engineer,* 8:15, (Winter 1959), p. 14.
534 Jackson, p. 15

working on the shopfloor. So important had it been to exclude them that when it was imperative that she visited this male preserve the board of management convened a special meeting to decide that the visits could go ahead. Her appearance caused such a commotion that 'everywhere I went the men marked the fact by hammering with anything handy' to warn each other of her approach'.[535] Jackson's idea that 'appropriately different' training was necessary also extended to 'appropriately different' expectations of how the work undertaken by women should be configured. Objections were raised about them being given jobs on the shopfloor in case this challenged male hegemony, as Willis pointed out, and it was considered that good labour relations were maintained by their absence from these areas.[536] Willis's examination of the 'machismo' of the shopfloor demonstrated the way in which this hampered women's progress. He pointed out, however, that the 'profound air of competence' of these skilled operatives also caused difficulties for male professional engineers when the employment of a 'theoretical approach to problem-solving' clashed with the practical techniques employed in this 'privileged site' making it difficult for any professional to have 'control over men'.[537] In such circumstances, it would have been particularly hard for women engineers to assert themselves, making the shopfloor an even more 'hostile' environment for them than for their male counterparts.

Dame Margaret Beckett experienced this kind of partiality at first hand. In 1961,

---

535 Entwisle, p. 2
536 P Willis, 'Shop floor culture, masculinity and the wage form' in *Feminism and Masculinities,* (ed.) P F Murphy, (Oxford: OUP, 2004), p. 109
537 Willis, p. 113

she became a Schools Apprentice at Metrovicks; her interest in becoming a metallurgist fitted in with Jackson's broad definition of 'engineering' and so she was able to apply for entry. Along with one other girl, 'who later dropped out', she began a five-year sandwich course split between UMIST and Trafford Park. During her time in the works she said that every Apprentice followed 'the same basic engineering training in welding, machining, and technical drawing' but at one stage 'the boys were put in the foundry as cheap labour' whilst she was 'sent to Heat Treatment re-organising the ordering system'. Dame Margaret 'raised it with the apprentice supervisor who missed the point and said 'Oh I see, you think you should be in the foundry' when Dame Margaret really wanted to draw attention to the fact that 'boys were not learning in the foundry but were just labouring'. She was unaware of the legacy of Sir Arthur Fleming who had thought it necessary for professional engineers to understand the workings of all parts of the factory and being 'put in the foundry' was, therefore, part of the learning process. This part of the learning process, however, did not extend to female apprentices and the foundry was one of the prohibited locations within the factory where it was considered 'inappropriate' for a women to gain work experience and where it was believed that good labour relations could only be maintained by their absence. Entwisle remembered that the foreman at the works said that 'if I went on his test bed he would leave the firm', and the idea of a girl working there was 'revolutionary'. [538]Dame Margaret, however, was 'glad' that she did not have to be trained in the foundry and she also talked about the difficulties that women faced 'when you were crossing the Aisles (Metrovick parlance for the shopfloor) and you

538 Entwisle, p. 2

had to learn to keep your head down'. Her experience showed that entrenched notions of male hegemony were rarely challenged. As Judith Evans suggested, women were often complicit in accepting them and that few would challenge accepted norms, and even Dame Margaret demonstrated the extent to which this was the case.[539] The wider issue relating to 'appropriate' spaces for women within the male-dominated environment of a large industrial concern where, like WES1 and Sewill, they often felt that they were not welcome remained largely unquestioned. As a consequence, few challenges to the status quo took place during the 1950s and 1960s.

As sandwich course training involved spending time in many different parts of the works, Dame Margaret also recognised that there were other areas where women were not welcome and in her interview, again like WES1, she said she was 'always looking for a department where you would fit in – find a niche'. For her, like many other women, this involved 'working on the research side' where she felt she was in a 'supportive' environment and she remained there until her 'one of her mentors' left the company.[540] Although her career as a Schools Apprentice had not been without its problems (failing examinations in her first year - 'no-one told me I *had* to pass!' and, as a consequence, 'having to pay fees in the second') Dame Margaret felt that she had received 'a thorough, liberal education', had had 'a fabulous experience in manufacturing', enjoyed 'the camaraderie' and felt that 'there was a frisson about the place' that owed much to the 'huge community that

539 J Evans, *Feminist Theory Today,* (London: Sage Publications, 1995), pp 2-3

540 He took up a post at the University of Manchester and she then left Metrovicks to go to work there.

was cultivated by Metrovicks'. [541] In summing up her training she concurred with the view expressed by other ex-employees who contributed oral testimonies for this study, especially where aspects of the corporate culture fostered by the company were concerned. Both the men and the women who made these contributions also emphasised that the Metrovick 'community' and 'camaraderie' had been of great importance to them. The way in which males and females experienced 'community' and 'camaraderie', however, were not necessarily the same.

Isabel Hardwich: A WES stalwart at Metrovicks

The investment made by Metrovicks in launching the careers of College and Schools Apprentices has already been discussed. It would be worthwhile briefly re-iterating those aspects of their training that were helpful to men but were not necessarily helpful to women. From the outset trainees were nurtured carefully by the staff in the Education Department. Attention was paid to the acquisition of technical knowledge and expertise but the kind of social fluency and corporate cohension that the company wished to foster amongst its future leaders was also given prominence.[542] Put simply, this meant that trainees were encouraged to adopt an 'officer class' mentality which emphasised the importance of *esprit de corps* to the organisation. Speeches given by high-ranking officials at important events, such as the Annual Dinners of the Apprentice Association, indicated the way that the up-and-coming generation were expected to comport themselves.

---

541 Interview with Dame Margaret Beckett. Although she knew nothing of the aims of Sir Arthur Fleming in relation to the provision of a 'liberal' education, it was interesting to note that she felt that this was what she had been offered.

542 MCL Q621.3 AE2 *AEI News*, 20:1 (January 1950)

Much of the advice they were given, therefore, reflected those aspects of Metrovicks' corporate culture that were embedded in 'old school tie' attitudes towards fraternity and mutual assistance and the adoption of the ethos of the public school. Thus male apprentices were encouraged to think of themselves as leaders, self-confident individuals who had both the ability to make decisions and where necessary to question those made by others. Where 'team spirit' was concerned it manifested itself in the mutual endeavour that was needed to represent the company on the sports field or in business negotiations, for example. This was not necessarily a female experience. The last chapter showed how girls' grammar schools did not want their pupils to be similarly forthright, assertive individuals but, instead, expected them to be compliant, obedient and self-effacing and to be generous to, and supportive of, others. Only rarely, as in the case of Anne Shaw, for example, was it anticipated that they would become leaders of men. The early influence wrought by their grammar school education meant female College Apprentices found difficulty in being able to 'fit in' with masculine notions of 'fellowship' that were perpetuated in male networking circles. As it was within such circles that apprentices were mentored, future career prospects were discussed, career development took place and offers of employment were made, as a result of their inability to 'fit in' they were excluded from this process, making it unlikely that they would be viewed as future executives. In addition, as Kelan stated, certain jobs carried gender assumptions which became clear when the characteristics ascribed to the 'ideal worker' are examined. She further suggested that when women are less likely to fit the ideal this meant that they 'have to fulfil

the parameters of masculinity to do the job' [543] Engineering was undoubtedly the masculine job *par excellence* and this obviously presented female trainees with great difficulties in this respect. Once they were placed within the working environment of the factory or the laboratory, therefore, their subsequent progress was more limited no matter how assiduously they attempted to play a role in these male preserves and however assiduously they attempted to further their career through sheer hard work and dedication. Baker made note of this in her survey of women engineering graduates and pointed out that it was '[…] often a battle to go on to a rewarding career'. [544] Accordingly, it was difficult for female College Apprentices to acquire the appropriate 'masculine' skills to enable them to be seen as functioning successfully and the company was slow to recognise this. The 'invisible barrier' to recognition and promotion was hard to combat.

It was the realisation that this was an issue that needed to be resolved that led Isabel Hardwich, nee Cox, (1919-1987) to respond to the challenge that it presented. Educated at a London County Council School, she did not come from a privileged background but, nevertheless, gained a place at Newnham College where she read for the Natural Sciences Tripos, specialising in Physics. [545] In 1941 she was accepted by Metrovicks as a College Apprentice. On completion of her training, she was employed in the Research Department working on projects such as the first Metrovicks hot-cathode electron microscope, the electron beam

543 Kelan, p. 29
544 N Baker, p. 11
545 Oral testimony WES1. She was told by Hardwich that her mother had been a midwife and that the family circumstances had been 'modest'. IEE NAEST 92A/2.6 *The Woman Engineer,* 7:1 (Spring 1951), p. 5

welder, x-ray crystallographic diffractometer and photometric equipment. Like other members of staff, she also lectured part-time at UMIST and RCAT, Salford and in 1960 was given responsibility for the employment and training of 'technical' women in the Research Department. This may have been a role that she thought suited her but for want of evidence from her archive it was difficult to say. There was a hint, however, that she may have lobbied for the post because her ambition to be taken seriously as a top-flight member of the research team was left unfulfilled. In a world-renowned facility such as that run by Metrovicks, only those who were eminent in their field gained recognition and promotion. Hardwich, however, was not a prolific author and was likely to have been 'side-tracked' into using her energies in a stereotypical female 'nurturing' role.

Encouraging young women to become professional engineers appeared to become her *raison d'etre* and she worked tirelessly to ensure that the uptake in technical education and training increased from the woefully low levels that characterised the post-war period, and that had begun to concern Jackson.[546] She believed that 'women are too bound by social prejudice' and the 'climate is so against the employment of women as professional engineers that in truth girls do not come forward'.[547]She was also exercised by the fact that even those women who were employed by the firm were unlikely to be promoted into the ranks of the Metrovicks' senior management team, or indeed in any of the large companies within the wider engineering industry. Her aim, therefore, was to assist young

546 IEE NAEST 92A/2.6 Hardwich quoted figures of between 0.1% and 2% of the female workforce but was unable to be precise about this.

547 IEE NAEST 92A/2.8 I H Hardwich, 'Women Engineers in Industry', p. 4. Conference held at the University of Warwick 24-26 March 1968

women 'to break through the glass ceiling', and in order to do this she used her position in the Women's Engineering Society to foster their ambitions. Joining the organisation in 1941, Hardwich became one of its most active members and served various terms as chair of the Manchester Branch, national Vice-President, and national President (1961-1962) and such was her reputation that in due course a medal named in her honour was awarded each year to the young woman who had made the greatest contribution in service of the Society.

Her education at Newnham marked her out as one of those 'exceptional' young woman who rarely had been faced with male contention for positions of power and privilege. Observations by those who knew her, as well as papers lodged in her archive, certainly hinted at a self-assured and, at times, 'forceful' individual who often 'tried to direct the way everyone did their job', perhaps because she was exasperated by an inability on the part of colleagues to get to the point. From the perspective of a much younger woman, WES1 saw Hardwich as a 'formidable persona' who made it clear that 'she did not suffer fools gladly'. Nevertheless, she also described her as 'kindly' and who as a person was always supportive of younger women who were keen to prosper in their careers. WES1 spoke of the hospitality offered by the Hardwich's on the occasions when she had been invited to stay with them when she had to travel to Manchester to attend meetings. She thought 'that went beyond the call of duty when they led such busy lives themselves'.[548] A one-time President of the WES, who knew of some of the pressures that came from taking on the role, also spoke of the immense amount

548 Oral testimony WES1

of effort that Hardwich invested in her own time in office and of the the stresses that were entailed 'in doing the job well'. She also remarked that this was a period when the WES was finding it difficult to attract members and suggested that Hardwich did not find it easy to relinquish her duties in case others had a different attitude towards the direction in which she felt the Society should take at this time. Nonethless, she recognised that Hardwich was 'tireless in her efforts on behalf of the WES', and that she was 'a force to be reckoned with'.[549]

Isabel Hardwich presented an example of a woman whose marriage did not conform to societal norms in the 1950s and 1960s. John Hardwich, whom she had married in 1945, had been a Schools Apprentice at Metrovicks and he seemed to be content to 'play second fiddle' to her ambitions, possibly because he was the less qualified partner. Evidence from her archives, from oral testimonies, and from the WES journal suggested that this was the case. She appeared to be the opposite of Ollerenshaw and Newsom's vision of a woman who had been schooled in the domestic arts, was able 'to produce an *Homard a l'Americaine* to perfection' and who was prepared to make 'the personal adjustments to match her husband's career'.[550] Indeed her husband's domestic credentials were confirmed by the production of 'Mr Hardwich's mince pies' at each Annual Members Evening of the Manchester Branch of the WES and WES1 recalled that 'he was usually in the kitchen […] the housewife who kept everything running smoothly so that she could get on with whatever she was doing'.[551] John Hardwich's

549 Oral testimony WES2 [30 October 2014]
550 Ollerenshaw, p. 124; Newsom, pp.82-83
551 Oral testimony WES1; WES2;.

unwavering support of her was clearly of great significance and an article in *The Woman Engineer* reported that 'it is only because of his generous sharing of absolutely all the burdens as well as the pleasures involved in running a home that Mrs. Hardwich has been able to continue at Metropolitan-Vickers'. There was no by-line to this article but it was probably written by Isabel Hardwich herself as she was the editor of the section of the journal in which it appeared. Theirs was a childless marriage, as Hardwich believed that 'you couldn't have children, a family and work' and she thought it 'unfair and selfish' to do so and oral testimony recorded this, as well as recording the 'intense', high-brow nature of the Hardwich's interests.[552] Based on this kind of evidence, it was hard to avoid the conclusion that she was the driving force in their relationship and hard to dismiss the accusation that Hardwich was often regarded as 'difficult' by those who knew her.[553] The fact that she often presented an image that ran counter to the accepted tropes of femininity that applied during the 1950s and 1960s did not seem to trouble her although she recognised the fact that she would have found it extremely difficult to carry out her work, especially if she had had domestic commitments and responsibilities. As her husband relieved her of these duties, she was able to focus much of her attention upon furthering the work to which the WES was dedicated and to lobby on behalf of women in order to encourage a recognition of their contribution to the industry. This was the most important aspect of her work, and this is reflected in the many papers on this subject that she

552 Oral testimony WES1; WES2 both mentioned their membership of various societies at Metrovicks that were devoted to such activities, with the Music Society reflecting their particular interest in this direction.

553 Oral testimony. Both WES1 and WES2 suggested that this descriptions could be applied to her.

placed in her archive. Throughout her working life, therefore, she devoted much time and her considerable energies to fostering these aims and appeared undaunted by the effort that was needed to encourage young women to enter the profession.

Hardwich's position within the Research Department at Metrovicks gave her ample opportunity to fulfil the aims of the WES in this respect, especially in relation to the way in which women within the industry were perceived by the wider public. The company often made use of her expertise in this area and she also acted on its behalf by promoting the apprenticeship scheme to different audiences throughout the country. Isabel Hardwich was a 'formidable' campaigner who 'was not easily intimidated' by the fact that women engineers at Trafford Park formed only a tiny fraction of the workforce; some of the figures that she collated suggested that between 1951-1961 only forty women were trained as such by the company.[554] Her forthright way of dealing with problems meant that she was not afraid to tackle issues that were unpopular or that others had chosen to ignore. She was, for example, the only person to take a stand over what she considered to be a serious dereliction of duty by Metrovicks in relation to radiation levels linked to one of the secret projects undertaken by the Metallurgy Department.[555] With these

554 Oral testimony WES1; WES2; I H Hardwich, 'Women Professional Engineers in British AEI', p.8. The accuracy of Hardwich's figures was difficult to confirm.

555 An unauthenticated posting on the internet suggested that Hardwich might have been involved in an altercation with the management at Metrovicks in relation to one of the secret projects undertaken by the Research Department. The relatives of a worker who had emigrated to Australia after having worked at Trafford Park were adamant that his terminal illness was a result of dereliction of duty by the firm and that only Hardwich had been prepared to tackle the problem. 'This state of affairs came to light due to a Mrs Isobelle (sic) Hardwich, a scientist who had a low blood count who came to work in part of our Laboratory and as a safety precaution she requested that it be monitored by the Radiation Section. All staff then had to have blood

credentials it might have been assumed that Hardwich, as well as other WES members working both at Metrovicks and within the wider group of AEI companies, would have found it possible to exert pressure on the organisation to identify and fast-track more young women in order that they might eventually become senior executives. There was little evidence, however, to suggest that this was the case and instead the older women already established 'in post' appeared to concentrate most of their energies on persuading girls still in full-time education to consider taking up engineering as a future career.

There were a number of reasons why it was hard for them to exert their influence on the company hierarchy: women engineers were numerically weak and were therefore unable to form a significant caucus within an industry where the pace of change was slow and was driven by traditional male expectations. In addition, members found it difficult to broaden the stance of the WES from its underlying parochialism during this period. The Society rarely presented a high profile to the general public and preferred to work within its own somewhat narrow spheres of influence. For example, it did not choose to become the kind of pressure group that openly challenged the status quo in order to provoke a response from industrial leaders or from politicians. Instead the original remit 'to encourage and stimulate all women who are interested in engineering' and 'to remove the artificial prejudices and artificial restrictions' which 'prevent women from taking up engineering as a profession' was broad enough to allow members to concentrate

---

and urine tests. The whole place had to be decontaminated to eliminate radiation and toxicity levels linked to uranium fuel element plates'. www.mixx.com/...youtube-uk-kills-own-soldier-at-secret-nuclear-lab-s-17 and http://youtube.com/watch?v=xc...Sparticusia. 14.10.10 [10 July 2013]

on those areas such as education, where they believed that their best contribution could be made.[556] Delivering conference speeches on technical education, explaining the work of engineers to schoolgirls, producing a house magazine, and attending meetings at local branch level was the direction that the WES took during this period. This was not the hallmark of a dynamic organisation and the Society appeared to be trapped in old- established modes of thought and action. In her archive, lodged at the Institute of Electrical Engineers, which contained material that she had curated from a wide range of sources, Hardwich showed women upholding their choice of career in the face of equivocal attitudes to their status. It showed that within the engineering industry they were put at a disadvantage in relation to a number of important issues ranging from access to support where domestic commitments were concerned, as well as in the way in which they were prevented from having authority over male workers, and their more limited prospects of promotion, to the ban imposed on them that prevented them from operating in dirty or physically challenging conditions. It is fair to say that little challenge was presented to this state of affairs during the 1950s and 1960s and as a result there was to be no 'Storming of the Bastille' by the WES. Members appeared to work within parameters where they felt comfortable and seemed to attach much importance to their programmes of education which they hoped would appeal to young girls and draw more of them into the profession. Thus chances to offer radical solutions to the problems that beset women within the industry drifted by and the Society adopted an evolutionary, to say nothing of

556 IEE NAEST 92A/8.25 E Williams, 'Man is still ruling the engineering roost', *The Engineer,* 26 April 1979, pp. 30-31.

cautious, approach to change.[557]

Combating prejudice and resisting pressure: an examination of the expectations placed on the female apprentice and the young woman engineer

In her archive Hardwich included a small cutting from *The Guardian,* entitled 'Equality for the Exceptional' which suggested that these were main disadvantages that faced young women who might contemplate a career in engineering.[558] There was, in addition, a factor that appeared to occupy the minds of many members of the profession. Many women engineers seemed to have a distinct sense of unease about the way that they felt that they were being presented to the general public when, as Williams suggested they were regarded 'as something of a novelty'.[559] For the most part this seemed to have hinged on the idea that, despite their unusual choice of career, they did not wish to be viewed as being 'different' from other women. In a period when marriage and motherhood was extolled as the ultimate destination for young women, it seemed to be imperative to women engineers that they did not present themselves in opposition to this culturally accepted norm. Time and again, in speeches, reports and articles, reassurances were given to prospective entrants to the profession that women engineers did not necessarily have to reconcile themselves to being single.[560] This preoccupation may have related to ideas of 'spinsterhood' left over from the

---

557 WES2 felt that the Society only began to take on a more active approach to these issues in the 1980s.

558 IEE NAEST 92A/8.2, *The Guardian,* 29 September 1960

559 Williams, p. 31

560 I H Hardwich, 'Overall Record of the Company's experience of Full-Time Training Schemes for Women'

Victorian era and to the 'surplus women' debate in the aftermath of the Great War when there were two million more women than men in the population. Despite the fact that Philip Snowden, writing in *The Woman Engineer* in 1921, declared that 'many women decline marriage because they prefer a life of singleness blessed with a congenial occupation' his remarks may well have been tempered by the fact that there were those in his audience who were counted as 'surplus women'.[561] Indeed Hutchins, writing in 1915 when it was not so clear cut that so many women would remain single, had already suggested that 'the old fashioned assumption that women will all get married and be provided for by their husbands cannot be maintained' although she did add that 'many have economic self-dependence forced upon them'.[562] Hutchins, however, was expressing a minority view and Gertrude Entwisle's comment about professional women being regarded as 'freaks' was probably a more accurate reading of 'the conditions at that time'.[563] Robinson offered a particularly useful survey of the sort of prejudice that had surrounded girls entering university who wished to use their qualifications in order to pursue a professional career. This was in an era when it was considered that such action would 'threaten' their 'tenuous femininity', and when the idea that 'anyone seriously ambitious to become a grandparent should not send their daughter to university' was not unknown. Nicholson also covered this ground and the residue of such sentiments still existed in the 1950s and beyond.[564] WES2, however, mentioned that a number of 'older' unmarried members of the WES felt

---

561 E Williams, p. 31
562 B L Hutchins, *Women in Modern Industry (1915),* 1978 reprint (Wakefield: E.P. Publishing), pp. 7, 78
563 G L Entwisle, p. 1
564 J Robinson, p. 204; V. Nicholson, *Singled Out*

differently about this issue. Like Snowden's readers some 'had lost loved ones in the First World War', and having found a 'congenial occupation' were 'unenthusiastic' about women who married and then wished to take career breaks to raise families. WES2 said that it took a long time for 'the old guard to relinquish their grip', whilst many of her own contemporaries were caught up with the demands of family life.[565] Hardwich also seemed to be affected by the issue of marriage and family. She made sure that she annotated the most trivial of material to include not just maiden but also married names. The reason why she did this remained unclear, but it may have been a way in which she wished to make it clear that engineers were as likely to marry as women in the general population. Even when recording the fact that, by 1961, of the 230 women who had obtained full-time industrial training at Metrovicks, '58 are known to have married', she felt it necessary to underline the fact by adding this superfluous information.[566] The image that the WES seemed to wish to project was bound up with the idea that marriage and a career in engineering were not incompatible, even though this was often under scrutiny. In an article in *Science Journal* published in the mid-1960s, the assistant editor Jean Phillips, confirmed that women should centre their life around home and family. Much like Ollerenshaw, she stated that 'a married woman must adapt herself to the work available in the area set by her husband's job', which often meant that 'she cannot do the work for which she has been trained'.[567] By suggesting that if a woman wished to return to work after having brought up a family she 'must take on an undemanding or part-time job', Phillips upheld the

565 Oral testimony D H
566 I H Hardwich, 'Women Professional Engineers in British AEI'.
567 IEE NAEST 92A/8.9 J Phillips, 'Women in Science', *Science Journal,* (May 1966), p. 78

prevailing view about the place of women in society during this period.[568] Such notions might have been actively challenged by the WES but instead were often given tacit approval by many members, presumably in a quest for the Society to be seen as a reasonable and moderate voice representing reasonable and moderate women. Not only did young women engineers recognise that theirs was an 'unusual' choice of career but they also wished that this was seen as being no different from the career choices that had been made by other working women. There was also a dilemma they faced when wishing to be able to combine work with marriage and motherhood when the societal norms in the 'long 1950s' demanded that all women should accommodate themselves to the needs of their husbands and families, and this also contributed to the pressures with which graduate wives had to contend, and this will be discussed later in the chapter.

