Compiling Inequalities: Computerization in the British Civil Service

and Nationalized Industries, 1940-1979

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A dissertation submitted in partial fulfillment of
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ABSTRACT

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Abstract

In the early 1950s, Great Britain led the world in the development and application of electronic computers for business and administrative work. From the late 1950s on, the British government and civil service, paragons of meritocracy in a country stratified by class, committed themselves to implementing computerized data processing techniques throughout the sprawling public sector, in order to modernize their economy, maintain the competitiveness of British high-technology industries, and reconsolidate the nation's strength and reputation worldwide. To succeed in this project, the British government would need to leverage the country's existing expertise, cultivate the heterogeneous field of computing manufacturers, and significantly re-train labor.

By the 1970s, Britain's early lead in the field of computing had evaporated, government computing projects had produced disappointing results, and the nation's status as a world power had declined precipitously. This dissertation seeks to explain why British computing achieved so few of its intended results by looking at the intractable labor problems within the public sector during the heyday of the Britain's proclaimed "technological revolution." The dissertation argues that the interpretation of, and solutions for these labor problems produced disastrous effects.

Sources used include government documents, civil service records, records of the nationalized industries (the post office, national health service, central electricity generating board, coal industry, railways, and others), computing industry records, press accounts, and oral interviews. By using methodologies from the history of technology, institutional history, and labor history, as well as gender analysis, this dissertation shows that despite the government's commitment to both high technology usage and labor

meritocracy, competing claims of technological expertise and management tradition led the government to misjudge the role of this technology within the public sector and the nation.

Beginning with a labor situation in which women did the majority of computing work, and seeking to achieve a situation in which young men and management-level technocrats tightly controlled all digital computing, the British government over-centralized its own computing endeavors, and the nation's computing industry, leading to a dangerous winnowing of skill and expertise within the already-small field. The eventual takeover of the British computing market by IBM, and purchase of the last viable, major British computing company by Fujitsu, marked the end of any hope for Britain's computing dominance in either their home market or the global market.

While multiple factors contributed to the failures of government computing and the British computing industry—including, but not limited to, American competition, inability to effectively create a global market for British machines, and misjudging the public sector's computing needs—this dissertation argues that labor problems, arising largely from gendered concerns about technological change and power, constituted a critical, and unrecognized, stumbling block for Britain's government-led computing revolution.

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List of Abbreviations

ADP	Automatic Data Processing
AEA	Atomic Energy Authority (UK)
BL	British Library
CCA	Central Computing Agency
CCB	Central Computing Bureau
CEGB	Central Electrical Generating Board
CMO	Chief Machine Operator
COBOL	Common Business Oriented Language
CSCA	Civil Service Clerical Association
CSD	Civil Service Department
CTI	Combined Tabulating Installation
EO	Executive Officer
GPO (or post office)	General Post Office, London
HEO	Higher Executive Officer
HMSO	Her Majesty's Stationery Office
ICL	International Computers Limited
ICT	International Computers and Tabulators
LMA	London Metropolitan Archives
MinTech	Ministry of Technology
MO	Machine Operator
MRC	Modern Records Center.
NAHCM	National Archive for the History of Computing, University of Manchester, UK

NAWCS	National Association of Women Civil Servants
NCC	National Computing Center
SEO	Senior Executive Officer
SMO	Senior Machine Operator
TNA	The National Archives, London.
TUC	Trades Union Congress
VA	Vickers Archive, University of Cambridge
WL	Women’s Library, London.
WRNS (or wrens)	Women’s Royal National Service

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1. Introduction: The Importance of the Early History of Computing to the History of Technology, Labor, and the Modern British State

> "Britain is the only country outside the United States which has a significant indigenous computing industry, capable of development into a world-class international enterprise."
>
> -Ministry of Technology Official[1]

> "A New Britain—mobilizing the resources of technology under a national plan; harnessing our national wealth in brains, our genius for scientific invention and medical discovery; reversing the decline of the thirteen wasted years; affording a new opportunity to equal, and if possible surpass, the roaring progress of other western powers…"
>
> -Harold Wilson[2]

1.1 Computerizing Work

In 1945, Alan Turing presented a proposal for an "Automatic Computing Engine" to the National Physical Laboratory of Britain. His paper outlined a stored-program electronic computer that would revolutionize data processing by vastly increasing the speed at which input and output could be run through the computing unit. Through eliminating "all that is done by the normal human operator" and transferring these functions to the machine, this system could vastly reduce what Turing called "the human brake."[3]