Other issues were of concern. Hardwich was ever at pains to convince young women that working as an engineer would be 'clean' and would have 'no direct connection with the shop floor', and thus she equated her profession with notions of 'femininity', 'appropriateness' and ‘docility'.[569] In the face of the undisputed fact that women engineers were atypical and stood outside the traditional career boundaries set for women, the WES had always had to work hard to combat prejudice. WES members were thus much exercised by the sort of prejudice that suggested that engineering was an 'unfeminine' occupation. Such ideas were not new. Williams found a comment made in *The Engineer* in 1920 on this subject which declare that 'Nature has not fitted women for engineering and though here

568 Phillips, p. 78
569 I H Hardwich, 'Women engineers in industry', University of Warwick, p.22

and there one may break away from the normal […] so few times in a century women may reach eminence in engineering'.[570] The pressure to be seen to fit in with notions of 'femininity' was not always nuanced. In 1965 a feature in *Topic* looked into the life of a female College Apprentice at Trafford Park.[571] When interviewed, Anne Bainbridge was adamant that 'engineering is not just a man's field' but was also careful to reassure the readership that she was 'by no means a militant suffragette'. Indeed, the whole tone of the article emphasised the idea that, even though young women engineers were 'tougher than the men think', there were areas of the profession that would remain 'exclusively male'. No comment was made about the fact that the young trainee felt, like Sewill, that her progress was limited because she was 'only given the easier jobs' to tackle. The article was not written to celebrate the prowess of women engineers but was intended to let it be known even an 'exceptional' minority conformed to the societal expectations placed on all young women during this period. Although reference was made to the active working life of the apprentice, this was balanced by an emphasis on her domestic prowess and on her awareness of 'the problems inherent in giving a married woman a responsible position, as she may have to leave to look after her children'. Despite attempts by the reporter to emphasise these traditional aspects of 'femininity' there was a tension between this and the way in which Bainbridge seemed to wish to portray herself. The overall impression she gave was that she was more frustrated by her lack of opportunity in the workplace than anything else and, as marriage and children were 'not very important' to her, seemed far less concerned about fulfilling a 'traditional' role in

570 Williams, p. 30
571 IEE NAEST 92A/8.8 *Topic,* June 1965, p. 11.

society than perhaps her audience might have expected. Analysing the aspirations of, and surveying the attitudes towards, a rising generation of female engineers was difficult to assess from reading this brief newspaper article. Despite editorial attempts to cast her in a representative light, Bainbridge may well have been atypical of female apprentices. When interviewed for a different publication, Elizabeth Sadler too noted that she saw herself as 'sensible – a bit flat-footed' and hesitated to 'play feminine' as she thought it 'wasn't cricket'. [572] That Hardwich saw fit to include these cuttings in her collected papers, suggested that she must have thought they contained something of the 'flavour' both of what it was like to be a female College Apprentice at Metrovicks and of some of the pressures that beset 'exceptional' young women who were hoping to pursue long-term careers in the industry. By 1969, however, the Central Office of Information saw fit to present a very different image of such young women. In stills from the career film that it produced, and which was contained in Hardwich's archive, the fashionably dressed young engineers were seen to be working in a variety of environments both in offices and on the shopfloor. The accompanying script demonstrated their confidence in their skills and highlighted their competencies in the workplace. This film clearly set out to challenge stereotypes about the ability of women to 'hold their own' in a male dominated profession.[573] When it was produced the difficulty in recruiting young girls into the profession was acute, and the attempt by the CIO to counter the effects of this by offering visual images that portrayed engineers as typical of examples of the 'Swinging Sixties' generation has to be viewed in this

572 IEE NAEST 92A/8.4 L Owen, 'Women in Engineering: the first of the few'. [n.d. unknown provenance]

573 IEE NAEST 92A/4.2.2. Central Office of Information, 1969, 'The Engineer is a Woman'

light. Arguably, these were images both of themselves and also of the heavy engineering industry with which most young female trainees at Metrovicks were unfamiliar.

Attitudes towards women working in the industry were much slower to change than the images presented by the CIO film suggested Sixteen years after the interview with Bainbridge, *Electrical Living* ran a feature on Eileen Evans, the first woman engineer to work for the South Wales Electricity Board.[574] The author wrote of the discrimination Evans faced in 'gatecrashing the inviolable sanctums of a male dominated industry' but was keen to stress that 'Eileen's masculine job title belies her gentle character', adding that 'she is also the prettiest and is the only Board engineer who dares to list knitting as an enjoyable pastime'.[575] Like Bainbridge before her, Evans tried to deflect attention away from the idea that women needed to conform to this 'docile' image by stressing the importance of her engineering credentials and of her fight to avoid discrimination in the job market. Whilst the patronising language employed by the reporter was hardly likely to have spearheaded changes in attitude, it has to be said that there was a hint of insecurity in some of Evans's own statements. She was 'content' to be a 'housewife' rather than a career woman which she emphasised was 'too harsh a term' and she insisted that girls would not 'lose their femininity if they worked in a male world' as long as they did not have 'control of men'.[576] As already noted,

574 IEE NAEST 092A/8/37 'Woman in a Man's World', *Electrical Living,* Electrical Association for Women, Summer 1981, pp. 26-27

575 'Woman in a Man's World', p. 27

576 'Woman in a Man's World'. p. 27; See also IEE NAEST 92A/8.21 I.H. Hardwich., 'Opportunities for Girls in Industry', Sixth Annual Report – The Developing Field of Technical

Willis's examination of the 'machismo' of the shopfloor demonstrated the ways in which this hampered women's progress.[577] In stating that 'a position of wide authority in a big organisation involving power and control of men in large numbers is a difficult combination for a woman to handle', Hardwich also demonstrated how even 'exceptional' women accepted limits to their ambitions and, indeed, often set their own limits to their ambitions.[578] It was, therefore, a little incongruous that from the outset one of the main aims of the WES had been to combat male stonewalling and prejudice. The membership ploughed on regardless, even though there was a propensity to be put on the back foot over issues such as this.

The question of equality between the sexes was a trial to the Society especially in relation to the widely held belief that women could only be equal if they were the same as men. Judith Evans pointed out that 'same' did not mean 'identical', though it was not always obvious that women in the engineering industry fully recognised this.[579] In the discussion session of the Sixth Annual Conference of the British Association for Commercial and Industrial Education held in 1957, an unnamed participant suggested that women engineers should not 'do heavy and dangerous jobs' because 'their survival is more important to the race than the survival of a male'. [580] This was a curious way of expressing what Evans described as the major structures that informed the female condition, 'production,

---

Education, British Association for Commercial and Industrial Education (BACIE), p. 47, 1-3 March 1957.

577 P. Willis, p. 109

578 Hardwich, 'Opportunities for Girls', p. 51

579 J Evans, *Feminist Theory Today,* pp. 2-3. She suggested that 'alike' would be a better word to use. She also suggested that often little thought was given to 'equality and difference' between different groups of women and between different individuals within these groups.

580 BACIE, 'The Developing Field of Technical Education', p. 52.

reproduction' and the 'socialization of children'.[581] Questioning the assumption that within production women were 'relegated to a secondary place' as a result of 'greater physical weakness', Evans concentrated her argument on the idea that it was not just this, nor was it childbearing that kept women from the productive sphere. Rather, it was 'the whole structure' that rested upon keeping women from 'the road to freedom' which made their subordination 'inevitable'.[582] She made the important point that domestic work had always been arduous and that women's greater physical weakness had not 'exempted' them from productive labour especially when they were 'prey to the needs of the time'. The imperative for women to work in the engineering industry during both World Wars demonstrated this fact. [583] Although the issue of equality became more pressing during the 1960s, there was little evidence to suggest that the WES took much account of the fact that there was a wider discourse relating to equality for *all* women that began to surface at this time. Hughes, for example, described the way in which activists involved themselves in 'consciousness-raising groups' of the early Women's Liberation Movement that began to tackle this problem, but it was hard to envisage many established women engineers allying themselves with such a forum.[584]

It could be argued that addressing these issues lay outside the remit of the Society but whether or not a rising generation of engineering trainees felt the same way is a moot point. Whatever the case, a long period of stasis set in which resulted in a

581 J Evans, p. 73.
582 Evans, p. 73
583 Evans, p. 73
584 C Hughes, 'Realigning political and personal selfhood: narratives of activist women in the late 1960s and 1970s', *Women's History Magazine,* 68, (Spring 2012), pp. 22-27

sharp decline in membership, with the WES only being able to attract 252 members during the 1960s and this caused much frustration to Hardwich, as her correspondence during this period testified.[585] As a result, and inspired by its 'energy', she began to focus her attention on her membership of the American Society of Women Engineers (SWE).[586] She was anxious to play an active part in the organisation and so took part in the First International Conference of Women Engineers and Scientists in New York in 1964 which was attended by politicians from both sides of the Atlantic, including Sir Edward Boyle M P and Governor Nelson Rockefeller. Hardwich, however, must have been disappointed to hear the New York City Commissioner of Public Work describe the illustrious group of women as 'distaff engineers and scientists' who 'should emerge as helpmates in the profession, as well as being housewives in our home'.[587] It was clear that both the WES and the SWE had some way to go before such stereotypical, and casually expressed, attitudes could be effectively combated.

That talent was wasted and women struggled to maintain a place in the industry demonstrated that prejudice existed. Phillips suggested that a woman has to be rather better than her male colleagues to achieve the same degree of recognition, but even though there was a growing recognition that talent was being wasted, by the end of the 1960s discrimination and 'incalculable depths of prejudice' still

---

585 IEE NAEST 99A/12.Isobel Hardwich to Inez van Vranken, Executive Secretary, Society of Women Engineers, [n.d.]. D.H., a member of the WES during this period, confirmed that membership did stagnate, and it was only in the 1980s that matters improved. She was not able to pinpoint any specfic reasons as to why this was the case.

586 I H Hardwich, Box 189, Reuther Library Collection

587 Speech by Bradford N. Clark, 17 June 1964. Proceedings of the First International Conference of Women Engineers and Scientists, June 12-21 1964

existed.[588] Indeed Phillips quoted Kathleen Baxter who said that prejudice was like an iceberg – a certain amount being visible but 'below the surface are incalculable depths', an assessment that chimed in with statements from contributors to this study who seemed reluctant to say that they faced prejudice, but at the same time mentioned being 'side-lined' from their jobs, or being regarded as little more than a 'dogsbody'. The WES had always been aware of this problem and, as a result, sponsored two senior members on a fact-finding mission to the USSR to investigate how women engineers were deployed there and to see if any lessons could be learned. Lesley Souter, an employee of AEI and well-acquainted with Hardwich, found that women occupied one in three engineering jobs, but felt that this would not work in Britain where men 'would not happily take orders from women'.[589] Her results highlighted the fact that whilst such prejudice did not exist in Russia, this was not the case in Britain. In addition, other examples of prejudice also presented problems to women, especially where the need to take career breaks was concerned, and this made them sensitive to the accusation that their training was costly, and that 'wastage' came from 'retiring' to raise a family. Willis Jackson, too, was concerned about the economic ramifications of 'a likely short duration' of their 'service to the firm' and suggested that this was 'an understandable query' that could not be 'answered convincingly' until a 'substantial number' of women had finished their training and then occupied 'responsible engineering positions'.[590] Critics complained that women left the profession within the first five years of completing an apprenticeship, just at the point when the

588 Phillips, p. 78 . I.H. Hardwich, (BACIE). pp. 47-48.
589 IEE NAEST 92A/8.3 'How Would You Like a Woman Boss? (At Work, Of Course)', *Daily Express,* 11 October 1960.
590 Jackson, Opportunities for Girls', p. 17

results of intensive training should have begun to pay dividends. Little attention was paid, however, to the fact that men also moved on seeking career advancement or left the industry altogether for some other calling as Dummelow had noted. These 'by-products of the Education Department', as he called them, thus remained in the workforce even if they were no longer engineers.[591] Presumably, therefore, these men were categorised in a different way to women who were raising children, and 'wastage' of their engineering training did not apply to them and these were the sort of problems with which the WES had to grapple. Problems were caused, for example, by the so-called ‘Brain Drain in the 1950s and 1960s when highly qualified young men were enticed by the promise of better opportunities in science and engineering and took their talents abroad, especially to the United States. Recognising this, one member of the WES offered a spirited defence of women by drawing attention to the fact that there was 'a very large proportion of male wastage', but this did not alleviate matters for those eager to return to the industry.[592] Although the fact that the 'Brain Drain' had economic ramifications for the country and posed a huge problem to British industry, the idea that highly qualified young women might step in to take the place of these men was not offered as a solution. Lobbying on their behalf did not take place within either industry or the scientific community. The WES was not a powerful force in this direction either, despite offering Sargant's views for scrutiny in *The Woman Engineer.*

If the 'Brain Drain' caused consternation so did the issue of 'wastage' which

591 Dummelow, p. 208. calling them all 'by-products of the education department'.
592 G Sargant, 'Women in Industry', *The Woman Engineer,* 8:9 (Summer 1958), p.5.

became a preoccupation of some members of the Society. The graphic account by Rosemary West, a former Metrovicks' Vacation Apprentice, who wrote an article in *The Woman Engineer* recounting her struggle to bring up three young children and maintain some semblance of a career, was intended to throw open the debate to the wider membership.[593] Members, however, seemed unable to offer constructive advice about how to alleviate the problem faced by many of those who had had to leave the industry in order to rear their children. Phillips suggested that most had felt compelled to 'enter teaching for which the hours of employment are so much more compatible with family needs', in order to be able to 'maintain the standards at home which her family has come to expect', and this was a route followed by women like WES2. It was clear from this article, however, that young women like West wanted to continue to work in the industry but found it extremely difficult to do so. [594]

The problems faced by graduate wives during this period have been well documented by Dyhouse, who suggested that 'the question of their participation in paid employment was complex and controversial'.[595] She found that those who were most confident about combining childrearing with professional work, where husbands were 'supportive of their careers and cooperative in domestic arrangements', constituted a 'significant group' though 'not necessarily a numerically significant group', and were identified by the Rapoports as 'dual career

593 R West, 'Reluctant Retirement', *The Woman Engineer,* 9:9, (Summer 1963), pp. 2-3. She was an Oxford graduate, a Vacation Apprentice at Metrovicks, a development engineer at GEC and sometime President of the WES.

594 Hardwich, 'Women Engineers in Industry', p 10 and Phillips,'Women in Science', p. 78

595 C Dyhouse, 'Graduates, Mothers and Graduate Mothers:family investment in higher education in Twentieth-Century England', *Gender and Education,* 14:4, (2002), pp. 325-336 (p.332)

families'.[596] Doctors and academics were 'prominent amongst this group'. Although these women were aware of 'a good deal of social disapproval' and spoke of the 'stresses and strains' of combining paid work with motherhood, they continued to pursue their career in the same field in which they had been trained. She did not cite engineers as being amongst these numbers and it was interesting to speculate about why they found it more difficult to return to their posts than, say, doctors who were also required to keep abreast with rapid scientific and technical change. As a mother of three, and despite 'a semi career break of seven years', WES2 had been determined to keep her employment prospects alive.[597] In 1956 she was the first woman to have been offered a formal apprenticeship at Vickers-Armstrong Aircraft Company at Brooklands, and she went on to gain a first-class honours degree in Aeronautical Engineering and to become a Fellow of the Royal Aeronautical Society. Whilst she was bringing up her children, however, she had to take on 'odd bits of work' that were 'only loosely connected' with her career, such as teaching Ordinary Level mathematics and her experience tied in with findings by Thane as well as Dyhouse. Eventually hers became 'a dual career family', greatly helped by the fact that her husband was also an engineer and that it was his employers who offered her the chance to return to work. To some extent, therefore, she 'bucked the trend', but she was careful to stress that her connections within the industry had led to her being able to resume her career. She felt that it might have been 'almost impossible' to 'get back into engineering' without such contacts. She also felt that some members 'dismissed' the young

---

596 Dyhouse, 'Graduates, Mothers' p. 333. She refers to R. Rapoport & R. Rapoport, *Dual Career Families Re-examined: new integrations of work and family,* (London: Martin Robertson, 1976)

597 Oral testimony WES2.

women engineers who did become pregnant and held attitudes that were 'slightly fossilised', or were not always encouraging to younger women, or were 'unable to see how it was from someone else's angle'. Much like the careers of other women discussed in this study, WES2 also acknowledged that whilst she was able to 're-engage' with the industry, nevertheless she had been 'sidelined from pure engineering' into what she described as 'engineering knowledge' but she was adamant that this was her 'choice'.[598] Whether this would have been her choice had she been childless, she said 'was another matter'. Nonetheless she expressed her gratitude to her employers for taking her on when she had 'a family to consider', because she believed that this was 'very unusual' at that time. Thane, too, covered this ground. In a survey of those who graduated from Girton between 1920-1980, she found that the experience of 'all too many of the women who ventured into male-dominated careers' was fraught with difficulties, adding that, in any case, 'teaching was the career '*expected'* of standard Girton graduates'.[599] Thane also found that 'almost all' who entered mixed-sex occupations described 'tensions' and feelings of 'discrimination' or 'hostility' and she highlighted the fact that the 'exhausting' battle restricted career options in an 'unreceptive male world'.[600] Her findings confirmed evidence presented in this thesis. It was small wonder that as Thane made clear, many women's careers were shaped by what was available to them and were not shaped by personal choice, a verdict that tied in neatly with the career pattern of other women who contributed to this study.