Turing's concept of a human brake on computing machinery's efficiency, and his research on how to circumvent it, were early steps in the study of human-computer interaction. Using programming that could be stored inside the machine's memory, he reduced the human brake at the level of the machine itself, but the brake persisted elsewhere as large computerized systems made up of machines, workers, and

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[1] *Times* (London), "Buying Policy Aids ICL, Says MinTech," 30 April 1970.
[2] Harold Wilson as quoted in Ben Pimlott, *Harold Wilson*, (New York: Harper Collins, 1992), 348.
[3] Alan Turing, *A.M. Turing's Original 1945 Proposal for the Development of an Electronic Computer, reprinted with a foreword by D.W. Davies, Superintendent of the Computer Science Division* (N.p.: National Physical Laboratory, Division of Computer Science, 1972), 2.

organizational entities grew. Not everything could be encapsulated into the machine.[4] As the computer moved out of solely scientific and military operations and into a wide variety of commercial and governmental workplaces, its sphere of influence continually grew.[5] Likewise, the importance of the human brake increased, and the varied forms of that brake proliferated, as digital, programmable computers designed with business and administrative applications in mind began to replace mechanical and electromechanical office automation machinery.

As British offices and institutions computerized, the interaction of labor and management with this new technology became of critical importance to the maintenance and expansion of the British government's power. Indeed, successive governments recognized computing as a critical component of national progress. Harnessing the power of these early computing systems, which were often untested and unwieldy, did not naturally lead to a streamlining of the bureaucracies within government and the nationalized industries.

The history of human interaction with automated systems forms a critical facet of the history of early computing. The British government modeled the organization of new information systems on that of older office automating machinery, and constructed their computing staff with reference to existing labor models in their data processing workforce. The long-term feminization of mechanical accounting and pre-electronic

[4] David Mindell has discussed the historical construction of human-machine interaction and the legacy of earlier kinds of control and feedback mechanisms on modern machine operators in *Between Human and Machine: Feedback, Control, and Computing Before Cybernetics* (Baltimore: The Johns Hopkins University Press, 2002). Mindell argues that this history strongly influenced the current shape of control and feedback in computing: even where the technologies may seem discontinuous, similar mechanisms of control, and abstractions of the problem of control, remain and build upon one another.

[5] Turing's ACE project would form the basis for English Electric's Deuce line of business computers, while the EDSAC computer project at Cambridge was the technology behind the first commercial office computer, the LEO. Manchester University's computing research also led to the product line of the business and scientific computing company Ferranti.

computing in British offices, followed by the pressures of post-World War II economic exigencies, combined to unexpected effect during the British government's drive to computerize. Indeed, despite Britain's early lead in the field of computing, this labor landscape undercut the nation's "revolutionary" technological project, directed by the government and public sector.

Ensuing attempts to undo decades of labor feminization in data processing grew out of concerns about computing's implications for power distribution within the bureaucracy. The government's unsuccessful attempts to control this powerful new technology, from the shape of the computing industry and its products and the highest levels of government administration, down to the lowest levels of labor management and hiring, displayed a nation deeply at odds with the process of modernization. This misjudgment of how best to organize administrative computing accounts for the failure of Labour's "technological revolution" of the 1960s, in which computing played a major role. Far from being Labour's mandate alone, the idea that computing technology could revolutionize Britain was shared by Conservative and Labour leaders alike, and fared equally poorly under each party. As a result, computing technology's potential to change the British economy and social structure remained largely untapped through the 1970s.

1.2 Electronic Computing and the British State

The history of attempts to leverage the transformative potential of electronic computing forms part of the discourse on the trajectory of British decline in the latter half of the twentieth century.[6] Unlike other, older industries caught in this decline, the computer industry formed one of the nation's last, best hopes to boost productivity and

[6] A key counterpoint to the decline argument is that Britain did not decline in actual terms in the decades following World War II, but only relative to their industrial and economic rivals' explosive rates of growth. See Alan Sked and Chris Cook, *Post-war Britain: A Political History* (New York: Penguin, 1984).

efficiency nationwide, improve the balance of payments, and reskill key portions of their labor force. Britain's indigenous computer industry was positioned to reinvigorate the state as a whole, altering its position in global trade along with repairing its worldwide image. In addition, computer-based organization and management techniques could make Great Britain relevant once again, to established and emerging economies alike. Successive British governments firmly believed that electronic computing technology, and the management techniques it enabled, would allow the nation to forge a new, but no less lucrative, type of global empire.