---

598 Oral testimony. WES2

599 P Thane, 'Girton Graduates: Earning and Learning 1920-1980s', *Women's History Review,* 13: 3 (2004), 347-361 (pp. 354, 357, 358)

600 Thane, 'Girton Graduates', pp. 357-358

These dilemmas were not easily resolved, as McIlwee and Robinson suggested, and women engineers were hardly responsible for the situation in which they found themselves.[601] Although their work focussed on American engineers a generation younger than the graduates of the 1950s and 1960s, the experiences of both groups were remarkably similar; much of the analysis offered by the authors, therefore, was both interesting and challenging. Their research into 'dual career' couples confirmed that marriage to an engineer appeared to provide a career advantage for 'women without children', especially when the husband was able to mentor, advise, and provide useful contacts for his wife.[602] The authors were, however, 'surprised' to find that mentoring undertaken by their husbands came 'at the expense' of the woman's technical self-confidence' as engineers.[603] Erosion of their status also took place as young women engineers married to engineers were 'especially likely' to 'subordinate their careers to their spouses', mainly because the wives 'generally' had lower paid jobs.[604] The findings of McIlwee and Robinson also suggested that marriage to an engineer created 'a particular pattern of deference, dependence and insecurity', for women especially 'when children entered the picture'.[605] The authors noted that this seemed to be a result of the significant adjustments women made in order to cater for the needs of their families, usually entailing an interrupted, scaled-back, or abandoned career much as West had reported. In concluding that 'the marital resources they reaped

---

601 J S McIlwee & J G Robinson, *Women in Engineering*
602 McIlwee & Robinson, pp. 151
603 McIlwee & Robinson, p. 152
604 McIlwee & Robinson, p. 153
605 McIlwee & Robinson, p. 154

from their status as professionals were not enough to counter the greater occupational status of their husbands, the inflexibility of their employers, or the cultural mandate of the larger society', McIlwee and Robinson might just as well have been describing the situation that applied during the 1950s and 1960s rather than that of the 1990s when their research was conducted.[606] The resemblance to the situation in which WES members found themselves was remarkable. Indeed, these comments might as well have applied to Lovelace, Ayrton, Curie and many of the other pioneers at Metrovicks and elsewhere suggesting that a long history of struggle for women engineers to be recognised in the same way as their male counterparts remained unresolved.

Female skills and competencies: the relationship between women and engineering

Inhibiting factors such as these prevented young women from finding it easy to return to the same job after childrearing duties, but other matters also needed to be taken into consideration. For instance, women engineers were trained to think and operate within parameters that were specific to a profession that was peopled mostly by men. Nevertheless, some may of them have lacked the necessary 'qualities' that were thought to have been needed to in order to progress successfully in a male-dominated environment, even when they were operating within their own narrow field of expertise. There was, therefore, a tension between the way in which women and men engineers viewed engineering and technology which led to women feeling that they had been placed in an iniquitous position

606 McIlwee & Robinson, p. 173

where they lacked the ability to negotiate a better standing for themselves. Tsaliki looked at this state of affairs and concluded that the relationship between women and technology had 'always' been 'an uneasy one' because the traditional perception of technology was 'heavily weighted against women'.[607] She also suggested that technical competence, central to dominant perceptions of masculinity, forged a 'natural polarity between masculine and feminine' and that, in any case, sexual stereotypes identified 'men with culture and science and women with nature and intuition'.[608] Hacker also gave some thought to the culture of engineering and the impact of technological change, and described her own experiences when she studied engineering. She noted that in the classes and seminars she attended reference was made to the fact that technology was considered to be an all-male preserve where women were not welcome, not only on the grounds that it was believed that they lacked innate ability but also on the grounds that it would be difficult for women to gain 'masculine' skills and competencies. Whilst Hacker directed her attention to industry in the United States in the 1980s, her research also underlined the problems faced by women engineers in Britain in the period covered by this thesis.[609] By pointing out the fact that women's entry into 'the traditionally masculine' included 'but a few women', but that this produced 'tremendous contradictions' and indeed strengthened 'masculinization', she attempted to explain why female recruitment into the profession was always a difficult task to accomplish.[610] Hacker went further by

---

607 L Tsaliki ,'Women and New Technologies', in *Feminism and Postfeminism,* (ed.) S. Gamble, (London: Routledge, 2006), pp. 65-74, (pp. 70-71)
608 Tsaliki, pp. 70-71
609 S L Hacker, 'The Culture of Engineering', pp. 341-353
610 S L Hacker, *Pleasure, Power and Technology*, p. 49.

stating that 'both men and women in the field of engineering' experienced an 'externally imposed discipline appropriate to a masculine and hierarchical structure', and thus posited the idea that 'gender exists only in the context of gender stratification' which was 'the fundamental process that shapes and organises patriarchy'.[611] Lerner's contention that patriarchy implied that 'men hold power in all the important institutions of society and 'women are deprived of access to such power' fitted in with this analysis, as did Willis' argument that the forms through which patriarchy 'is articulated', be that 'private or state capitalism', can 'disguise its own mechanism of oppression and exploitation'.[612]

It has not been the intention here to divert much attention away from the technical and vocational education and training of the 'exceptional' young women at Metrovicks and to re-locate in an over-long discussion of gender inequality, patriarchal capitalism, and occupational segregation. It would be foolish to deny, of course, that these factors contributed to an understanding of the interaction between young women and the workplace and of what this was comprised. It would be worthwhile, therefore, to concentrate attention on those texts that addressed the situation in which engineers and scientists found themselves. In *Patriarchy at Work,* Walby gave a short overview of the 'discouraging atmosphere' which was to be found 'in most branches of engineering' and noted that 'a negligible number of women were members of professional engineering

611 Hacker, *Pleasure, Power and Technology,* p. 148

612 G Lerner, *Creation of Patriarchy,* p. 239, She pointed out that 'this does *not* imply that women are either totally powerless or totally deprived of rights, influences and resources'; P Willis, p. 139

associations'.[613] Whilst Game and Pringle argued that culpability for this state of affairs 'rested within the patriarchal structure of management', Kelan struck a somewhat different note.[614] Her research highlighted some of the interesting ideas expressed by her cohort of male and female interviewees where she discovered that the responses of both sexes to the idea that women should engage in technology were stereotypical. She found that women who undertook this type of work were seen to be 'exceptional', but were also viewed as 'not like other women' and therefore were not regarded as 'normal'. In examining these responses, Kelan came to the conclusion that most women did not want to 'engage with a machine' and instead, like Hacker, suggested that they preferred to engage in 'social interaction'.[615] She was, however, optimistic about the place of women within the industry, and stressed the fact that 'women have agency' and that 'negative discrimination' against women could be 'overcome'.[616] Nevertheless, the example she came across of a woman engineer who was mistaken for a secretary and then 'distanced' herself from the 'technically less able individual' and 'constructed' herself as 'different', showed that at least one of the participants in Kelan's sample 'downgraded experiences of discrimination'; she failed, however, to recognise her own discriminatory attitudes towards other women.[617]

Walby's assertion that 'gender inequality cannot be understood without the concept of patriarchy' was central to her argument, and her discussion

---

613 S Walby, *Patriarchy at Work,* (Cambridge: Polity Press, 1986), p. 236
614 A Game & R Pringle, *Gender At Work,* (London: Pluto Press, 1983,
615 Kelan, pp. 153, 155
616 Kelan, p. 156
617 Kelan, pp. 169-172.

encompassed much that applied to the engineering industry.[618] Cockburn, however, presented the most intriguing and thought-provoking aspects of both gender and patriarchy in relation to engineering, and her examination of the relationship between women and technology had particular relevance for this study. In looking at the place of women in engineering she considered that what held them back was 'the way in which jobs and promotion paths' were 'defined in the workplace' and her evidence pointed to the idea that 'men's special relationship to technology' had 'something to do with women's non-relationship to it'.[619] Examining the process of 'gendering people and jobs', Cockburn discussed inequality and gender difference as 'important mechanisms in sustaining male dominance' and showed how 'occupations themselves have come to be gendered'.[620] More importantly, she suggested that 'the jobs in turn have a gender character which rubs off on the people who do them', and as 'men identify themselves with technology and identify technology with masculinity', this presented particular problems for women engineers as they tried to negotiate their way in the industry.[621] She also pointed out that 'for many men' it was 'unthinkable that women could possess a technical competence equal to their own', a view that coincided with a remarkably similar comment by Hardwich that 'women would have to be rather better than her male colleagues to get the same amount of recognition'. [622] Indeed Entwisle made the point that if a boy fails 'no one will say

618 Walby, *Patriarchy at Work,* p. 243
619 Cockburn, pp. 142, 166
620 Cockburn, pp. 168-169
621 Cockburn, p. 171
622 Cockburn, p. 188; I.H. Hardwich, 'Opportunities for Girls in Industry', p. 48.

that boys are unsuited to engineering, but if one girl fails, many will say it'.[623] Cockburn also proposed that women who entered 'masculine' occupations faced a tension between 'two incompatible values' because gendering ascribed a series of polarized characteristics to the 'masculine' and the 'feminine'. Thus, when women stepped into male work 'they upset a widely accepted sense of order and meaning' where 'male power is the bottom line'.[624] This view coincided with the fact that there were 'physical' spaces within the factory where females were excluded in case their presence 'threatened' male power in some way. Cockburn's analysis, therefore, also described the situation facing the female apprentices at Metrovicks who, being regarded as 'exceptional' women, were likely to have faced challenges from 'the intellectual engineer', the type of man who was unable to claim that 'physical prowess' was intrinsic to his work and so was 'obliged' to find reasons to explain why he thought that women could not 'compete' with him. [625] She further suggested that in masculine ideology women were always represented as non-technological and 'incompatible with machinery', except when in a controlled, supervised, and guided situation, and this formed the basis of the prejudice that young women engineers had to struggle to combat, much as Hacker's experience testified. If, however, female apprentices adopted 'the discourse of gender neutrality', as Eisenhart and Finkel made clear, they risked overlooking the extent to which the 'culturally male features of the workplace disempowered them and jeopardised their success'.[626] Thus to 'act like a woman, or to ask for special treatment' threatened prestige, but failure to do so

623 Entwisle, p. 11
624 Cockburn, pp.190-190
625 Cockburn, p. 196
626 M A Eisenhart & E Finkel, *Women's Science,* pp. 233-234

'subordinated women's needs' to those of the workplace' that was 'permeated by patriarchy'; as such, the authors cautioned against women shaping their careers in accordance with 'the established furrows of institutional power and patriarchy'.[627] It goes without saying that this was easier said than done for the female apprentices at Trafford Park, especially in the period under consideration in this study.

'It is probably easier for the rich man to get through the eye of the proverbial needle than it is for a girl in Britain to become an engineer': the response of Metrovicks, the WES and government during this period

As it has been shown, the inability to exercise power and control, even by those whose academic pedigree and elite technical and vocational training were second to none, frustrated ambition and led to the failure of young women to capitalise on their skills and expertise. By the end of the 1960s the idea that women engineers were being marginalised also started to be recognised by politicians. Ushering in the 'Women in Engineering Year' in 1969, Shirley Williams declared that 'it was probably easier for the rich man to get through the eye of the proverbial needle than it is for a girl in Britain to become an engineer'.[628] Ironically, as a member of a government that had once put the 'white heat of technology' at the core of its thinking, she did not herald a new dawn for women. [629] Instead, by underplaying aspects of engineering that might involve 'heavy work, boilersuit work' and

627 Eisenhart & Finkel, p. 234

628 IEE NAEST 92A/1.2.3 Press Notice, Department of Education and Science, Wednesday 5 March 1969.

629 In his 1963 speech to the Labour Party Conference Harold Wilson said 'The Britain that is going to be forged in the white heat of this revolution will be no place for restrictive practices or for outdated methods on either side of industry' but this is usually paraphrased as 'the white heat of technology' speech. Shirley Williams became an M.P. for Hitchin in 1964

stressing those involving 'very delicate work', Williams failed to challenge stereotypes. To compound matters, saying that there was no 'reason at all why a girl in engineering should be less feminine than a girl in home economics', one of the most forthright exponents of women's equality was caught in the trap of pandering to the kind of innate prejudice that defined working within the industry.[630] Indeed, twelve years previously, Hardwich and Godlet had presented papers to a conference on 'The Developing Field of Technical Education' that bore a striking resemblance to Williams's concerns.[631] In the intervening years little had changed. Negative attitudes towards the training of girls in the industry, the ability of technically trained women to be utilized effectively, and the steering of young women towards 'clean' careers with 'no direction connection with the shopfloor and the control of men', had not abated. [632]

Much hand-wringing went on amongst members of the WES, amongst other organisations, about such issues and also about the indifference displayed by schoolgirls of this period towards taking up a career in engineering. *AEI News* pondered the issue in an article entitled 'Where Are The Women?' The author wondered if 'industry is disinclined to recruit and train them on a comparable basis with boys because of the short period of responsible employment […] before she gets married', or whether it was the fact that young women had been given insufficient encouragement to 'undergo systematic training' or whether it was because girls' schools were not willing 'to regard employment in engineering as

630 Shirley Williams M P, Speech launching the Women in Engineering Year.
631 B L Godlet, 'The Scope of the Conference', (BACIE) pp. 1-13; I.H. Hardwich, (BACIE), pp. 46-56.
632 J Phillips, p. 77.

very suitable for their pupils?' [633] No answers were given to this conundrum but it was clear that these concerns occupied a wider audience than that of the engineering industry. Savery highlighted these problems in her capacity as a member of the Youth Employment Committee in Redditch, although she also noted that a small number of girls were attracted to the industry because of the influence and support of male members of their family, and this appeared to be a factor in the case of some female apprentices at Metrovicks. This was a point made by Owen who interviewed a number of young women engineers and found this to be the case; the Apprentice Register also noted that a small number of trainees, such as Ann Elce whose father was a Director and Chief Mechanical Engineer at Trafford Park, were the daughters of professional engineers at the firm.[634] Notwithstanding the fact that support of this nature encouraged some girls to find a place in the profession, most girls displayed a reluctance to do so. This reluctance was a subject that not only occupied the minds of employers, but also those of politicians and educationalists alike and it was one that generated a considerable amount of anxiety. Responding to these concerns Seear *et al,* on behalf of the London School of Economics, undertook a comprehensive investigation into the career choices of grammar school girls in the early 1960s.[635] As part of the study, Roberts looked at the panoply of reasons why so few girls studied science at grammar school and came to some dispiriting conclusions

633 MCL Q.631.3.AE2 *AEI News,* 29:8 (August 1959), p. 3

634 Imperial College Archives B/JACKSON FW 16. W D Savery, 'Are Girls Interested in Engineering?', Report of WES Conference, 'Careers for Girls in Engineering', Coventry, 13-14 July, 1957, p. 11; L. Owen, 'Women in Engineering'

635 N Seear, V Roberts, & J Brock, *A Career for Women in Industry.* Most of the data was collected between 1959 and 1961.

about the fact that 'girls had very low regard for engineering'.[636] The statistics gathered were partly based on figures from a Ministry of Education report in 1960 and the University Grants Committee (UGC) returns from 1955-1960 and focussed on examination results at GCE Ordinary and Advanced Levels as well as numbers of first degrees passed in pure science and in technology. In this five year period the total number of men awarded an Honours degree in pure science was 14,960 and the figure for women was 3806; men awarded an Ordinary degree numbered 3956 whilst this degreee was conferred on 1854 women. As far as technology was concerned the five year totals saw 7720 men and a mere 50 women being awarded an Honours degree whilst an Ordinary degree was given to 3976 men and 35 women. Where Advanced Level passes were concerned the survey found that the total science passes for boys in 1952 was 30,226 and in 1960 the figure was 61,432 (% increase of 92.4 during the period) and for girls the figures were 6623 in 1952 with 13,463 passes in 1960 (% increase of 116.7 during the period).[637] Where the Ordinary Level pass rate was concerned, it was shown that the total science passes for boys in 1952 was 80,769 which by 1960 increased to 170,447, whereas for girls the figures for 1952 totalled 45,801 which rose to 91,205 in 1960. What was perhaps predictable was the outcome of data collected on the Ordinary Level subject preference of girls, where the arts featured heavily at the expense of all science subjects, with the exception of biology.[638] In addition, the survey asked girls to state why they had decided to drop science subjects at

---

636 Seear, *et al,* p. 33

637 Seear, *et al,* pp. 47-48. In Mathematics, Physics and Chemistry passes for girls were vastly outnumbered by those for boys. In 1960, for example, 18,009 boys and 2100 girls gained a pass in Physics, though the distinction rate did not lag far behind - 66.9% for boys and 61.1% for girls.

638 Seear et al, p. 49

Ordinary Level, with the category 'do not like it, cannot do it', eliciting the most responses for Mathematics, Physics, Chemistry and Physics-with-Chemistry.[639] The girls who had opted to study science subjects at Advanced Level made their choices based on interest more than on perceived attitude and only a minority gave voice to the idea that there were 'good prospects in science' or that their choice would be useful for a career; even fewer felt that school or their parents encouraged them to take up these subjects as information contained in the previous chapter of this study suggested. Seear *et al* also probed the reasons why the girls rejected science based careers and placed in front of their sample eighteen different examples of occupations requiring scientific qualifications. Engineering fared the worst by some considerable margin, being cited as being 'impersonal' and 'not suitable for a girl' and was the least popular option of all the careers cited.[640] In trying to ascertain why this was the case, the sample was asked to consider why so few girls wanted to take up engineering and although some replies focussed on the idea that it was 'dirty, messy, heavy and unfeminine', or that there was 'no future for girls in it', or that 'girls don't want to be pioneers', more emphasis was paid to the idea that it was 'a man's field' in which girls were 'not interested' and were 'never encouraged to try it'.[641] Ostensibly there was a 'need for more girls to obtain qualifications in applied science and technology' to meet the shortfall in employees experienced by employers in these areas. When, however, Glover and Kirton examined the issue of economic expansion within the engineering sector they found that although some 'women were seen as an

639 Seear et al, p. 50
640 Seear et al, p. 55
641 Seear et al, p. 56

available pool of labour', the extent to which the 'untapped' potential of female professional engineers was thought to be a solution to a pressing problem was less easy to discern.[642] Nevertheless such stark figures pertaining to university entry highlighted a state of affairs that had already prompted the Committee on Scientific and Technical Manpower led by Solly Zuckermann to report in 1962. This gave rise to a wide ranging, and somewhat tetchy, debate in the House of Commons in the same year, and was examined in detail by the committee on Higher Education, chaired by Lord Robbins, and presented to Parliament in October 1963.[643] This, however, was not an easy task to resolve. Those who formed Roberts' cohort for the Seear study, for example, pointed out that it was 'hard to get a training', or that 'it would take a lot of courage to be the only girl doing it', or that 'boys would get all the best jobs' and, as the findings of this part of the study concluded, this seemed indicative of 'a general aversion to the industry'.[644]

It has to be said that Metrovicks thought that it was possible to attract young girls into the industry and perhaps believed that, having engaged its first woman apprentice as far back as 1923, it was an organisation that was well qualified to counteract the disenchantment with engineering expressed by many young girls. As already noted, by the 1950s and 1960s the Education Department had rolled out an energetic programme which included staff visiting grammar schools to

642 J Glover & G Kirton, *Women, employment and organisations,* (London: Routledge, 2006), pp. 3-4

643 Committee on Scientific Manpower, 'Scientific and Technical Manpower in Great Britain 1962', Cmnd. 2146 (London: HMSO 1963); Science and Industry HC Deb 12 July 1963 vol 662 cc1527-661 hansard.millbanksystems.com.;Higher Education Report, (The Robbins Report), Cmnd. 2154 (London: HMSO, 1963)

644 Seear *et al.,* p. 27

encourage sixth-formers to take up engineering as a career, addressing pupils in the lower school at Speech Days, giving lectures to parents' associations about the benefits of Schools and College Apprenticeships, organising vacation courses at the Trafford Park works, producing educational films, issuing informative booklets and pamphlets and ensuring that these activities were widely reported in the press in an attempt to appeal to prospective trainees. That this programme appealed to young men is in no doubt. What is less certain is that all these activities were directed specifically towards engaging schoolgirls in the process. Hardwich noted that there was little literature produced that was designed to appeal to girls and found that even though English Electric was the only company to design material specifically directed at them, this was merely a booklet containing a few basic pieces of information about job opportunities.[645] On the other hand the substantial amount of publicity material circulated by Metrovicks, and targeted at prospective College and Schools Apprentices, made the assumption that the readership was exclusively male and thus included information about the male-only hall of residence, male-oriented sporting activities, male-only social occasions, and so on. Young females, who were required to possess 'the necessary qualities, aptitudes and *robust* (my italics) health' and wishing to embark on their training with the company were left in the dark as to where they might safely reside or socialise, or make progress within their career.[646] One of the many booklets issued during this period by the firm, 'Pre-

645 IEE NAEST 92A/5.5 Hardwich placed this booklet entitled 'Think About Engineering. There Are Opportunities For Girls With English Electric' in her archive. As she was an avid collector of material that related to the training of young women engineeers it seems surprising that there were not more pamphlets of this nature to be found.