For these reasons, the British government took a major financial interest in the British computing industry. From the early 1950s, when Lyons Tea Shops created the world's first dedicated electronic business computer modeled on the Cambridge EDSAC, the government took steps to strengthen the British computing industry. Informal consultations and the imperative to "buy British" grew to formal control and price protection policies for British computers in the 1960s. The government paired these strategies with a push to get industry to adopt new and largely untested computerized techniques, even when older, electromechanical punched-card computing and tabulating systems still performed adequately and cost vastly less.

During the Conservatives' control of the country from 1951 to 1964, the government argued for, but failed to institute, modernization agendas focused on greater government direction of high technology.[7] The Labour Party quipped that these were "thirteen wasted years" that represented the ultimate discontinuity with Labour's

[7] Jim Tomlinson stresses that Harold Macmillan began the push for greater modernization and rationalization of the government and the nation's industry, pointing out the intellectual congruence in this respect between the Conservative and Labour projects for technology from the fifties through the seventies. Jim Tomlinson, "Conservative Modernization: Too Little Too Late." *Contemporary British History* 33, no. 3 (1997): 18-38.

"Technological Revolution" mandate of the mid sixties, but in fact both parties agreed on the need to support science and technology for much-needed modernization, and both backed the idea that direct state intervention was a critical tool in this endeavor.

In 1964, the Labour government institutionalized the concept of strong, centralized, top-down guidance for technology in industry in the form of the new Ministry of Technology. MinTech, as it was known, took the initiative to control the shape and growth of British computing, brokering computing company mergers and consolidations, providing large government loans and investment, and attempting to direct computer purchasing, use, and labor policy throughout industry and the massive public sector, which included the government, the nationalized industries, and the National Health Service.

By directing computing policy, and leading by example through large installations of British computers, the national government injected much-needed capital into British computing for the sake of a technological future in which British tools, machines, and techniques would once again have worldwide influence. Leveraging a pseudo-imperialist ideal of intellectual and economic dominance, the British government and press positioned computing technologies and techniques at the zenith of modern British culture throughout the 1950s, 1960s, and 1970s. Computing would be both a standard-bearer for Britain throughout the world and a way to enhance the productive potential of the British state as a whole.

Machines alone, however, were not expected to produce revolutionary effects. The management and labor required by the new systems were just as critical to this nation-building project. These new technology workers would direct the organization and

application of computers, ensuring that the extensive capital investment the government was making in this new technology would not end in disaster.

As a result, the government instituted a large-scale effort to reshape its labor force in conjunction with the changeover to electronic computing machinery. Career-long computing "specialists" would start out as operators or programmers and grow into managers who understood both the technical and policy implications of computing. These new technocrats were to replace the only liminally white-collar, feminized classes of machine workers upon whose work the government's data processing had previously relied.[8] Computing within the public sector was to increase efficiency and re-tool the government itself, making possible new methods of work, control, and governance.

Yet the British computing industry never achieved the international market share its advocates envisioned. As the computing hardware trade deficit jumped from £27 million in 1968 to close to £40 million in 1969, it became increasingly clear that the global economic trends in which Britain's national computing project was enmeshed were unfavorable to British technology. The history of this facet of decline and the concomitant dominance of American business computing technology have been the focus of several excellent studies on Britain's computing industry.[9] These histories, however, fail to explore the role of labor in constructing a governmental response that led to disastrous measures. The government's program for computing crippled not only

[8] Carla Freeman studies the theory and dynamics of pink-collar work, and the relationship of this category to white-collar identities, in *High Tech and High Heels in the Global Economy: Women, Work, and Pink-Collar Identities in the Caribbean* (Durham, NC: Duke University Press, 2000).
[9] See John Hendry, *Innovating For Failure: Government Policy And The Early British Computer Industry* (Cambridge, MA: MIT Press, 1989), and Martin Campbell-Kelly, *I.C.L.: A Business and Technical History*, (Oxford: Oxford University Press, 1989).

overseas trade and the home market for British machines, but seriously undermined its own highly ambitious projects for computerized administration.

Michel Foucault has described the tendency of states to bring into existence discourses of power that, while describing, also enforce, regulate, and define the subjects described. Foucault's theory of governmentality posits that state institutions call into being their ideal subjects, actually constructing the governable citizen that best fits with the policies and mechanisms of control of the state.[10] This concept describes the project of twentieth-century British computing in multiple ways.