646 MOSI YA 2001.228 'Pre-University Training for Professional Engineers', (Manchester:

University Training for Professional Engineers', was typical of this type of literature and gave the impression that young women were of minor consideration and that it was not necessary to include mention of them when describing the all-embracing protection of the Metrovicks '*fraternity'.* Bearing this in mind, the regular visits to schools made by Education Department personnel simply did not recognise or address the particular problems faced by girls wishing to enter the profession. The vocational and educational programmes it promoted were designed to stimulate interest in the application of science and technology in industry but the way in which this was presented concentrated on the needs of boys whom the Company knew were most likely to take up the majority of College and Schools Apprenticeships. Isabel Hardwich was keen to counter this state of affairs. Writing in her capacity as vice-president of the WES, she was eager to meet the challenge of what she described as 'an appalling ignorance of the meaning and content of engineering' which led to the belief that this was a profession that was 'unsuitable for women and women are quite unsuited to engineering'. [647] In the early 1960s, when student training through project work was beginning to be introduced into industrial training schemes for engineers, she became an advocate of this 'hands-on' type of technical and vocational education. This method involved a team effort controlled by a graduate trainee and took place after approximately ten months of practical experience within the industry. The project was often a small-scale version of an actual piece of industrial work, essentially a production exercise, and was intended to help trainees to decide on the area of engineering expertise in which they wished to specialise. It also helped the Company to assess the

---

Metropolitan-Vickers Electrical Company Limited), n.d., c. 1955

647 I.H. Hardwich, 'Women engineers in industry', pp . 22-23

capabilities of each individual employed on the task and the fact that it concentrated on team effort may well have made it more accessible to young women whose 'technical competence and emotional/social competence' often lay in this area, as Kelan suggested.[648] Hardwich's involvement in similar projects, such as the Schools Council Project Technology in 1968, was an acknowledgement of the fact that widening the appeal of engineering with projects tailor-made to meet the needs of young girls was only just beginning to gain ground. Metrovicks enabled her to take part in this work, but whether or not this translated into attracting more female College and Schools Apprentices to its ranks was hard to calculate. Hardwich made mention of the fact that more than twenty girls were in training in 1961, which marked a substantial improvement on the figure for 1955 quoted by Jackson and which was mentioned in the previous chapter. It has not been possible, however, to access any more up-to-date figures to prove the worth of this innovative approach to technical and vocational education within a school setting.[649]

The previous chapter surveyed the issues that surrounded the education of young women of the 'forgotten generation', and pointed out problems that existed where the provision of teaching in mathematics and science subjects was inadequate. As it was demonstrated, teachers at girls' grammar schools hardly felt that it was part of their remit to advance the cause of engineering as a career amongst their pupils. As Roberts noted, the 'upbringing of girls tended to direct their interests into personal and literary channels which were socially accepted as being

---

648 Kelan, p. 85
649 Hardwich, 'Women Professional Engineers in British AEI', p. 8

traditionally more feminine than physical sciences'.[650] She found that headmistresses taking part in her study agreed that 'our best girls prefer arts' and the heads also had confidence in the ability of the staff who taught arts subjects to nurture the aspirations of their pupils, but implicit in these statements was the idea that the same might not always apply to their science teachers. In stating, however, that 'only our best girls take the full range of science subjects', one headmistress inadvertently highlighted the fact that 'best girls' were always few in number, often because many schools simply did not have highly qualified teachers in the separate sciences. Dame Margaret Beckett, amongst other contributors, pointed this out in her interview. The delivery of science within girls' grammar schools had always attracted attention, though not in a way that was welcomed by most of them. For example, Sir Graham Savage, chief assessor of the Industrial Fund for the Advancement of Scientific Education in Schools, reporting in 1964, was critical of both teaching standards and the paucity of university places for science students and called for an improvement in the lot of the 'younger generation'.[651] This was hardly a startling revelation, and his observation that 'girls do not envisage careers for themselves in science' and that 'many headmistresses hold this view' was also reflected in the findings of Seear *et al.* Such dismissive, and somewhat unhappy, conclusions perhaps were to be expected from a Report that was couched in terms of male rather than female expectations and educational achievement. Indeed, whilst the Industrial Fund was set up in 1955 by

650 Roberts, in Seear *et al.,* pp. 13, 18, 19

651 IEE NAEST 92A/8.15 'Sixth Form Traffic Jam of Science Students', *The Times,* 2 March 1964; IEE 92A/7.4 Report of the Executive Committee of the Industrial Fund for the Advancement of Scientific Education in Schools, p. 54; H.G. Alston, 'Technological Training and Employment of Women', *The Woman Engineer,* 8:4, (Spring 1957), pp. 13-17

companies such as ICI, Shell and Vickers to help public, independent, and direct-grant schools to modernise their laboratories, only three girls' schools were given grants – Cheltenham Ladies College, Derby High School for Girls and Withington High School in Manchester. By the end of the decade this was to become the subject of further intense debate. With the possible demise of the single-sex grammar school looming, the tussle between the advocates of co-educational comprehensive education and those who wanted to maintain the status quo highlighted the problems that were faced by girls hoping to study subjects like engineering at university. Writing in *The Guardian* in March 1968, Margaret Higginson, Headmistress of Bolton School (Girls' Division), addressed those issues that had long attended attempts to attract girls to study mathematics and the sciences at Advanced Level.[652] In questioning whether 'social conditioning and the fear of appearing to excel in nakedly intellectual studies' held girls back or whether there was 'a real incapacity' on their part which accounted for them being 'less inclined' to study these subjects, she identified the concerns that formed the nub of the problem. She failed to consider, however, that 'too few' women honours graduates in mathematics and the sciences were entering school teaching and that to encourage more girls to do so necessitated 'providing good teachers for them', as Willis Jackson had pointed out a decade previously.[653] Her article instead focused on a criticism of the recommendations of the Dainton Committee Report which sought to reverse the tendency of sixth-formers to choose to study arts or

652 IEE NAEST 92A/8.14. M Higginson, 'If we really want more women scientists we ought to reverse the present trend towards coeducation', *The Guardian,* 18 March 1968, p. 7 She was the Headmistress of a highly selective school catering for girls who displayed exceptional ability across the curriculum.

653 Jackson,'Careers for girls in industry', p. 19

social science subjects and which she thought would 'greatly diminish the feminine competition for places at university'. She was, however, unable to offer any radical solutions, short of insisting that it was essential to keep the single-sex schools in order to guarantee wider access to university when only thirty per cent of places were allocated to girls across *all* subjects at this time.[654] Taking into account the fact that, as an influential educator, Higginson gave credence to the idea that it was possible to detect 'a characteristic sex difference' which explained why girls 'seek the human and personal' and feel 'instinctively that success in hard intellectual competition will not endear them to boys', pointed to the wider issues that have been discussed in the last chapter. She further suggested that these difficulties prevented 'the last great untapped reservoir of scientific talent' being mobilised. Inevitably her arguments drew responses that questioned the validity of her statements, which related closely to her stance on co-education and the comprehensive system but, surprisingly perhaps, did not address her thought-provoking views on the reasons why young girls chose to study particular Advanced Level subjects and chose to reject others.[655]

Much hot-air was generated on this subject and this debate rumbled on. Although an International Labour Office Enquiry (1954-1958) on apprenticeships for women and girls had reported that more emphasis should be placed on science and mathematics, Miss K.A. Kennedy from the Ministry of Education stated, with a fair

---

654 IEE NAEST 92A/8.9 A survey a decade later showed that 80% of girls studying on engineering degree courses had been to all-girls secondary schools. IEE NAEST 92A/8.27 M.J.Harthill, 'Engineering needs the woman's touch', *Engineering,* November 1979, p. 23.

655 IEENAEST 92A/8.14 Letters, *The Guardian,* 26 March 1968, p. 9 commented on her article on the study of science in girls' schools.

degree of complacency, that as far as the United Kingdom was concerned there were 'facilities' that were 'generally available' to those girls 'who want to take advantage of them'.[656] Reports and recommendations such as those from Zuckerman, Robbins and Dainton, however, took time to be absorbed and politicians and mandarins were ever anxious to ensure that a tight grip was kept on the level of government spending needed to implement such changes. Evidence from TNA files revealed obfuscation. Correspondence about the CASIG scheme, for example, was a pointed reminder that, at all levels, the issue of women's employment was not a priority as far as the government was concerned. Acting on behalf of the British Association of Women Executives (BAWE), Miss Nora Walley wished to inaugurate a scheme which hoped 'to give advice to schoolgirls', to help 'women to return to employment [after] bringing up families' and 'to bring to the notice of employers the vast untapped source of female executive talent'.[657] A letter from Miss D M Rogerson on 26 October 1967 to an unknown recipient, however, stated that she had advised Miss Walley that 'it was inopportune to try to press the claims of women' when there were 'a lot of good quality unemployed male executives available'. Although she continued to press for funding, Miss Walley was advised on more than one occasion that there was little point in pursuing any of the aims of the BAWE until 'the economic situation improved'. Despite believing that it was vital that the Association should at least continue its work in schools, it appeared from this evidence that she had little

656 TNA LAB 19/472, ILO Enquiry: Apprenticeships for Women and Girls 1954-1958

657 TNA LAB 829 Miss Walley was the director of a group of civil engineering companies. Financial assistance for setting up the Careers Advisory Service on Industry for Girls (CASIG) scheme 'was not forthcoming from anywhere', which was the reason why the BAWE turned to the government for help. Minute sheet dated 12 October 1965 from meeting between Mr. O'Donovan and Miss Walley.

success in extracting any support, financial or otherwise, from any quarter. Miss Walley's persistence did not pay off. By 1967 George Dorking, Minister of State at the Board of Trade, re-emphasised the reluctance of government to fund a scheme that was tailor-made for the needs of young women stating that the government believed that it was 'more in the interest of the girls themselves to use our resources in building up existing facilities than to subsidise an entirely fresh source of information'.[658] The declaration concerning 'resources' was sufficiently vague as to be almost meaningless to Miss Walley and the BAWE, as the main point that the organisation had been trying to make was that few 'resources' actually existed. A search in this section of the archive failed to find any more communication with her. She had been fobbed off on this occasion, though she was not to be dismissed altogether. In May, 1958 CASIG was launched to some fanfare and was greeted with enthusiasm by the CBI whose Director of Education and Training opined that it was time to 'give more attention to girls' as they were 'the largest untapped source of manpower' and 'maximum prosperity' demanded 'more participation by women in industry'.[659] Mary Stott, writing in *The Guardian,* noted that 'all the financial details have not yet been announced' and it was clear that although CASIG had been 'patted on the head by the Confederation of British Industry, the Industrial Training Foundation and the Careers Research and Advisory Foundation', there was some way to go before attitudes to women's

---

658 TNA LAB 19/829 Minister of State at the Board of Trade, 19 February 1967

659 CASIG was launched at Grosvenor House, Park Lane in the presence of Princess Margaret, Shirley Williams, the Minister of State for Education, and the founder president of the Femmes Chefs d'Entreprises whose members were taking part in the nineteenth international conference of the organisation in London in May, 1968.

employment changed.[660] Speaking at the opening ceremony, A A Bridgewater pointed out that a recent survey of women's employment carried out by the government revealed that 'one in every six working wives were working in spite of their husband's disapproval and two in six were working without any help with the washing up'.[661] Stott, the doyenne of campaigning journalism on behalf of women's causes, emphasised the fact that, indeed, there *was* some way to go before women could be taken seriously, also noting the fact that 'several hundred employees' of Miss Walley referred to their chief executive as 'Mum'.[662]

In much the same way as Miss Walley had been fobbed off, so too had Miss Hodgkiss of Bromsgrove who catalogued her difficulties in finding an engineering apprenticeship and in the answer to her letter to James Dance M P, an unnamed civil servant rather airily informed her that 'engineering apprenticeships for girls' were 'difficult to find' and 'the best way of overcoming prejudice' was for 'more girls to show an active interest in obtaining apprenticeships'.[663] For Miss Hodgkiss, and all the other young women like her, this was frustratingly close to being put into a 'Catch-22' situation. Within TNA files that were examined there was little to suggest that anything more than a few anodyne comments in draft reports and papers addressed the many issues that faced young women trying to prepare for

660 NAEST 92A/8.15 M. Stott, 'Women executives' way to advise girls on industry', *The Guardian,* 15 May 1968. It was clear from this article that Miss Walley was still plagued by the issue of funding and was having to resort to asking for a fee from those using the services of CASIG.

661 M. Stott, 'Women executives'

662 Perish the thought that Chandos' employees might refer to him as 'Dad'.

663 TNA LAB 715 Employment and Training of Girls 1961-5 Letter to James Dance M.P., P.O. 317/1964.The reply was penned by an unknown civil servant and the copy was left in the file. This was, presumably, written on the instructions of Dance, although it may well have been a 'standard' reply to such enquiries during the period.

and to forge careers in male-dominated industrial jobs.[664] In stating that 'far fewer girls than boys' equipped themselves 'for careers in science and technology', little attention was paid to the fact that this was a task that was far more difficult for girls, where specialist help was lacking, and where support was not always forthcoming. In further recommending in a draft paper that 'girls themselves should be persuaded to pursue science and mathematics to a higher level at school', because the 'disturbing' fact had emerged that 12% of girls passed examinations in physics in 1951 but the figure had dropped to 11.8% in 1957, there was yet another hint that it was believed that there was a degree of culpability on the part of young women for allowing standards to slip.[665] The fact that the Ministry of Education report, 'Technical Education for Girls' found that 'the woman who has taken an engineering degree at a university is still a rare phenomenon and only one was recorded in 1955' also spoke volumes about the inability of politicians to come to grips with the issues facing them in relation to the technical and vocational education of young women at this time.[666] The report also recorded the fact that the Institution of Mechanical Engineers included a mere 15 women graduate members whereas 40,000 men claimed membership; the IEE figures were 74 women and 40,000 men respectively. In stating that 'opportunities for women engineers are therefore rather hypothetical' and concluding that there was 'so much pioneering work to be done' the Ministry might well have been accused of displaying a degree of ignorance about those who had already 'pioneered' and

664 TNA LAB 19/522 Correspondence 1958;, 'Opportunities for Employment for Girls in Industry in the fields of Science, Technology and Engineering', 1958, for example.

665 TNA LAB 19/522 Draft Paper, pp. 1, 5

666 TNA LAB 19/522. Ministry of Education 'Technical Education for Girls', p.2, [n.d.] This part of the file was also referenced HQ 497-60 7/57 EL, though there was no hint as to what this meant.

those who were still 'pioneering'. The Ministry might also have been accused of having failed to recognise that this situation was, to a large extent, the result of political inertia. In displaying a complete disregard for initiatives put forward by the likes of Miss Walley it was demonstrated that the needs of young women could, by and large, be put to one side.

It was convenient to place the blame for the fact that so few girls were inspired to excel in science and engineering on some failing on the part of the young women themselves but this would be to ignore the often fractious debate that was taking place in the 1950s and 1960s about the recruitment and training of young people in industry. This became a running sore where tangled political negotiations characterised the inability of government to come to grips with the subject and, as already noted, this was best characterised by the publication of the Carr Report (1958), the Industrial Training White Paper (1962-1963) and the Industrial Training Act (1964).[667] The Act had three objectives – 'to enable decisions on the scale of training to be better related to economic needs and technological developments', to improve the overall quality of industrial training and to establish minimum standards, and to spread the cost more fairly. Hansen has written with a great deal of clarity about the complicated background to these initiatives and has identified the problems associated with apprenticeship schemes, the failure to produce numbers of appropriately skilled workers needed to boost the economy, and the

667 TNA LAB 18/833 Industrial Training White Paper 1962-1963. Press Notice Ministry of Labour, 5 December 1962. National Joint Advisory Council, Training for Skill: recruitment and training of young workers in industry (the Carr Report), (London: HMSO, 1958). Industrial training: Government proposals. Cmnd. 1892, paras. 6-7 (London: HMSO, 1962) The Industrial Training Act 1964, (London: HMSO, 1964)

looming spectre of 'the Bulge' entering the workforce.[668] More importantly, his critique suggested that there was a great deal of hesitancy on the part of politicians about the implementation of radical change in the system. In any case, the setting up the Industrial Training Boards (ITB) laid down by the Act was, as Hansen suggested, a long-winded process and faced resistance from trades unions and employers alike.[669] Little of this activity was directed at improving the position of young women setting out on a career in the industrial sector. The suspicion was hard to avoid that their needs were side-lined in the rush to impose legislation that was intended to solve the skills crisis and, in any case, lukewarm attitudes towards the place of professional women within the industry were prevalent. Their ability to make a real contribution towards the resolution of this problem was made extremely difficult by the fact that, as Brock stated, 'a scarlet thread of prejudice' ran through the idea that women should be accepted in positions of authority.[670] Furthermore, in suggesting that 'women will not be accepted by men' as 'valuable reinforcements; they will remain 'the weird sisters' ' and noting that, as a result, 'women have not gained so much as a toe hold on the south col in the industrial world', Seear *et al* voiced the unpleasant truth that prejudice and discrimination went hand in hand during the period covered by this study.[671]

---

668 G B Hansen, 'Britain's Industrial Training Act: its history, development and implications for America', U.S. Department of Health, Education and Welfare, Office of Education. Prepared for the National Manpower Policy Task Force, April 1967.

669 Industrial Training Boards represented both sides of industry, set standards, provided advice and paid allowances to trainees all of which was financed by a compulsory levy on firms within each industry.

670 J Brock in Seear *et al, A Career for Women in Industry,* p. 92

671 Brock, p. 93

As far as Metrovicks was concerned, however, the company managed to maintain its reputation for providing the very best technical and vocational training for every category of apprentice; there is little need to reiterate the fact that Fleming's initiatives served as a role model throughout the industry. Indeed the critical comments made by Lady Gertrude Williams, a forceful and authoritative voice on the ineptitude of industry to properly train 'a flexible and adaptable work force' to meet 'the extreme rapidity of technological change', might well have applied to many firms but could hardly have been laid at the feet of the management at Trafford Park.[672] Hence the Carr Report recommendations and the subsequent passing of the Industrial Training Act had less of an impact on Metrovicks than on the companies that were less well-equipped to deal with the ramifications of this legislation. On the face of it, therefore, the young girls taking up Metrovicks College and Schools apprenticeships in the 1950s and 1960s might well have believed that they were uniquely placed to profit by a system that appeared to welcome female trainees into its ranks. From 1915 onwards, when Entwisle found that the chief engineer had been happy to accept her onto his staff, there seemed to be no overt prejudice against training women as engineers. The company eschewed the kind of response that had once been demonstrated by Ferranti in a letter to the Chairman of Cammell-Laird. On behalf of a female relative studying engineering, the Chairman had enquired about a temporary placement for her within the firm. Ferranti, however, made it clear that the policy of the firm was to encourage women 'in the study of domestic electric development' which was 'by

672 G Williams, 'Industrial Training and the Future', pp. 149-153, Technology and Society. The First Bath Conference, (Bath: Bath University Press, 1966)

far the most useful to which any *lady* (my italics) engineer can apply herself'.[673] To be fair, the Cammell-Laird supremo admitted that 'none of the works with which I am connected take women engineering apprentices', a discriminatory attitude which Metrovicks, having once laid claim to reject, continued to reject in the post-war period. There was, however, a different way of interpreting these facts. The trailblazers, Entwisle, Dorothy Smith and Pearl Swan, were not followed by large numbers of entrants to the firm. As Hardwich suggested 'no special effort' had been made to recruit women and in any case, as she pointed out, the company 'took a risk' when it employed 'a young woman to try to offset the wartime shortage of men engineers'.[674] Before 1945 Metrovicks was not prejudiced against women especially where wartime exigencies were concerned. Like the rest of the engineering industry, however, it presented itself as a place where women were able to be employed in a wide range of occupations as long as in some way, these facilitated the ability of men to 'avoid blind alley work' as Fleming said of women who performed the menial tasks in the Research Department. It was more difficult to see that it was able to present itself as a place where women engineers were welcomed on the same terms as men. The reality and the rhetoric were often at odds in this respect.

Although the women engineers interviewed for this study were keen to say that they experienced little in the way of prejudice, they seemed oblivious to the fact that they played this factor down. Incidents they described did suggest that they

673 MOSI YA 1996/10/3/1/64. W.R. Hitchens to Mr. Ferranti 11 April 1932. Reply dated 19 April 1932

674 I H Hardwich 'Women Professional Engineers, pp. 1-2

were discriminated against although when they were asked if they thought this was the case, they brushed this aside. Dame Margaret Beckett remembered that it was the senior individuals at Metrovicks with whom she came into contact who had always been supportive of her, but they were few in number and were in positions of authority and she presented no threat to their status. Men who were further down the 'pecking order' often made life more difficult, as Joyce Sewill for example had also suggested. On being questioned about this, Dame Margaret said that it was possible to avert difficulties of this nature but further asserted that 'you were always looking for a department where you would fit it'. The idea that that young women were not just searching for a stimulating work environment but were also anxious to avoid situations where tension in relation to their position might occur was not one that she had 'thought about'.[675] Other women quoted in this study also expressed the idea that they too looked for a 'niche' area within the industry where they might 'get on'. Rather than being involved in male dominated 'mainstream' engineering activities, they suggested that their involvement in more peripheral activities was either 'their choice' because of family commitments, as in the case of WES2, or that their competencies were ignored. Sewill and WES1, for example, were unable to identify reasons why their careers languished when their qualifications were on a par with their male colleagues and they worked extremely hard in order to produce work of 'a really good standard'.[676] Their puzzlement over the reasons why they were not offered promotion indicated that there was an element of denial about the extent to which prejudice and discrimination had taken place. Their stoicism, nonetheless, in seeking to overcome the additional hurdles

675 Interview Dame Margaret Beckett
676 Interview WES1

that they faced in dealing with entrenched notions of male hegemony was obvious from their comments.

A working party report on behalf of the Institution of Civil Engineers looked at these issues in 1971 and suggested that, as 'the weaker sex' women would not be able to cope with the 'roughness' of the 'general working conditions' but added that any prejudice that was encountered 'was not of a belligerent nature'.[677] To be fair to the members of the working party, their findings did not necessarily reflect their own views on the role of women within the industry but were the results of a survey of employers carried out in 1969. Indeed one member of the working party, Sir John Baker, was keen to point to point out that there was 'a good deal of built-in, even unconscious, prejudice' against women. The general conclusions reiterated the need to provide the same technical and vocational education and training for both young women and men, insisted that women were 'welcome' within the industry, but nevertheless wished them to confine their activities to 'theoretical' departments such as design or research where they were less likely to be put in authority over men. [678] This tied in with Fletcher's research which showed that the 'feminine' side of work, that is, emotional intelligence and relational behaviour often 'gets disappeared' and viewed as inappropriate in the hard world of heavy engineering and she suggested that this had profound implications for any attempts to change organisational culture in a radical way.[679] Organisations

677 IEE NAEST 92A/7.14 'The Role of Women in Engineering', Report of a Working Party. The Institution of Civil Engineers. Reprinted from *Proceedings of the Institution of Civil Engineers,* 48: (Feb. 1971), p. 349 .
678 'The Role of Women in Engineering', pp. 343-344
679 Fletcher, *[Women Engineers] Disappearing acts*

like Metrovicks were unlikely to have changed this culture even if they had wanted to (and this seems unlikely) and as a result the young female College and Schools Apprentices found themselves channelled into these 'feminine' areas of work in research, design, or sales for example. The suspicion that the Company was content to see them so placed was hard to resist. To make much of the idea that every female engineering apprentice was able to pursue a career like that of Gertrude Entwisle, Metrovicks' female icon, was to deny the reality of the situation for women such as Joyce Sewill and all the others like her. Despite the intensity of purpose shown by 'exceptional' women like Isabel Hardwich, the WES was also incapable of making an impression on entrenched notions of male hegemony in an industry composed of bullish rhetoric and equally bullish attitudes. The WES, however, lives on; the world of the heavy electrical engineering industry struggled to survive to the end of the twentieth-century.

Conclusion

This thesis has demonstrated that Metropolitan-Vickers Electrical Engineering Company based its claim to be regarded as an 'industrial giant' on the abilities of both its highly skilled craftsman and of its professional engineers who thought of themselves as 'the aristocrats' of the electrical engineering industry. In addition, it has been shown that the renowned research facility and the education department headed by Sir Arthur P M Fleming was not only home to world-class scientists and engineers but also offered a pioneering apprentice training system that drew to its ranks both undergraduates and graduates who wished to become professional engineers. Young women who wished to be accepted into this male-dominated environment, however, faced a number of difficulties. It has been demonstrated that societal pressures during the 'long 1950s' did not encourage them to embark upon professional careers and, in any case, their grammar school education had not prepared many of them so to do. This thesis has also shown that the 'exceptional' young women who did manage to negotiate a place for themselves within the industry faced a great deal of prejudice. Some of this related to the idea that female skills and competencies did not fit easily into male perceptions of what was required to become a successful engineer. Many pressures were put upon these women, one of which related to the image that they presented to a public unused to seeing females taking on what were considered to be male-only occupations. Other factors concerned the issue of 'wastage' when they had to take a career-break to raise a family, and their subsequent inability to find a job when they wanted to return to full-time work. This thesis has also shown how the

attempts of the Women's Engineering Society, particularly Isabel Hardwich, to negotiate a better position for its members was not always successful and that the organisation was unable to act as an effective pressure group in order to initiate change in the industry and to influence government. This thesis has demonstrated that there were not enough appropriately trained scientists, engineers and technologists, especially young women, during this period and this led to a skills crisis within British industry. The debate that centred round this issue was fractious. It has been shown that the ways in which different agencies thought that the problem might be resolved elicited a mixed response from government, civil servants, educationalists, the Women's Engineering Society and Metrovicks alike.

This thesis has highlighted a number of contentious issues. In the first chapter the proposition that Metrovicks wished to be portrayed as a 'giant' of the engineering industry came under scutiny. It was shown that the fact that the company only occupied the fifteenth place in the rankings of large industrial concerns in Britain, and it only achieved this standing because it was regarded as part of the AEI consortium, meant that Metrovicks had to find another way by which to so define itself. It was further demonstrated that one of the distinguishing features of the company was that its highly skilled labour force and its engineers and scientists, who had acquired a world-class reputation for industrial research and development, ensured that their reputation as 'the aristocrats of the engineering industry' was more secure. This claim was contested especially by BTH and, to a lesser degree, by firms such as English Electric and Ferranti Limited. Evidence contained in this chapter showed that all these organisations had developed along

the same lines as Metrovicks, but at a slower rate and on a smaller scale; the research facility at BTH, Metrovicks' main rival, demonstrated this fact. Whilst Ferranti could not be faulted for the far-sightedness of its founding fathers in this respect, this was a smaller family-run firm and to make comparisons with the Trafford Park operation was much more difficult. It was also shown that the business acumen displayed by the company hierarchy, especially Lord Chandos, was questionable. His capacity to understand the workings of the City and to bring much needed investment to the AEI group as a whole was initially successful, but it has been demonstrated that this led to over-confidence and an inability to resolve the financial problems that he had created. In addition, his management style was often at odds with those who understood the engineering industry far better than he, and he created unnecessary friction as far as professional engineers were concerned. Other problems also stood in the way of progress in the late 1950s and 1960s. Metrovicks ran a large operation at Trafford Park but its position as a constituent member of the AEI group meant that it often became difficult to respond quickly to the challenges presented by the new technologies that were beginning to emerge during this era. Oral testimony has suggested that the firm was hampered by its size, and began to cling to outdated methods. It has also been shown that the decision to combine Metrovicks and BTH into one company and to cease using separate names led to a loss of identity in the market as well as a narrowing of its product base. This chapter pointed out the difficulties faced by the whole of the electrical engineering industry during the 1960s which resulted in the crisis that brought about the demise of AEI in 1967 when it was taken over by GEC. Chandos in his pomp had personified AEI in the early 1950s

but Metrovicks had only ever been a part of that group. This thesis has argued that Metrovicks' claim to be regarded as an industrial 'giant' headed by a member of a leading aristocratic family, along with all the connotations that this involved, was difficult though not impossible to sustain.

This thesis has also established that surprisingly little attention has been paid to a company that was so well-known and so well-regarded in the north-west region and in Britain and the rest of the world. As a result there is scope for a much more extensive survey to be undertaken by future historians. Although a few doctoral theses have concentrated on aspects of the industrial research and technological innovation undertaken by the firm, and one book has investigated the merger of AEI with GEC, this is the first piece of research that has attempted to determine the place occupied by Metrovicks within the electrical engineering industry during this period. It is also the first piece of research that has set out to investigate and to reflect upon the corporate culture that was developed by the company which in no small measure led to the belief held by the workforce that they were the 'aristocrats of the engineering industry' and that Metrovicks was a 'giant' company within that field.

The second chapter of this thesis also established that corporate culture was a 'slippery' concept and not easily defined. To an extent it was image based and thus there were many ways in which it was possible for to it to be developed. Metrovicks' corporate culture was sustained in large measure by Fleming's vision of the centrality of apprentice training to the identity of the firm, a vision that

sometimes seemed purblind to the needs and aspirations of its female population. His structure, nonetheless, was held in high regard and was subject to little criticism at Metrovicks. Indeed it has been shown that this form of training served as a paradigm for the rest of the industry, and educationalists and politicians alike took note of the way in which it was configured and urged others to follow in its footsteps. This system drew upon aspects of Fleming's own experience of growing up during a period when Britain's imperial power was at its zenith. It has been argued that some of his early writings, especially those concerned with identifying the type of young man best suited both physically and intellectually to be taken on as an apprentice, owed much to the theories of Kerschensteiner, and to his own training at the American Westinghouse company. It has been further argued that he was greatly influenced by the ethos developed within the public schools that was one of the mainstays of the ruling elite who built and administered the empire. This thesis demonstrates that this was a system from which Fleming took inspiration. The thinking that lay behind the organisation of the College and Schools apprenticeship system also played an integral part in the way in which the corporate culture fostered by the company was conveyed to its workforce. Thus it has also been shown that Fleming sought to infuse a sense of 'fellowship', of 'loyalty and comradeship' into this system and these ideas also informed the way in which the rest of the workforce was encouraged to ascribe to the image that the company was eager to promote. This thesis has pointed to the fact that female apprentices were excluded from that interpretation of 'fellowship' that owed much to the ethos of the public school. This ran counter to the ways in which young women thought and operated and left them having to negotiate a

social minefield based on constructs that were foreign to them. Their inability to identify with the expressions of male solidarity that were communicated to the apprentice body as a whole by Fleming and other senior executives of the company meant that it was difficult for them to negotiate a place for themselves in a male-dominated environment that was not always eager to welcome them and, as a result, their progress in it was fraught with difficulties.

Sir Arthur Fleming has largely disappeared from the record. This thesis is the first piece of research to give full attention to the influence that he exerted over apprentice training both at Metrovicks and within the electrical engineering industry as a whole. His pioneering methods were lauded by politicians and educationalists not only during the period under consideration here but dating back to the period prior to the outbreak of the first world war. The way in which he was able to forge links with the universities resulted in a cross-fertilisation of ideas and an exchange of personnel that was conspicuous both within the industry and the academy alike. Importantly, this ensured that the influence of these links on the apprentice population was paramount. It has also been demonstrated that he was, uniquely perhaps, a complex mixture of both innovator and conservator as far as his system of technical and vocational education was concerned. Adopting aspects of Muscular Christianity found within the English public school way tradition did not, however, dull his admiration for, or prevent both his endorsement and his implementation of, the modernising influences that he found in continental thinking and in American methodologies. This dichotomy has been explored in chapter two, a chapter devoted to the pivotal role that he assumed in the history of

research and education at Metrovicks. That Fleming supported individual female apprentices has been demonstrated by evidence contained in this thesis. It has been far more difficult to assess the extent to which he actively encouraged them to join the company. The fact that his successor, Sir Willis Jackson, felt that it was necessary to redefine the term 'engineer' in order to attract more young women onto the College and Schools apprenticeship courses may have been indicative of Fleming's stance on the issue. The time is ripe, therefore, for a fuller appraisal of his work in order to examine critically his contribution to technical education in this country.

The third chapter of this thesis showed that those young women who were apprentices at Metrovicks during this period were part of the 'forgotten generation' whose experiences have, to some degree, been overlooked by historians. It has been shown that this thesis has attempted to contribute towards reviving an interest in exploring their education and their workplace training. When world war two ended pressure was placed upon all women to once again centre their lives within the home and the family. This thesis has demonstrated that pressure was also applied to young women to accept a trope of femininity that valued marriage and motherhood above the pursuit of a professional career, especially one that involved working in a male-dominated environment like the engineering industry. It has been demonstrated that their grammar school education played a major part in influencing the career choices that were available to young girls during this period. In a society that seemed to value continuity over change in the aftermath of the upheavals of the second world war, there was a tension between the desire

of many young girls to express their independence and a grammar school education which was careful to emphasise and encourage docility and obedience in their pupils in order to reinforce these societal expectations. The grammar schools, and other concerned adults, wished to shelter girls and preserve in them a 'ladylike' demeanour more redolent of Victorian notions of femininity than of the mid-twentieth symbolism of the 'New Elizabethan Age'. Girls' grammar schools were not always adept at encouraging ambition, and the aspirations of many students were thwarted. This thesis has pointed to the bias towards the arts in the curriculum and the failure to offer opportunities to girls wishing to study science, where teachers were neither qualified nor always available to teach these subjects. It has also been pointed out the generation of schoolmistresses who taught during this period were unfamiliar with the workings of industry and commerce and this had a bearing on the informed advice that they were able to offer to their pupils. This thesis has shown that a number of influential educators and commentators during the 1950s and early 1960s enshrined in their thinking the idea that only a small percentage of the population of the girls' grammar schools were to be regarded as 'exceptional' pupils who might benefit from a university education. It has also been pointed out that, in any case, the paucity of university places offered to young women during this period meant that only these 'exceptional' candidates were able to gain entry to courses that would enable them to put themselves forward as College Apprentices at the company. The untapped reservoir of young women who might have wished to train as apprentices but were not granted places at university turned to more traditional preserves for young women, such as teaching or nursing. This thesis also demonstrated that, although

issues of class have been explored by a number of other historians, it was these factors that appeared to be more inhibiting as far as the education provided by the girls' grammar schools were concerned.

The final chapter of this thesis showed that although there was only a slow shift in perceptions about the position of young women both in the workplace and in society at this time, some were able to push back boundaries and confront stereotypical assumptions about their ability to become professional engineers. It was also demonstrated that the pioneering women in fields of science and engineering in the nineteenth and early twentieth-centuries had faced a number of obstacles that had been difficult to overcome. It has been further demonstrated that these problems had not been resolved by the time the female College and Schools apprentices at Metrovicks began their training. They were not welcome in male-dominated areas of the workplace, such as the shopfloor, nor were they always welcomed in other areas where the hegemony of male professional engineers might be challenged by their presence. This thesis has also shown that, in contrast to male apprentices, females often faced difficulties when trying to gain access to vital parts of their training and sometimes had to struggle to complete the work necessary to finish their course. It has been further demonstrated that the work that was given to women was dull and routine and that they were often side-lined from taking on the more stimulating and demanding tasks that were instead allocated to men. In addition, 'hidden' prejudice attended the idea that female engineers were 'exceptional' and because they wished to engage with technology which was a male preserve and, therefore, they were not like other

women. Their skills and competencies were often called into question and this thesis has investigated the way in which this put pressure on women to conform to an image that emphasised their femininity and their willingness to conform to the societal expectations that applied to all women during the 'long 1950s'.

This thesis has explored the role played by the Women's Engineering Society, especially Isabel Hardwich at Metrovicks, in trying to ameliorate this situation and to help women to make progress within the industry. The Society was numerically weak and found it difficult to present itself as a significant caucus both within the industry and within political circles where decision makers tended to focus on encouraging males rather than females to develop their skills and secure their place within the profession. It was also shown that young women were faced with dilemmas about taking career-breaks to bring up children or care for members of their wider family circle. The issue of 'wastage' occupied the Women's Engineering Society and although a spirited defence of women was mounted, this thesis demonstrated it was difficult for the voice of the Society to be heard during this era. As women were perceived to be encroaching on a male-dominated environment, aspiring 'returnees' found it difficult to secure a place for themselves if they had once left the industry for a length of time, and many had to be content to diversify and use their talents and expertise in areas like teaching. Even if, exceptionally, they managed to return to engineering they found themselves downgraded so that they were unable to undertake 'mainstream' engineering activities, and had to be content with work that was peripheral to the main focus of projects or enterprises. This thesis shows that when the 'Brain Drain' during the

1950s and 1960s resulted in a loss of scientific and technological expertise, this 'skills' crisis did not result in women returnees being offered the jobs that men had vacated. No large scale initiative was launched in order to entice them back into the industry and, indeed, the idea that women should replace these men was met by silence.

Research into the work undertaken by the Women's Engineering Society during the 1950s and 1960s has been scant, and no large-scale critical analysis of its activities during this period has been written. This opens up the possibility of developing many of the themes surveyed in this thesis to wider scrutiny and to a lengthier discussion than the space here has permitted. The part played by doyennes of the Society, such as Isabel Hardwich at Metrovicks, is in need of further examination and a comparative study of the way in which other engineering companies, aside from Metrovicks, enabled the members of the WES to promote its activities and to engage in the education and recruitment of young girls into the profession is overdue.

This thesis has demonstrated that it was necessary to have been an 'exceptional' young woman in order to have become a College or Schools apprentice at Metrovicks but it was not necessary to have been an 'exceptional' young man. Comparatively large numbers of men of differing abilities and talents became apprentices and were shepherded towards securing flourishing careers in the engineering industry. It has been shown that, although politicians recognised that it was extremely difficult for a girl in Britain to become an engineer, the government

response to this problem was muted. Evidence from The National Archive has shown that the needs of young men were put before the needs of young women as far as the ability to access training was concerned. In addition, initiatives by women already established in their careers that were intended to help to young women were stifled. It was further shown that politicians, civil servants, educationalists and other interested parties accused young women of taking little interest in studying science and engineering whilst at grammar school. This ensured that the blame for their inability to pass examinations in these subjects in order to be able to enter university rested on the girls themselves rather than on any other single cause. It was shown that, without support and encouragement, it was unsurprising that so few of them went on to study engineering at university. Although Metrovicks and the Women's Engineering Society worked to counteract the lack of commitment on the part of politicians, the response of both organisations to rectify this situation was not adequate enough to ensure a better place within the industry for 'forgotten generation' of female apprentices and young women starting out on their careers.

This thesis has highlighted many areas that have been overlooked by historians, and these have already been mentioned. Recent initiatives such as STEM have increased awareness of issues that affect young women within the industry today. Many of these issues were faced by female apprentices during the 'long 1950s'. The fact that they remain unresolved suggests that there is scope for a comparative study of both groups of young women in order to highlight the most acute of these. There is also scope for an investigation into the way that women

engineers in other countries fared during this period. Contemporary sources and a few brief references in the literature have suggested that there were differences between the way in which engineering as a career for young women was viewed in continental Europe, the former USSR, and a number of far-eastern countries and the way in which it was viewed in the United Kingdom. This might well be a fruitful area of research for historians of science to undertake in the future. Finally, this thesis was unable to take account of women, such as coil winders, who worked in areas of the shopfloor that were reserved only for females. Metrovicks, as well as other engineering companies and the various trades unions barred them from taking up apprenticeships. It was impossible, therefore, to conduct a comparative study in this area. As some of these women who worked at Trafford Park, however, were able to exert a degree of influence on fellow workers and on the company hierarchy, this opens up further lines of research in order to create a fuller picture of women who worked in the engineering industry during this period.

In summary, this thesis has demonstrated that Metrovicks occupied an important place in the history of the electrical engineering industry both within the north-west region and beyond. The reputation of the company rested not only on the technical abilities of its highly trained workforce but also upon its renowned research facility whose members criss-crossed the divide between the universities and industry. In this way their expertise enhanced the technical education of College and Schools apprentices alike. The pioneering apprenticeship scheme inaugurated by A P M Fleming enabled a few 'exceptional' young women to enter the industry. Along with societal expectations, the grammar school education

offered to girls during the 'long 1950s' did not encourage them to undertake this type of training and once they entered the profession they were often met with hostility or 'hidden' prejudice. Isabel Hardwich at Metrovicks, and the Women's Engineering Society worked to overcome discrimination but this was a difficult task when so many different factors impeded women's progress, such as 'wastage', family commitments, and questions that were raised about their skills and competencies. Few initiatives were undertaken to relieve this situation and government agencies were slow to act upon recommendations for change that came for various quarters within industrial and educational circles.