The government's discourse on computing, and its attempts to marshal it to the ends of the British state, focused on computing's transformative potential for the British economy, labor force, and nation as a whole. Yet, it simultaneously neglected to account for the vast space between these ideals the state's current form. The British economy was struggling to recover in the decades following World War II, as the overseas empire contracted and other nations looked to the United States for consumer goods. Britain's relatively small workforce meanwhile required significant, and expensive, new training and reorganization in order to compete with United States industries. As workers rebelled against years of postwar austerity and what many saw as the unfulfilled promises of the welfare state, Britain faced the intractable problem of having masses of high-cost, low-skill workers.

Computerization, in the government's view, promised to fundamentally reconstruct citizens' relationship with the state and their roles within the changing economy. Yet, this reconstruction operated within the definitions of older models of

[10] Michel Foucault, "Governmentality," in *The Foucault Effect: Studies in Governmentality*, ed. Graham Burchell, Colin Gordon and Peter Miller (Chicago: University of Chicago Press, 1991), 87-104.

British society, even as it sought to undo them. The government attempted to shift certain responsibilities of the state and its citizenry to new bureaucratic computing structures. Ultimately, this had as much to do with ensuring the state's ability to govern by reproducing its mechanisms of class and control as it did with tangible, measurable gains in efficiency, economy, and productivity. As a result, many of the key changes fostered by the government's computing projects strengthened traditional conceptions of British citizenship and labor, and undercut the promise of the computing revolution.

1.2.1 Technology, Labor, and the Historiography of National Progress

The history of a technology is inseparable from the history of its utilization. While this premise is central to the history of technology as a discipline, it is also a concept that can be interpreted in multiple ways. Through this process of interpretation, some facets of a technology's deployment can take precedence over others.

The early history of computing, in particular, often focuses on the histories of the scientists, designers, engineers, and businessmen who created and deployed the technology, but rarely on the workers who used the technology once deployed.[11] Where these histories exist, they do not yet connect the history of this labor force in the aggregate to larger issues in the history of computing or the development of large-scale systems. As a result, the development of the early computing workforce, the history of the quintessential twentieth-century technology worker, remains largely unexplored,

[11] For studies of computing from the perspectives of industry and engineering, see: Martin Campbell-Kelly and William Aspray, *Computer: A History of the Information Machine* (New York: Basic Books, 1996); Campbell-Kelly, *I.C.L;* Peter J. Bird, *LEO: The First Business Computer* (Wokingham: Hasler Publishing Ltd., 1994); James Cortada, *Before the Computer: IBM, NCR, Burroughs, and Remington Rand and the Industry They Created, 1865-1956* (Princeton: Princeton University Press, 1993); and, Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, MA: Harvard University Press, 1987).

disconnected from the systemic and institutional histories that are required in order to understand the impact of computing on modern societies.[12]

Though still under-explored in the history of computing, the ability of labor, shaped by management, to play a critical role in determining the socio-economic influences of technology has been well attended in literature on the first and second industrial revolutions, as well as histories of twentieth-century manufacturing work. As discussed below, histories of these previous social, technological, and labor revolutions present patterns that recur in the context of the computing revolution.

Throughout the history of automation in industry, labor rationalization, deskilling, and feminization encroached upon work processes. Maxine Berg has argued that the conceptual utility of the term "industrial revolution" in fact turns on the existence of feminized and feminizing fields of work.[13] In discussing the aggregate output of British industry in the eighteenth and nineteenth centuries, Berg points out that industries that did not fit the traditional model of centralized factory work, like textiles, were those in which mechanization and labor combined to greatest effect to increase productivity. Not coincidentally, these industries were also more heavily populated by female and child laborers, rather than adult male workers.

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[12] Ensmenger and others have begun to address this lacuna in computing history. See: Nathan Ensmenger, "The Question of Professionalism in the Computer Fields," *IEEE Annals of the History of Computing*, October-December 2001, 1-19; "Letting the 'Computer Boys' Take Over: Technology and the Politics of Organizational Transformation," *IRSH* 2003: 48 Supplement, 153-180; and Jennifer Light, "When Computers Were Women," *Technology and Culture* 1999: 40 (3), 455-483. Janet Abbate has argued that an early emphasis on the creation and design of hardware in the history of computing has had the unintended consequence of obscuring women's work in computing, as men were primarily the inventors and designers of computer hardware. See Janet Abbate, "Women and Gender in the History of Computing," *IEEE Annals of the History of Computing* 2003: 25 (4), 4-8.