BIBLIOGRAPHY

Archives

Bodleian Library

Marconi Archive

MSS Marconi 2859-2871 P.9.2	*Metropolitan-Vickers Gazette* 1937-1958
MSS Marconi 3041-3066 R.4.5.a	*AEI News* 1931-1956
MSS Marconi 3067-3077 R.4.5.6	*Topic* 1956-1967
MSS Marconi 3089-3096 R.5.4.a	*AEI Engineering* 1961-1967

Museum of Science and Industry, Manchester (MOSI)

British Westinghouse Electric & Manufacturing Company Limited Archive

YMSO.176	Photographs showing the erection of the British Westinghouse works at Trafford Park
YA 2003.109	British Westinghouse bulletins. Research Library, Vols III and IV, A.P.M. Fleming.

Ferranti Limited Archive

YA 1996.10/3/1/2	General recruitment leaflet – 'O' and 'A' Level students, c. 1984 L/WIE/01/045/10m
YA 1996.10/3/1/7	'Progress with Ferranti. There is a wide scope for Youth in the Ferranti Organisation'. Poster reprint from *Manchester Guardian,* 1955
YA 1996.10/3/1/11	Careers for University Graduates in Electrical Engineering, Physics and Mathematics. List Careers/UG/1. 1958
YA 1996.10/3/1/12	Careers with Ferranti for University Graduates. List/Careers/UG/2. 1967
YA 1996.10/3/1/32	Apprentice Training Schemes. List Careers/ATS/101. 1958

YA 1996.10/3/1/34	Apprentice Training Schemes at Ferranti including computer maintenance apprenticeships. List Careers/ATS/102. 1963
YA 1996.10/3/1/61	Correspondence
YA 1966.10/3/1/64	Correspondence: apprentice training. Letters: W.R. Hitchens to Mr. Ferranti
YA 1996.10/3/3/1	'Your First Step on the Road to a Successful Career', Booklet L/GR/01/114/10000, [n.d.] c. 1985
YA 1996.10/3/3/75	'The Story of Ferranti Ltd'. Brochure reprinted from 'Electrical Industries', 23 February 1927
YA 1996.10/3/3/93	'S.Z. de Ferranti Pioneer of Electric Power'. Booklet by A. Riding, the Ferranti archivist. Published by the London Science Museum, 1964
YA 1996.10/3/3/144	'Yesterday and Today – A Brief History of the Ferranti Organisation', November 1957
YA 1996.10/6/6/10	Programme details etc: Inauguration of the Ferranti Atlas Computer at Manchester University, 7 December 1962.

Metropolitan-Vickers Electrical Engineering Company Limited Archive

YMSO.176	Photographs showing the erection of the British Westinghouse works at Trafford Park
YA 2003.109	British Westinghouse bulletins. Research Library, Vols III and IV, A.P.M. Fleming.
YA 1996.139/8/neg/SP 4679	Easter Vacation School
YA 1996.139/8/neg/12 /4749	Monthly graph of female workers trained in the Works School, [n.d.]
YA 1996.139/8/neg/SP 6301-16	Soviet Delegation of Power Engineers
YA 1996/139.8/neg/SP 6727-46	Opportunities for Young Women in Industry
YA 1998.16	British Westinghouse Club News Vol V Nos 2-61 and Nos 63-66 The Metropolitan-Vickers Club News Vol V Nos 67-76; Vol VI

	No 78-Vol VIII No 116; Vol VIII No 118-Vol IX No 138; Vol IX No 140-Vol XII No 196 AEI News Vol 1 No 1-Vol 6 No 12
YA 2001/228	Booklet: Pre-University Training for Professional Engineers, (Manchester: Metropolitan-Vickers Electrical Engineering Company Limited), [n.d.] c 1955

Peter Damson Collection

YA 1996.1735/MS053 1/2	**Notes entitled "The Holy Forty", May 1937**
YA 1996.1735/MS053 1/10	'Bridging the Gap'. A brief outline of research at Trafford Park
YA 1996.1735/MS053 1/13	'Metropolitan-Vickers – A Great Electrical Concern', [n.d.]
YA 1996.1735/MS053 1/17	Summary of proceedings of the Second Metropolitan-Vickers Summer School on engineering practice and training, 20-24 April 1936
YA 1996.1735/MS053 1/178	'85 Years in Trafford Park', GEC Turbine-Generators Ltd.
YA 1996.1735/MS053 1/188	Booklet entitled 'Welcome to Trafford Park Works'
YA 1996.1735/MS053 1/208	Photocopy of article by Joyce Sewill, 'A woman in a man's world', *IEE Review,* June 1989
YA 1996.1735/MS053 1/209	Press cuttings
YA 2003/50/1/2/174	Report on Organisation of M.V. Research Department, Report No 4207, 1924
YA 2003/50/1/2/665	Research Department Report No 4705. Dorothy E.M.Garfitt, 'A Study of Switching Phenomena in Inductive DC Circuits', Degree of M.Sc.Tech., The University of Manchester, [n.d.]
YA 2003/50/1/2/1015	Metropolitan-Vickers Electrical Company Limited. Research Department Report No 5071, 1956. 'The Digital Computer As An Aid To The Electrical Design Engineer'

YA 2003/53/1/1/108	Photographs: 2ZY
YA 2003/53/1/1/2	Souvenir Brochure.”Laying the Corner Stone”, Westinghouse Works, 3 August 1901
YA 2003/53/1/5/1	Introductory information: MetroVick Education Department, [n.d.] c.1950
YA 2007/48/1	Associated Electrical Industries (Manchester) Ltd. Apprentice Hostels and Clubs [n.d.] c. 1960

Frank Harris Collection

YA 1999/39/4/3	'Education for Industry'. A Description of the Apprenticeship Courses and Methods of Training of the Metropolitan-Vickers Electrical Company Limited. Special Publication No 7985/1 [n.d.] c. 1938
YA 1999/39/4/6	*Rotor,* 26 (Summer 1943)
YA 1999/39/4/7	*Rotor, 26* (Christmas 1943)
YA 1999/39/4/9	Metropolitan-Vickers Electrical Company Limited. '1899-1949. Fifty Years in Brief'. Brochure compiled to celebrate the Golden Jubilee of the Metropolitan-Vickers Electrical Company 1949

J.G. Hardman Papers

YA 2008/14	Documents relating to the 1010 AEI Computer

Sound Archive

	Interview with Peter Balmer, Learning Studio 2, 11 February 2010

Institution of Electrical Engineers (IEE)

Sir Arthur P.M. Fleming

NAEST Box 2

070/7	'The future of the plastics industry'. Presidential address to the Institute of the Plastics Industry, 24 November 1944
070/8	Speech to the British Electrical and Allied Industries Research Association, 9 February 1945
070/11	**'The impact of science on industry'. Manchester College of Technology, 21 February 1946**
070/12	'The Section', Twentieth Annual Dinner, College and Schools Section,Apprentice Association, 22 February 1946

070/18	'Industrial Research and the Training of Industrial Personnel in Great Britain'. Address to Konkinklyk Instituut van Ingenieurs, 8 September 1946
070/22	'Education of Engineers'. Speech given to the Engineers' Association, Pretoria, 15 October 1946
070/31	Education and Training in the AEI Group
070/32	'The place of the engineer in the post-war world', IEE Student Lectures, 1947-8
070/33	**Metropolitan-Vickers report on a visit to India. Exchange of apprentices, 31 December 1946-9 February 1947**
070/36	'The Education of the Man of Science'. Address to the British Association for the Advancement of Science, Dundee, 2 September 1947
070/43	'The practical training of professional electrical engineers', draft, *M-V Gazette,* January 1948, [n.p.]
070/44	A.P.M. Fleming and K.R. Evans. Report 'Education Schemes in Industry, [n.d.] c. 1948
070/48	'Research and development in relation to the economic conditions of the times'. Address given at University College, London, 28 January 1948
070/50	'The part being played by scientific research and industrial education in Britain's economic recovery'. Address given to the 113th National Meeting of the American Chemical Society, Chicago, 19-23 April 1948
070/52	Report to the National Advisory Council for Education in Industry and Commerce. The North-West Regional Council, 1948
070/57	'The Young Worker in Industry', British Association for the Advancement of Science, 13 September 1948
NAEST Box 3	
070/64	Speech given at Urmston Grammar School Speech Night, 9 February 1949
070/65	'Training in Industry'. Report to the Parliamentary and Scientific Committee on Technical Education, 5 April 1949
070/77	Report of a visit to Canada and the USA to discuss exchange of overseas students as apprentices at AEI, 15 March-17 May 1950
070/88	'The organisation of research to deal with the problems of power generation and utilization'. World Power Conference, Delhi, January1951

070/101	'Technical training in the United Kingdom', Address to The British Council, 5 July 1951
070/106	'Training Within Industry', Cambridge University Human Relations in Industry Group, 22 October 1951
070/113	'The Humanities in Higher Technological Education', Address to College of Preceptors, 19 March 1952
070/118	'Part-time day release', Address to British Association for Commercial and Industrial Education (BACIE), Birmingham, 4 December 1953

NAEST Box 4

070/11/42	Correspondence: 'Athlone Fellowships' for Canadian engineering graduates
070/111/1	Correspondence: Report on the scheme of training trade apprentices during the War, [n.d] c. 1914
070/111/11	Correspondence: Sub-Committee of Consultative Committee of the Board of Education, 24 and 26 August 1914

6 T.P. File

E.105	Prince Henry's Grammar School, Otley. Speech Day 20 November 1943

NAEST

92A/1.3.1	Photocopy of speech entitled 'Engineering as a Career for Girls' given by Miss G. Entwisle at Portsmouth College of Technology, May 1955
92A/1.2.3	DES Press Notice – Engineering for Girls, 5 March 1969
92A/2.2	'Women in Engineering', Institution of Electrical Engineers, 24 April 1959
92A/2.3	'Women Professional Engineers in British AEI', [n.d.]
92A/2.5	Associated Electrical Industries (Manchester) Limited – Overall record of the Company's Full-Time Training Schemes for Women, 15 September 1961
92A/2.6	Hardwich, I.H., 'Women Engineers in Industry'. Address sent to W.P. Baker, RCAT, Salford, 4 September 1961
92A/2.8	Hardwich, I.H., 'Women Engineers in Industry', Science and Technology for Girls Conference held at the University of Warwick, 25-26 March 1968
92A/3.4.2	Correspondence: I. Hardwich to E. Stephens, 15 January 1963 and E. Stephens to I. Hardwich, 30 January 1963
92A/4.4.2-92A/4/4/7	'The Engineer is a Woman', British Information Services, Central Office of Information, London, September 1969
92A/5.5	'Think About Engineering'. Booklet issued by the English Electric Engineering Company Limited, [n.d.] c 1960
92A/7.1	'Enquiry Concerning the Employment of Women Graduates in Industry', University of Liverpool, n.d.

92A/7.3	Godlet, B.L., 'The Developing Field of Technical Education', British Association for Commercial and Industrial Education (BACIE),Sixth Conference report, 1-3 March 1957
92A/7.4	Report of the Executive Committee of the Industrial Fund for the Advancement of Scientific Education in Schools, 1957
92A/7.5	'Earnings of Administrative, Technical and Clerical Employees, October 1959, *Ministry of Labour Gazette,* LXVIII, No. 9, September 1960
92A/7.6	Symposium on Graduate Training, The Education and Training Group of the Institute of Mechanical Engineers, 22-23 March 1962
92A/7.7	'Commission on the Status of Women'. Report of the Sixteenth Session of the Economic and Social Council, 19 March-6 April 1965, New York: United Nations
92A/7.9	'The Survey of Professional Engineers 1966', Ministry of Technology and the Council of Engineering Institutions, (London: HMSO 1966)
92A/7.11	'Women Engineers in Industry', Schools Council Project Technology, Occasional Paper I, [n.d]
92A/7.12	ATTI Working Party Report, Appendix 2: 'Education, Training and Employment of Women and Girls'., (London: ATTI, 1973)
92A/7.14	'The Role of Women in Engineering', [n.d.] [no provenance], pp. 343-344
92A/7.17	'Women in Engineering', EITB Reference Paper RP/4/79
92A/8.1	Hardwich, I.H., 'Girls in Engineering', [n.d.] c 1960
92A/8.3	Press cutting: 'How Would You Like A Woman Boss? (At Work Of Course', *Daily Express,* 11 October 1960 [n.p.]
92A/8.4	Press cutting: Owen, L., 'Women in engineering: the first of the few'. No provenance
92A/8.8	'A Woman Engineer. Engineering is not just a man's field...', *Topic,* June 1965, pp. 11-12
92A/8.9	Phillips,J. 'Women in Science', *Science Journal,* May 1966, n.p.
92A/8.13	Press cutting: Bourne, R., 'Making science attractive', *The Guardian*, 1 March 1968, [n.p.]
92A/8.14	Press cutting: Higginson, M., 'If we really want more women scientists we ought to reverse the present trend towards coeducation;, *The Guardian,* 18 March 1968, [n.p.] Letters: Girls' schools science, *The Guardian,* 26 March 1968, n.p.
92A/8.15	Press cuttings: 'Sixth Form Traffic Jam of Science Students', *The Times,* 2 March 1964, [n.p.] Stott, M., 'Women Executives' way to advise girls on industry', *The Guardian,* 15 May 1968, [n.p.]
92A/8.16	Letters to *The Guardian,* 24 September 1969
92A/8.17	Weiss, R., 'Firms 'unfair' to women graduates', *The Guardian,* 27 October 1969
92A/8.19	Press cutting: Keyworth, F., 'Still far too few women engineers',

	Daily Star, 3 February 1970
92A/8.25	Williams, E., 'Man is still ruling the Engineering Roost', *The Engineer,* 26 April 1979, 30-1
92A/8.27	Harthill, M.J., 'Engineering Needs the Woman's Touch', *Engineering,* November 1979, 23-4
	'What is Engineering? Engineering as a Career for Women', Society of Women Engineers, New York, [n.d.]

Institution of Electrical Engineers IEE

92/08	*The Woman Engineer,* 1919-1989 series

Imperial College Archives

Sir Willis Jackson (Baron Jackson of Burnley FRS)

B/JACKSON

B/1	Letter: Appointment of Willis Jackson as Director of Research and Education, Metropolitan-Vickers Electrical Engineering Company Limited, 9 July 1953
B/2	Correspondence: 3 files
B/5	Metropolitan-Vickers – Postgraduate engineering courses 1954-5 (3 folders)
B/8	Metropolitan-Vickers Summer Schools 1950-8 (1 folder)
B/10	Apprentice Association 1953-9
B/11	Various Programmes and Speeches, Metropolitan-Vickers Parents' Days
B/13	Various publications – Metropolitan-Vickers Training School
FE/2	Electrical Association for Women
FO/2	Correspondence: Kathleen Ollerenshaw
FW/16	Women's Engineering Society, 1957-63

Manchester Central Library (MCL)

MCL.Q.631.3.AE2	*AEI News.* Various issues, January 1949-January 1967
MCL 338.476213.AE2	'Welcome to Trafford Park', Associated Electrical Industries (Manchester) Ltd., [n.d.] c. 1962

North-West Sound Archive

2010.02 SADVOI	Sheila Dewsbury 8.3.2010
2013.05	Gay Doyle 1.6.2010

The National Archive, Kew

ED 149/37	Metropolitan-Vickers Works School 1946-1950
ED 156/129	School Inspectors' Reports, Lancashire
ED 267	Independent Schools 1975 Database
ED 278	Grant Maintained Schools Database
LAB 18/833	Industrial Training White Paper 1962-3
LAB 19/472	ILO Enquiry: Apprenticeships for women and girls 1954-8
LAB 19/522	Opportunities for Employment and Training for Girls in Science, Technology and Engineering Industry Fields: correspondence 1955-8
LAB 19/620	Training Advisory Service of the Industrial Training Council 1961-3
LAB 19/621	National Joint Advisory Council – Apprenticeships in Britain 1961-3
LAB 19/624	Recruitment and Training of Young Persons for the Engineering Industry 1961-3
LAB 19/663	National Youth Employment Council – Triennial Report 1959-62
LAB 19/715	Employment and Training of Girls 1961-5
LAB 19/729	Young People Entering Employment: Occupational Statistics 1962-8
LAB 19/754	Development of Industrial Training 1963
LAB 19/761	Recruitment and Training Young Workers for Industry: Offers of Training Facilities by Industrial Concerns 1963-4
LAB 19/797	General Purposes Committee Working Party. Draft Report on Youth Employment Services and Employers 1965-6
LAB 19/812	Industrial Training Act 1964. Co-operation of Youth Employment Services with Industrial Training Board 1965-8
LAB 19/829	British Association of Women Executives: Proposed Careers Advisory Service on Industry for Girls (CASIG) 1965-9

Working Class Movement Library (WCML)

AG-Education	'From School to Work. Education, Recruitment and Training for Industry and Commerce'. A Report of a Conference held in London by the British Association for Commercial and Industrial Education (BACIE), 27 March 1942
AG-Education	King George Jubilee Trust. 'The education of the young worker'. Report of the third conference held at Oxford, July 1950
AG-Education	'The Education, Training and Employment of Women and Girls', (London: NAFTHE, February 1967)
AG-Education Box 8	The Labour Party, 'Industrial Training'. A Discussion Document to be presented to the National Conference of Labour Women, Southend-on-Sea, May 1967
AG-Fabian Research	E. Allsopp & D. Grugeon, 'Direct grant grammar schools', (London: Fabian Society, 1966)
AG-Fabian Research	M. Croft, 'Apprenticeship and the 'Bulge' ', (London: Fabian Society, 1960)
AG-Labour Party	A. Williams-Ellis, 'Is woman's place in the home?', Labour discussion series; 9, (London: The Labour Party, 1946)
AG 1/36001193 Greater Manchester Box 1/A	'Background to the Metropolitan-Vickers Training Scheme', M-V Electrical Company Limited Special Publication 7985/5, [n.d] c 1955
AG-Labour Party	The Labour Party Youth Commission, 'The Younger Generation': Report of the Labour Party Youth Commission 1959, (London: The Labour Party, 1959)
ORG/METVIK	Metropolitan-Vickers: works committee minutes 1922-1930; 1946-1959 AEI: works committee minutes: 1960-1967
AG-Women	London and Home Counties Regional Advisory Council for Technical Education. 'The Vocational Education of Women'. Report of the Council's Vocational Courses for Women Committee, 1965-1976

HMSO

Education Act 1944 (7 & 8 Geo 6 c. 31)

Ministry of Education (Percy Report 1945). *Higher Technological Educational*

Lord President of the Council (Barlow Report 1946). *Scientific Manpower*

National Joint Advisory Council (1956). *Technical Education,* Cmnd 9703

White Paper (1956). *Technical Education*

National Joint Advisory Council (Carr Report 1958). *Training for Skill: Recruitment and Training of Young Workers in Industry* A report of the Central Advisory Council for Education (Crowther Report 1959). *15-18*

Albermarle Report (1960). *The Future Development of the Youth Employment Service*

Industrial Training: Government proposals (1962) Cmnd 1892

Committee on Scientific Manpower. *Scientific and Technical Manpower in Great Britain*
1962, Cmnd 2146

Committee on Higher Education. (Robbins Report 1963), Cmnd 2154 *Higher education:report of the Committee appointed by the Prime Minister under the Chairmanship of Lord Robbins 1961-64*

A report of the Central Advisory Council for Education. (Newsom Report 1963). *Half Our Future*

The Industrial Training Act 1964 (Elizabeth II c. 16)

The Dainton Report (1968). *Enquiry into the Flow of Candidates in Sciences and Technology into Higher Education.*

Royal Commission on Trade Unions and Employers' Associations (1968). Seear, N., *The Position of Women in Industry,:*Report on Independent Day Schools and Direct Grant Grammar Schools The Donnison Report (1970) . *'The Public Schools Commission: Second Report' Vol I*

The Report of the Committee of Inquiry into the Engineering Profession (The Finniston Report 1980 Cmnd 7794) *Engineering - Our Future: the Engineering Profession,*

Printed Contemporary Material

Fleming, A.P.M. & R. Johnson, 'Chemical action in the windings of high-voltage machines', *Journal of the Institution of Electrical Engineers,* 47:209, (1911), 530-51

Fleming, A.P.M. & R.W. Bailey, *Engineering as a Profession,* (London: J. Long, 1913)

Fleming, A.P.M. & R. Johnson, *Design of Electric Wirings,* (London: Longmans & Co., 1913)

Fleming, A.P.M., 'Training for the industrial side of engineering', *Journal of the Institution of Electrical Engineers,* 53:246, (1915), 566-73

Fleming, A.P.M. & J.G. Pearce, *The Principles of Apprentice Training with Special Reference to the Engineering Industry,* (London: Longmans, 1916)

Fleming, A.P.M., 'Planning a works research organisation', *Journal of the Institution of Electrical Engineers,* 57:279, (1919), 153-70

Fleming, A.P.M. & J.G. Pearce, *Research in Industry: The Basis of Economic Progress,* (London: Pitman, 1922)

Fleming, A.P.M. & H.J. Brocklehurst, *A History of Engineering,* (London: A. & C. Black, 1925)

Fleming, A.P.M., 'The recruitment and training of engineering craftsmen', *Journal of the Institution of Production Engineers,* 14:12, (1935), 606-18

Fleming, A.P.M. & R. Johnson, 'New materials and alloys in the field of engineering', *Journal of the Institution of Production Engineers,* 15:12, (1936), 691-703

Fleming, A.P.M., *Industrial Research in the United States of America,* (New York: Arno Press, 1972) reprint of HMSO report 1917 published for the Department of Scientific and Industrial Research

Hutchins, B.L., *Women In Modern Industry (1915),* (Wakefield: E.P. Publishing Limited, 1978 reprint)

Kerschensteiner, G., *Education for Citizenship,* (London: Harrap, 1912)

Sadler, M., *Continuation Schools in England and elsewhere,* (Manchester: Manchester University Press, 1907)

Books and Articles

Abbot, R., 'Early histories of some companies of the English Electric Group' from *English Electric and Its People, 1947-1965,* (Stafford: Engineering Research Laboratory, GEC Alsthom), [n.d.]

Ahlstrom, G., *Engineers and Industrial Growth: Higher Technical Education and the Engineering Profession During the Nineteenth and Early Twentieth Centuries: France, Germany, Sweden and England,* (London: Croom Helm, 1982)

Alston, H.G., 'Technological Training and Employment of Women', *The Woman Engineer,* 8:4 (Spring 1957), 13-7

Anon., 'Sandwich Girl – Diana Goth', *The Woman Engineer,* 8:15, (Winter 1959), 14

Anon., *History of the English Electric Company,* (London: Garroway, 1951)

Anon., 'Willis Jackson – Professor of Electrical Engineering at Imperial College', *Nature,* 17:4345 (February 1953), 242

Arnot, M., David, M. & Weiner, G., *Closing the Gender Gap: Postwar Education and Social Change,* (Cambridge: Polity Press, 1999)

Atherton, J.G., *Home to Stay,* (Manchester: Neil Richardson, 1991)

Bailey, B., 'Technical Education and Secondary Schooling 1905-1945' in *Technical Education and The State Since 1850,* (eds.), P. Summerfield & E. Evans, (Manchester: Manchester University Press, 1990), 97-119

Baker, N., 'Early Women Engineering Graduates from Scottish Universities', *Women's History Magazine,* 60 (Summer 2009), 21-23

Barber, M., *The Making of the 1944 Education Act,* (London: Cassell, 1994)

Barnett, C., *The Audit of War: The Illusion and Reality of Britain as a Great Nation,* (London: Macmillan, 1986)

Baxendale, J., 'English Culture and the Decline of the Industrial Spirit', *History*

Workshop, 21 (Spring 1986), 171-4

Beechey, V., 'Women's Employment in Contemporary Britain' in *Women in Britain Today,* (eds.), V. Beechey & E. Whitelegg, (Milton Keynes: Open University Press, 1986), 77-131

Benavot, A., 'The Rise and Decline of Vocational Education', *Sociology of Education,* 56 (April 1983), 63-76

Bennett, J. & R. Forgan (eds.), *Convent Girls,* (London: Virago, 1991)

Benokraitis, N. & J.R. Feagin, *Modern Sexism: Blatant, Subtle and Covert Discrimination,* (Eaglewood Cliffs: Prentice-Hall, 1986)

Beverstock, A.G., *Industrial Training Practices,* (London: Classic Publications, 1969)

Blackstone, T., 'Preface', in *Girl Friendly Schooling,* (eds.) J. Whyte, R. Deem, L. Kant & M. Cruickshank, (London: Methuen, 1985), xi-xiv

Bix, A.S., 'From “Engineeresses” to “Girl Engineers” to “Good Engineers”: A History

of Women's U.S. Engineering Education', *NWSA Journal,* 16:1 (Spring 2004), 27-49

Blackwell, L. & J. Glover, 'Women's Scientific Employment and Family Formation: A Longitudinal Perspective', *Gender, Work and Organization,* 15:6 (2008), 579-99

Borcelle, G., *Jobs for Women: A Plea for Equality of Opportunity,* (Paris, UNESCO, 1985)

Bradley, R.P., *GEC Traction and Its Predecessors – 1823 to the present day,* (Oxford: Oxford Publishing Company, 1993)

Braybon, G., *Women Workers in the First World War: The British Experience,* (London: Croom Helm, 1981)

Braybon, G. & P. Summerfield (eds.), *Out of the Cage: Women's Experiences in Two World Wars.,* (London: Pandora, 1987)

Brewster, P., 'School Days, School Days' in *Learning to Lose: Sexism and Education,* (eds.) D. Spender & E. Sarah., 2nd edn. (London: Women's Press, 1988), 5-11

Browne, J.F.A., 'Co-operation between the Universities and Industry and Commerce in the Matter of Placement', *The Woman Engineer,* 3, 13, (December 1932), 202-3

Byrne, E., *Women and Education,* (London: Tavistock, 1978)

Carter, R. & G. Kirkup., *Women in Engineering: A Good Place to Be?,* (Basingstoke: Macmillan, 1990)

Chandler, A.D., Jnr, *The Visible Hand: The Managerial Revolution in American Business,* (Cambridge, Mass.: Harvard University Press, 1977)

Clarke, P., *Hope and Glory: Britain 1900-1990,* (London: Allen Lane, 1996)

Cockburn, C., *Machinery of Dominance: Women, Men, and Technical Know-How,* (Boston: Northeastern University Press, 1988)

Cockburn, C., 'The Gendering of Jobs. Workplace relations and the reproduction of sex segregation', in *Gender Segregation at Work,* (ed.) S. Walby, (Milton Keynes: Open University Press, 1988)

Collier, B., *The Little Engines That Could've: The Calculating Machines of Charles Babbage,* (London: Garland, 1990)

Cooper, T., 'The early development of scientific research in industry: the case of Metropolitan-Vickers Ltd., 1901-1933' in 'The History of Science and Technology in the North-West', (ed.) J. Pickstone, *Manchester Regional History Review,* 18, (2007), 84-105

Cowman, K. and L. Jackson, (eds.), *Women and Work Culture: Britain c. 1850-1950,* (Aldershot: Ashgate, 2005)

Cregan, C., *Young People in the workplace: Job, Union and Mobility Patterns,* (London: Mansell Publishing Limited, 1999)

Crompton, R. & K. Sanderson, *Gendered Jobs and Social Change,* (London: Unwin Hyman, 1990)

Davenport-Hines, R.P.T., *Dudley Docker: The Life and Times of a Trade Warrior*, (Cambridge: Cambridge University Press, 1984)

Davidoff, L. & B. Westover, (eds.), *Our Work, Our Lives, Our Words: Women's History and Women's Work,* (Basingstoke: Macmillan Education, 1986)

Davis, M., 'Technology, institutions and status: technological education, debate and policy, 1944-56' in *Technical Education and the State Since 1850,* (eds.), P. Summerfield & E. Evans, (Manchester: Manchester University Press, 1990) 120-45

Deal, T.E. & A.A. Kennedy, *Corporate cultures: the rights and rituals of corporate life,* (London: Penguin, 1998)

Deem, R., *Women and Schooling,* (London: Routledge & Kegan Paul, 1978)

Deem, R., *Schooling for Women's Work,* (London: Routledge & Kegan Paul, 1980)

Delamont, S., *Sex Roles and the School,* (London: Routledge: 1990)

Dintenfass, M., *The Decline of Industrial Britain 1870-1970,* (London: Routledge, 1992)

Dormois, J-P. & M. Dintenfass, (eds.), *The British Industrial Decline,* (London:

Routledge, 1999)

Duchen, C. & I. Bandhauer-Schoffman, (eds.), *When The War Was Over: Women, War and Peace in Europe 1940-1946,* (Leicester: Leicester University Press, 2000)

Dummelow, J., *1988-1949,* (Manchester: Metropolitan-Vickers Electrical Company Limited, 1949)

Dyhouse, C., 'Graduates, Mothers and Graduate Mothers: family investment in higher education in Twentieth-Century England', *Gender and Education,* 14:4, (2002), 325-36

Dyhouse, C., *Girl Trouble. Panic and Progress in the History of Young Women,* (London: Zed Books, 2013)

Edgerton, D., 'Barnett's Audit of War: An Audit'. *Contemporary Record,* 4:2, (1990), 37-9

Edgerton, D., 'The Prophet Militant and Industrial: The Peculiarities of Correlli Barnet', *Twentieth Century British History,* 2:3 (1991), 360-79

Eisenhart, M.A. & E. Finkel, *Women's Science,* (Chicago: University of Chicago Press, 1998)

Elliott, A., *State Schools Since The 1950s: the good news,* (Stoke-on-Trent: Trentham, 2007)

Esland, G. (ed.), *Education, Training and Employment,* (Wokingham: Addison-Wesley Publishing Company for the Open University, 1990)

Evans, J., *Feminist Theory Today,* (London: Sage Publications, 1995)

Evans, M., *A Good School. Life at a Girls' Grammar School in the 1950s,* (London: The Women's Press, 1991)

Everett, P., *you'll never be sixteen again,* (London: BBC Publications, 1986)

Ferguson, M., *Forever Feminine: Women's Magazines and the Cult of Femininity,* (London: Heinemann, 1983)

Fletcher, J.K., [Women Engineers] *Disappearing acts: gender and relational practice at work,* electronic book, (Cambridge, Mass.: MIT Press, 1999)

Foulkes, R., 'Computers at Metrovick: the MV 950 & AEI 1010', *Resurrection: The Bulletin of the Computer Conservation Society,* 43, (Summer 2008), 14-23

Frow, E. & R. Frow, *Engineering Struggles: Episodes in the Story of the Shop Stewards' Movement,* (Manchester: Working Class Movement Library, 1982)

Frow, E. & R. Frow, *Manchester's Big House in Trafford Park: class conflict and collaboration at Metro-Vicks,* (Manchester: Working Class Movement Library, 1983)

Fulton, O., 'Higher Education and Employment: pressures and responses since 1960', in *Technical Education and the State Since 1950),* (eds.) P. Summerfield & E. Evans, (Manchester: Manchester University Press, 1990) 145-170

Gamble, S. (ed.), *The Routledge Companion to Feminism and Postfeminism,* (London: Routledge, 2006)

Game, A. and R. Pringle, *Gender At Work,* (London: Pluto Press, 1983)

Garfield, S. (ed.), *Our Hidden Lives,* (London: Ebury Press, 2005)

Garland, P., in *Dutiful Daughters,* (eds.), J. McCrindle & S. Rowbotham, (London:

Allen Lane, 1977), 266-99

Giles, J., *The Parlour and the Suburb,* (Oxford: Berg, 2004)

Glover, J. & G. Kirton, *Women, employment and organisations,* (London: Routledge, 2006)

Goff, A .C., 'Women Can Be Engineers' in *Women in Engineering: Pioneers and Trailblazers,* M.E. Layne, (Reston, Va: ASCE Press, 2009), 155-178

Goldthorpe, J.H., D. Lockwood, F. Bechhofer, & J. Platt, (eds.), *The Affluent Worker: Industrial Attitudes and Behaviour,* (Cambridge: Cambridge University Press, 1968)

Goldthorpe, J.H., et al, (eds.) *The Affluent Worker in the Class Structure,* (Cambridge: Cambridge University Press, 1971)

Goodman, P., *Women. Sexuality and War,* (Basingstoke: Palgrave, 2002)

Greenwood, P., *Love on the Dole*, new edn. (London: Vintage, 1993)

Grieco, M. & R. Whipp, 'Women and the Workplace: Gender and Control in the Labour Process' in *Studies in Gender and Technology in the Labour Process,* (eds.) D. Knights & H. Wilmott, (Aldershot: Gower Press, 1986), 115-137

Grinstein, L.S., R.K. Rose & M.H. Rafailovich,(eds.), *Women in Chemistry and Physics,*

(Westport, CT: Greenwood Press, 1993)

Gummett, P., *Scientists in Whitehall,* (Manchester: Manchester University Press, 1980)

Hacker, S., 'The Culture of Engineering: Women, Workplace and Machine', *Women's Studies International Quarterly,* 4:3, (1981), 341-53

Hacker, S., *Pleasure, Power, and Technology,* (Boston: Unwin Hyman, 1989)

Hakim, C., *Key Issues in Women's Work. Female Heterogeneity and the Polarisation of Women's Employment,* (London: Athlone, 1996)

Hall, D.E., *Muscular Christianity. Embodying the Victorian Age,* (Cambridge: Cambridge University Press, 1994)

Hansen, G.B., *'Britain's Industrial Training Act: its history, development and implications for America*, Prepared for the National Manpower Policy Task Force, (Office of Education: U.S. Department of Health, Education and Welfare, 1967)

Heaton, F., *Adelphi House Convent: The School by the Irwell 1852-1981,* (Salford: The Centre for the Study of Religion and Education, 1982)

Hennessy, P., *Never Again. Britain 1945-51,* (London: Penguin Books, 2006)

Hennessy, P., *Having It So Good. Britain in the Fifties,* (London: Penguin Books, 2007)

Heron, L. (ed.), *Truth, Dare or Promise. Girls Growing Up in the Fifties,* (London: Virago Press, 1985)

Hofstede, G., *Culture's Consequences: International Differences in Work-Related Values,* (London: Sage, 1980)

Hoggart, R., *The Uses of Literacy,* (Chatto and Windus, 1959)

Hubback, J., *Wives Who Went to College,* (London: Heinemann, 1957)

Hudson, P. & W.R. Lee, *Women's Work and The Family Economy in Historical Perspective,* (Manchester: Manchester University Press, 1990)

Huggins, M., *The Victorians and Sport,* (London: Hambledon & London, 2004)

Hughes, C., 'Realigning political and personal selfhood: narratives of activist women in the late 1960s and 1970s', *Women's History Magazine,* 68 (Spring 2012), 22-27

Hunt, F., (ed.), *Lessons for Life. The Schooling of Girls and Women, 1850-1950,* (Oxford: Basil Blackwell, 1987)

Jackson, B. & D. Marsden., *Education and the Working Class,* (Harmondsworth: Penguin Books, 1966)

Jackson, L.A., ' “The Coffee Club Menace”: Policing Youth, Leisure and Sexuality in Post War Manchester', *Cultural and Social History,* 5:3, 2008, 298-308

Jacobs, J.A. (ed.), *Gender Inequality At Work,* (London: Sage Publications, 1995)

James, D., *English Electric,* (Stroud: Tempus Publishing, 1999)

Jarvis, P. & C. Griffin, *Vocational Education*, (London: Routledge, 2003)

Jephcott, P., *Girls Growing Up,* (London: Faber and Faber, 1949)

Jones, R. & O. Marriott, *Anatomy of a Merger. A History of G.E.C., A.E.I. and English Electric,* (London: Cape, 1970)

Kamm, J., *Hope Deferred: girls' education in English history,* (London: Methuen, 1965)

Keeble, S.P., *The Ability to Manage: A study of British management 1890-1990,* (Manchester: Manchester University Press, 1992)

Kata, L., 'Spotlight on Emma Barth: A Typical Woman Engineer' in *Women in Engineering: Pioneers and Trailblazers,* (ed.) M.E. Layne, (Reston, Va.: ASCE Press, 2019), 211-218

Keil, T. & P. Newton, 'Into Work: Continuity and Change' in *Schooling for Women's*

Work, (ed.) R. Deem, (London: Routledge & Kegan Paul, 1980), 98-112

Kelan, E., *Performing Gender at Work,* (Basingstoke: Palgrave Macmillan, 2009)

Kelly, A., 'Where have all the women gone?', *Physics Bulletin,* 30 (1979), 108

Kendrick, M., *Altrincham County Grammar School for Girls,* (Altrincham: n.p., 1974)

Kirby, M.W., 'Britain's 'Manifest Industrial Destiny': The Culture of High Technology and Industrial Performance in the Twentieth-century', *Business and Economic History,* 26:2 (Winter 1997), 751-769

Knights, D. & H. Willmott, (eds.), *Studies in Gender and Technology in the Labour Process,* (Aldershot: Gower, 1986)

Kynaston, D., *Austerity Britain 1945-51,* (London: Bloomsbury, 2007)

Kynaston, D., *Family Britain 1951-57,* (London: Bloomsbury, 2009)

Kynaston, D., *Modernity Britain. Opening the Box, 1957-59,* (London: Bloomsbury, 2013)

Lacey, C., *Hightown Grammar: the school as a social system,* (Manchester: Manchester University Press, 1970)

Langhamer, C., 'The meanings of home in post-war Britain', *Journal of Contemporary History,* 40:2 (2005) 356-7

Layne, M.E. (ed.) *Women in Engineering: Pioneers and Trailblazers,* (Reston, Va.: ASCE Press, 2009)

Lee, N. & P. C. Stubbs., *The History of Dorman Smith, 1878-1972,* (London: Newman Neame, 1972)

Lerner, G., *The Creation of Patriarchy,* (Oxford: Oxford University Press, 1986)

Lewis, J., 'Myrdal, Klein, Women's Two Roles and Postwar Feminism, 1945-1960' in *British Feminism in the Twentieth Century,* (ed.) H. L. Smith, (Aldershot: Edward Elgar, 1990), pp. 167-188

Lewis, J., *Women in Britain Since 1945: Women, Family, Work and the State in the*

Post-War Years, (Oxford: Blackwell, 1992)

Leyland Motors, *The First Fifty Years,* (Leyland: Leyland Motors Ltd., 1948)

Liepmann, K., *Apprenticeship: An Enquiry Into Its Adequacy Under Modern Conditions,* (London: Routledge & Kegan Paul, 1968)

Lowe, R., *Education in the Post-War Years: A Social History, 1945-1965,* (London: Routledge, 1988)

Lyttleton, O. (Viscount Chandos), *The Memoirs of Lord Chandos,* (London: The Bodley Head, 1962)

McCrindle, J. & S. Rowbotham, (eds.), *Dutiful Daughters,* (London: Allen Lane, 1977)

McCulloch, G., *The Secondary Technical School: A Usable Past?,* (London: Falmer Press, 1989)

MacDonald, M., 'Socio-cultural reproduction and women's education' in *Schooling for Women's Work,* (ed.) R. Deem, (London: Routledge & Kegan Paul, 1980), 13-

25

McIlwee, J.S. & J.G. Robinson, *Women in Engineering: Gender, Power, and Workplace Culture,* (Albany: State University of New York, 1992)

McIntosh, I., 'Ford at Trafford Park: 'an Americanised corner of old jog-trot England' ', *University of Manchester Sociology Department Occupational Papers,* 20, n.d.

Mackay, R., *The Test of War. Inside Britain 1939-1945,* (London: UCL Press, 1999)

Malley, M, 'Hertha Marks Ayrton (1854-1923' in *Women in Chemistry and Physics,* (eds.)

L.S. Grinstein, R.K. Rose & M.H. Rafailovick, (Westport, CT: Greenwood Press, 1993)

Marwick, A., *War and Social Change in the Twentieth Century,* (London: Macmillan, 1974)

Marwick, A., *The Sixties: Cultural Revolution in Britain, France, Italy and the United States c. 1958-1974,* (Oxford: Oxford University Press, 1998)

Masson, M.R. & D. Simonton., *Women and Higher Education. Past, Present and Future,* (Aberdeen: Aberdeen University Press, 1996)

Mearns, K. & R. Flin, 'Applying science in a man's world: women in science, engineering and technology in the offshore oil industry' in *Women and Higher Education. Past, Present and Future',* (eds.), M. R. Masson & D. Simonton, (Aberdeen: Aberdeen University Press, 1996), 65-72

Metropolitan-Vickers Electrical Company Limited, *A Register of ex-apprentices and ex-trainees of the Metropolitan-Vickers Electrical Co. Ltd., 1902-1956,* 4th edition, (Manchester: Metropolitan-Vickers Electrical Company Limited, 1957)

Mills, V.J., 'A Practical Scheme of Training for the Female Engineer', *The Woman Engineer,* 9:11, (Winter 1963), 10-2

Munzenberg, G., 'Development of mass spectrometers from Thomson and Aston to present', *International Journal of Mass Spectrometry,* 339-350, (2013), 9-18

Murphy, P.F., *Feminism and Masculinities,* (Oxford: Oxford University Press, 2004)

Myrdal, A.R. & V. Klein, *Women's Two Roles: home and work,* (London:

Routledge, 1998)

Newsom, J., *The Education of Girls,* (London: Faber and Faber, 1948)

Nicholson, V., *Singled Out,* (London: Viking, 2007)

Nicholson, V., *Perfect Wives in Ideal Homes: The Story of Women In The 1950s,* (London: Viking, 2015)

Nuttall, J., *Bomb Culture,* (London: MacGibbon & Kee, 1968)

Nye, D.E., *Image World. Corporate Identities at General Electric,* (Cambridge, Mass.: The MIT Press, 1985)

Ollerenshaw, K., *Education for Girls,* (London: Faber and Faber, 1961)

Osgerby, B., *Youth in Britain Since 1945,* (Oxford: Blackwell, 1998)

Owen, G., *From Empire to Europe: the decline and revival of British industry since the Second World War,* (London: Harper Collins, 2000)

Page, G.T., *The Industrial Training Act and After,* (London: Deutsch, 1967)

Parker, D., *John Newsom: A Hertfordshire Educationalist,* (Hertfordshire: University of Hertfordshire Press, 2005)

Payne, I., 'A Working-Class Girl in a Grammar School' in *Learning to Lose. Sexism and Education,* (eds.) D. Spender & E. Sarah., (London: The Women's Press: 1980), 12-31

Peters, A.J., 'The Changing Idea of Technical Education', *British Journal of Educational Studies,* 11:2, (1963), 142-66

Peters, A.J., *British Further Education: A Critical Textbook,* (Oxford: Pergamon Press, 1967)

Pettigrew, A.M., 'On Studying Organisational Cultures', *Administrative Science Quarterly,* 24 (1979), 570-81

Prais, S.J., *The Evolution of Giant Firms in Britain,* (Cambridge: Cambridge University Press, 1976

Price, B., *Technical Colleges and Colleges of Further Education,* (London: Batsford, 1959)

Price-Hughes, H.A.*, BTH Reminiscences: Sixty Years of Progress,* (Rugby: The British Thomson-Houston Company Limited, 1946)

Purvis, J. (ed.), *Women's History, Britain 1850-1945,* (London: Routledge 1995)

Ransom, S. & R. Fairclough., *English Electric Aircraft and their Predecessors,* (London: Puttnam, 1987)

Rapoport, R. & R. Rapoport, *Dual Career Families Re-examined: new integrations of work and family,* (London: Martin Robertson, 1976)

Robinson, J., *Bluestockings,* (London: Penguin Books, 2010)

Rothblatt, S., 'Ideas of Decline', *London Review of Books,* 3:14, (August 1981), 13-4

Rowbotham, S., *Women's Consciousness, Man's World,* (Harmondsworth: Pelican

Books, 1973)

Rowbotham, S., *Promise of a Dream: Remembering the Sixties,* (Harmondsworth: Penguin Books, 2001)

Rowlinson, F., *Contributions to Victory,* (Manchester: Metropolitan-Vickers Electrical Company Limited, 1947)

Russell, D. & G. Walker, *Trafford Park 1896-1939,* (Manchester: Manchester Polytechnic, 1979)

Sampson, A., *Anatomy of Britain,* (London: Hodder & Stoughton, 1965)

Sampson, A., *The New Anatomy of Britain,* (London: Hodder and Stoughton, 1971)

Sanderson, M., *Educational Opportunity and Social Change in England,* (London: Faber and Faber, 1987)

Sanderson, M., *The Missing Stratum. Technical School Education in England 1900-1990s,* (London: The Athlone Press, 1994)

Sanderson, M., *Education and Economic Decline in Britain, 1870 to the 1990s,* (Cambridge: Cambridge University Press, 1999)

Saraga, E. and D. Griffiths, 'Would more women change science?', *Physics Bulletin,* 31, (1980), 166-7

Sargant, G., 'Women in Industry', *The Woman Engineer,* 8:9, (Summer 1958), 5

Scott, J.D., *Siemans Brothers 1858-1958,* (London: Weidenfeld and Nicholson, 1958)

Seear, N., V. Roberts & J. Brock, *A Career for Women in Industry,* (London and Edinburgh: Oliver & Boyd, 1964)

Sharpe, S, '*Just Like a Girl'. How Girls Learn to be Women,* (Harmondsworth: Penguin Books, 1976)

Simon, A., *The Simon Engineering Group,* (Liverpool: Northern Publishing Co. Ltd., 1947)

Simon, B., *Education and the Social Order, 1940-1990,* (London: Lawrence &

Wishart, 1999)

Smith, H.L. (ed.), *War and Social Change: British Society in the Second World War,* (Manchester: Manchester University Press, 1986)

Smith, H.L., 'The effect of war on the status of women' in *War and Social Change: British Society in the Second World War,* (ed.) H.L. Smith, (Manchester: Manchester University Press, 1986), 208-29

Smith Wilson, D., 'A New Look at the Affluent Worker: the Good Working Mother in post-war Britain', *Twentieth Century British History,* 17:2 (2006), 206-29

Spencer, S., *Gender, Work, and Education in Britain in the 1950s,* (Basingstoke: Palgrave Macmillan, 2005)

Spencer, S., ' 'Be Yourself': *Girl* and the Business of Growing Up in Late 1950s England' in *Women and Work Culture in Britain c. 1850-1950,* (eds.), K. Cowman & L.A. Jackson, (Aldershot: Ashgate, 2005), 141-58

Spender, D. & E. Sarah, (eds.), *Learning to Lose. Sexism and Education,* (London: The Women's Press, 1980)

Spender, D., *Invisible Women. The Schooling Scandal,* (London: The Women's Press, 1989)

Stone, P., 'Assessing Gender at Work: Evidence and Issues' in *Gender Inequality at Work,* (ed.) J.A. Jacobs, (London: Sage Publications, 1995), 408-423

Summerfield, P., 'Cultural Reproduction in the Education of Girls: a Study of Girls' Secondary Schooling in Two Lancashire Towns, 1900-1950' in *Lessons for Life. The Schooling of Girls and Women 1850-1950,* (ed.), F. Hunt, (Oxford: Basil Blackwell, 1987), 149-170

Summerfield, P., *Women Workers in the Second World War: Production and Patriarchy in Conflict,* (London: Routledge, 1989)

Summerfield, P. & E. Evans, *Technical Education and the State Since 1850,* (Manchester: Manchester University Press, 1990)

Swade, D., *The Difference Engine: Charles Babbage And The Quest To Build The First Computer,* (London: Viking, 2001)

Taking Liberties Collective, *Learning the Hard Way. Women's Oppression in Men's*

Education, (Basingstoke: Macmillan Education, 1989)

Tattersall, J & S. McMurran, 'Hertha Ayrton: A Persistent Experimenter', *Journal of Women's History,* 7:2 (Summer, 1995), 86-112

Tebbutt, M., *Making Youth: A History of Youth in Modern Britain,* (London: Palgrave Macmillan, forthcoming)

Thane, P., 'Girton Graduates: Earning and Learning 1920-1980s', *Women's History Review,* 13:3, 2004, 347-60

The Women's Engineering Society, 'Manchester Branch. New Members', *The Woman Engineer,* 5:14, (Spring 1943), 214-8

The Women's Engineering Society, 'New Members', *The Woman Engineer,* 5:19, (Summer 1944), 300-4

The Women's Engineering Society Thirty-First Annual Report, *The Woman Engineer,* 6:2, (Winter 1950-1), 391-7

Thom, D., 'Better a Teacher Than a Hairdresser? “A Mad Passion for Equality” or

Keeping Molly and Betty down?' in *Lessons for Life. The Schooling of Girls and Women, 1850-1950,* (ed.), F. Hunt, (Oxford: Basil Blackwell, 1987), 124-48

Thom, D., 'The 1944 Education Act: the 'art of the possible'?' in *War and Social Change. British Society in the Second World War,* (ed.), H.L. Smith, (Manchester: Manchester University Press, 1990), 102-28

Thompson, F., *Gentrification and the Enterprise Culture: Britain 1780-1980,* (Oxford: Oxford University Press, 2001)

Thompson, P. & D. McHugh, *Work Organisations,* 3rd edition, (Basingstoke: Palgrave, 2002)

Tinkler, P., *Constructing Girlhood. Popular Magazines for Girls Growing Up in England 1920-1950,* (London: Taylor and Francis, 1995)

Tinkler, P., 'Girlhood in Transition? Preparing English Girls for Adulthood in a Reconstructed Britain', in *When The War Was Over: Women, War and Peace in Europe 1940-1956,* (eds.), C. Duchen & I. Bandhauer-Schoffman, (Leicester: Leicester University Press, 2000), 59-89

Todd, S., *Young Women, Work, and Family in England, 1918-1950,* (Oxford: Oxford University Press, 2005)

Todd, S., *The People. The Rise and Fall of the Working Class, 1910-2010,* (London: John Murray, 2014)

Todd, S. & H. Young, 'Baby Boomers to 'Beanstalkers'. Making the Modern Teenager in Post-War Britain', *Cultural and Social History,* 9:3, (2012), 451-67

Tsaliki, L, 'Women and New Technologies' in *The Routledge Companion to Feminism and Postfeminism,* (ed.), S. Gamble, (London: Routledge, 2006), 65-74

Turner, B. & T. Rennell, *When Daddy Came Home,* (London: Hutchinson, 1995)

Turner, G., *The Leyland Papers,* (London: Eyre and Spottiswoode, 1971)

Tweedale, G., 'Marketing in the Second Industrial Revolution: A Case Study of the Ferranti Computer Group 1949-1963', *Business History, 24:9,* (1992), 96-122

Venables, P., 'Industrial Education in Great Britain. Second Thoughts on the Robbins Report', *International Review of Education,* 11:2, (1965), 151-64

Veness, T., *School Leavers. Their Aspirations and Expectations,* (London: Methuen, 1962)

Venkataiah, S., *Vocational Education,* (New Delhi: Amnol, 2007)

Vlaeminke, M., 'The subordination of technical education in secondary schooling, 1870-1914' in *Technical Education and the State,* (eds.), P Summerfield & E. Evans, (Manchester: Manchester University Press, 1990), 55-76

Walby, S., *Patriarchy at Work,* (Cambridge: Polity Press, 1986)

Walby, S., *Theorising Patriarchy,* (Oxford: Blackwell, 1990)

Walby, S., *Gender, Segregation and Work,* (Milton Keynes: Open University Press, 1998)

Walker, S. & L. Barton, (eds.), *Gender, Class and Education,* (Abingdon: Routledge, 2013)

Walker, S. & L. Barton, 'Gender, Class and Education: A Personal View' in *Gender, Class and Education,* (eds.) S. Walker & L. Barton, (Abingdon: Routledge,

2013), 1-18

West, R., 'Reluctant Retirement', *The Woman Engineer,* 9:9, (Summer 1962), 2-3

Whyte, A.G., *Forty Years of Electrical Progress. The Story of the GEC,* (London: Benn, 1930)

Whyte, J., R. Deem, L. Kant & M. Cruickshank, *Girl Friendly Schooling,* (London: Methuen, 1985)

Whyte, W.H., *The Organisation Man,* (New York: Anchor, 1956)

Wiener, M.J., *English Culture and the Decline of the Industrial Spirit 1850-1980,* (Cambridge: Cambridge University Press, 1981)

Wightman, C., *More than Munitions: Women, Work and the Engineering Industries 1900-1950,* (London: Addison Wesley, 1999)

Williams, Lady G., *Apprenticeships in Europe: the lessons for Britain,* (London: Chapman & Hall, 1963)

Williams, Lady G., 'Industrial Training and the future', in *The First Bath Conference: Technology and Society,* (Bath: Bath University Press, 1966), 149-53

Willis, P., 'Shopfloor culture, masculinity, and the wage form', in *Feminism and Masculinities,* (ed.), P.F. Murphy, (Oxford: Oxford University Press, 2004), 108-20

Wilson, E., *Only Halfway to Paradise. Women in Postwar Britain: 1945-1968,* (London: Tavistock, 1980)

Wilson, J.F., *Ferranti and the emergence of the British electrical industry, 1864-1930,* (Manchester: Manchester University Press, 1991)

Wilson, J.F., 'Government and the Electronic Components Industry: The Case of Ferranti, 1953-1973', *University of Manchester Working Papers in Economic and Social History,* 7, (March 1991)

Wilson, J.F., *Ferranti: A History. Building a Family Business, 1882-1975,* (Lancaster: Carnegie Publishing Ltd., 2000)

Wilson, J.F., *Ferranti: A History Volume II. From Family Firm to Multinational, 1975-1987,* (Lancaster: Crucible Books, 2007)

Wilson, J.F. & A. Thomson., *The Making of Modern Management. British Management in Historical Perspective,* (Oxford: Oxford University Press, 2009)

Wilson, J.F., *Ferranti: A History Volume III. Management, Mergers and Fraud,* (Manchester: Manchester University Press, 2013)

Unpublished Theses

Clements, S. *Feminism, citizenship and social activity: The role and importance of local women's organisations, Nottingham 1918-1969,* (Unpublished PhD thesis, University of Nottingham, 2008)

Cooper, T. *The Science-Industry Relationship: the case of Electrical Engineering in Manchester, 1914-1960,* (Unpublished PhD thesis, University of Manchester, 2003)

Freeguard, J. '*It's time for the women of the 1950s to stand up and be counted',* (Unpublished D.Phil thesis, University of Sussex, 2004)

McCarty, E. *Attitudes to women and domesticity c 1939-1955,* (Unpublished D.Phil thesis, University of Oxford, 1994)

Niblett, C. *Images of Progress: Three Episodes in the Development of Research Policy in the U.K. Electrical Engineering Industry,* (Unpublished PhD thesis, University of Manchester, 1980)

Weatherburn, M.R., *Scientific Management at Work: the Bedaux System, Management Consulting, and Worker Efficiency in British Industry, 1914-48,* (Unpublished PhD thesis, Imperial College London, 2014)

Whitfield, J., *Metropolitan-Vickers, the Gas Turbine, and the State: A Socio-Technical History, 1935-1960,* (Unpublished PhD thesis, University of Manchester, 2012)

Wolpe, A-M., *Factors Affecting the Choice of Engineering as a Profession Among Women,* (Unpublished MA dissertation, University of Bradford, 1971)

Robinson, E.M., *A Rugby Company and Their Female Clerical Workers: The British Thomson-Houston Company Limited, 1930-1955,* (Unpublished MA dissertation, University of Warwick, 1993)

Online sources

Ministry of Education, *Education 1900-1950. The report of the Ministry of Education and the statistics of public education for England and Wales, 1950*

http://researchbriefings.files.parliament.uk/documents/SN04252/SN04252.pdf

Accessed 30 July 2015

House of Commons Library SN/SG/4252. P. Bolton, Social and General Statistics Education: historical statistics, 27 November 2012

www.researchbriefings.files.parliament.uk

Accessed 15 April 2015

'Science and Industry' HC Deb 12 July 1962 vol 622 cc 1527-66

http://hansard.millbanksystems.co/commons/1962/jul/12/science-and-industry

Accessed 1 November 2013

Lord Bowden speaking in the Debate on the Second Reading of the Industrial Training Bill, HL Feb 06 February 1964 vol 225 cc 292-303

http://hansard.millbanksystems.com/lords/1964/feb/06/industrial-training-bill-1

Accessed 9 March 2015

Lord Ardwick, 'Economic Recovery: Co-operation with Industry', HL Deb 09 April 1986 vol 473 cc 236-239

http://hansard.millbanksystems.com/lords/1986/apr/06/economic-co-operation-with-industry

Accessed 12 January 2014

Proceedings of the Committee on Science and Technology. Sixth Report, 'Women in Scientific Careers' 20 January 2014

http:www.publications.parliament.uk/pa/cm201314/cmselect/cmsctech/701/70102.htm

Accessed 4 March 2015

Obituary: T.E. Allibone, *the guardian,* Monday 15 September 2003

http://www.theguardian.com/news/2003/sep/15/guardianobituaries.nuclear

Accessed 23 June 2015

Obituary: Dame Kathleen Ollerenshaw

http://www.theguardian.com/science/2014/aug/12/dame-kathleen-ollerenshaw

Accessed 17 August 2014

Obituary: Claudia Parsons 1990-1998

www.independent.co.uk/arts.../obituary-claudia-parsons-1167736.html

Accessed 11 August 2015

Obituary: Lady Katherine Parsons – Heaton Works Journal, December 1933

http://www.wes.org/content/obituary-hon-lady parsons

Accessed 12 February 2012

Obituary: Lord Scanlon of Davyhulme. *The Guardian* 28 January 2004

http://www.theguardian.com/politics/2004/jan/28/uk.obituaries

Accessed 15 April 2012

Marjorie Malley, 'Hertha Marks Ayrton 1854-1923' in *Women in Chemistry and Physics,* (eds.) L S Grinstein, R K Rose & M H Rafailovich (Westport, CT: Greenwood Press, 1993). Contributions of Women in Physics, UCLA

www.cwp.library.ucla.edu

Accessed 13 June 2015

Hayley Martin, 'A woman engineer', 17 November 2010

http://www.thefword.org.uk/2010/07a_woman_enginee/

Accessed 25 January 2011

Rachael Hawkins, 'The Experience of Young Women in Science', 16 November 2002

http:/www.thefword.org.uk/features/2002/11/the_experience_of_young_women_in_science

Accessed 25 January 2011

Betsey Morais, 'Ada Lovelace, the first tech visionary', 1 October 2013

www.newyorker.com

Accessed 12 December 2014

Jim Perrin, 'Benny Rothman. Inspirational figure who led the Kinder Scout Mass Trespass in its fight for open access', 25 January 2002

http://theguardian.com/news/2002/jan/25/guardianobituaries

Accessed 16 March 2012

Rosemary Anne Reynolds, 'My academic journey 1966 to 2011'

http://www.open.ac.uk

Accessed 19 October 2014

Vince Cable says UK economy hampered by lack of female engineers

http://www.theguardian.com/politics/2013/nov/04/vince-cable-uk-economy-female-engineers

Accessed 12 January 2015

Judith Burns. 'Girls can't what?' - bid to boost women in engineering, 23 June 2014

http://www.bbc.co.uk/news/education-27922770

Accessed 24 June 2014

Katie Allen. 'Forget damsels in distress: we need more female engineers', *The Observer,* 20 July 2014

http://www.gu.com/p/4v47z

Accessed 8 August 2014

D Birkett, 'Women Engineers in the First World War', *E&T Engineering Technology Magazine,* 9:6, 2014

http://eandt.theiet.org/magazine/2014/06/wartime-women-at-wor.cfm

Accessed 2 April 2015

R Carmody, *Daniel Farson*

http:///www.transdiffusion.org/tv/tvheroes/daniel_farson

Accessed 11 October 2013

Dr Williams' School Old Girls' Association, *Dr Williams' School, Dolgellau, 1878-1975*

http://www.dwsoga.org.uk

Accessed 11 July 2015

H Glennerster & R. Pryke, 'young fabian pamphlet 7 – the public schools', (London: Fabian Society, November 1964)

http://digital.library.lse.ac.u/objects/lse:nax552jav

Accessed 30 July 2015

Grace's Guide

http:www.gracesguide.co.uk/Metropolitan-Vickers

Accessed 9 April 2011

Kollewe, J. & G. Wearden, 'ICI: from Perspex to paints', *theguardian,* Monday 18 June 2007

http://www.theguardian.com/business/2007/jun/18/2

Accessed 12 October 2013

Shackleton, A.J., 'The Passing Years, 144-163

http://www.museum.timaru.gov.nz/data/assets/pdf_file/0008/32687/The_Passing_Years-Nov-2014-Part-Two.pdf

Accessed April 2015

Society of Women Engineers (SWE) Archive

http://www.reuther.wayne.edu/node/11511

Tell, F., 'Strategy, capabilities and corporate coherence: exploring some dynamics of learning'. Department of Economic History, LSE. Paper submitted to the EURAM Conference, Stockholm, 9-11 May 2002

esocman.hse.ru/data/685/650/1219/str_cap_x26corp_coherence.pdf

Accessed 12 March 2013

Time Magazine, Great Britain: Mother England', 1 May 1944

http://time.com/time/magazine/0,9263,7601440501,00.html

Accessed 30 March 2014

TUC Interview – Hugh Scanlon transcript 'The Union Makes Us Strong'

http://unionhistory.info/britainatwork/emuweb/objects/common/webmedia.php?irn=166

Accessed 4 May 2013

Watson, N.J, S. Weir & S. Friend., 'The Development of Muscular Christianity and Beyond', *Journal of Religion and Society*

http://moses.creighton.edu/jrs/toc/2005/html

Accessed 3 September 2013

Whitfield, J., 'Thrust Vector: The RAE, Metrovick, and the gas turbine, 1934-1960'

https://www.thrustvector.wordpress.com

Accessed 1 October 2014

http://www.mixx.com/...youtube-uk-fil-won-soldier-at-secret-nuclear-lab-s-17

Accessed 10 July 2011

http://youtube.com/watch?v+xc...Sparticusia

Accessed 10 July 2011

.