[13] Maxine Berg, "What Difference Did Women's Work Make to the Industrial Revolution?" *History Workshop*, 35, Spring (1993): 22-44.

While lower wages played a role in women's dominance in textiles, other rationales also underlay the preference for women and children as industrial workers. "When women workers were introduced in new industries or new settings, they usually entered these along with a whole range of organizational and technological changes," Berg points out. In fact, through investigating relative wages, she is able to argue that "it was not wages which determined this gender divide, but the organizational and technological attributes of a women's workforce."[14] Low wages alone did not create a preference for female industrial workers. Rather, the ability of management to reconstruct feminized labor forces in tandem with automation played a key role.

The industries that yielded the highest productivity gains, and simultaneously employed the highest proportions of women and children, were those that lacked or severed links to artisanal production and forms of organization, and simultaneously deployed new technological and managerial regimes. Workers who matched or could be easily molded to new organizational rubrics allowed the latest production technologies to flourish. Managerial practices, in turn, were designed to heighten and build upon certain aggregate labor force characteristics. Feminized labor, therefore, distinguished certain industries from others where the persistence of older models of organization continued to encourage higher numbers of male workers. As a result, the quintessentially "revolutionary" industries within Britain's long industrial revolution must be understood with reference to gendered shifts in the labor force in conjunction with technological changes.

Berg's analysis, like other work on gender and industrialization, begins to show that women's work was not performed by women out of necessity for a particular set of

[14] Ibid., 33.

physical or mental aptitudes; the particular attributes of one sex or the other made little concrete difference. Instead, socially and economically constructed characteristics of women workers, in the aggregate, defined their higher suitability for certain work in particular time periods.[15] As a class of workers in the early industrial period, women had different attributes than men as a class. Lower rates of industrial organization, less flexibility in where or when they could work, and the acceptance of lower rates pay defined this class. As industrialization progressed, gender and class became increasingly unmoored from one another in certain industries, where relatively high wages for women allowed female upward-mobility and where men increasingly became drawn into the deskilling processes of industrial progress. Nonetheless, highly gendered classes of workers persisted well into the twentieth century.

1.2.2 Changing Gender Ideals and the Concept of "Women's Work"

Late industrialization overlapped with the "long nineteenth century," during which social discourses increasingly codified separate spheres of endeavor for men and women. This shift in gendered norms tended to discourage married, middle class women from seeking paid work in what was becoming an ever more urban and socially mobile nation. While putatively only a middle-class concern, as working class laborers could not afford to enact such ideals, the concept of a separate sphere of undertaking for women nonetheless produced far-reaching effects throughout British culture. In addition to defining home maintenance as the proper role for women, this ideal demanded that pre-marital work for women conform to certain criteria of social and physical cleanliness.

[15] See also: Anna Clark, *The Struggle for the Breeches: Gender and the Making of the British Working Class* (Berkeley: University of California Press, 1995); Ivy Pinchbeck, *Women Workers and the Industrial Revolution 1750-1850* (London: Virago, 1981); and, Jane Rendall, *Women in an Industrializing Society: England, 1750-1880* (Oxford: B. Blackwell, 1991).

Women who aspired to this middle-class existence therefore found their work choices powerfully shaped by gendered notions of class.

Legal, economic, political, and social interdependence with a nuclear, heteronormative family defined the "Angel in the House" ideal for middle-class women.[16] This ideal gained influence in the early nineteenth century and became entrenched by the 1840s. In large part, Catherine Hall argues, this cultural shift was a result of the Anglican Evangelical movement, which embarked on several campaigns to re-order Britons' morality in response to the reorganization of people's lives by the rise of industrial capitalism.

Yet, this redefinition of the family did not affect only the lives of the devout. By the mid nineteenth-century "the bourgeois family was seen as the proper family and that meant married women should not work" in *any* familial situation where it was not a necessity. Furthermore, if women were required to work, they should cleave to ideals of modesty and conduct inspired by their future roles as mothers and wives: "They should not flaunt their independence like the mill girls did."[17]

Yet the dichotomy between the free-wheeling factory girl and the middle-class women constrained by the dictates of respectability was oftentimes a false one. Kathleen Canning's work on German textile workers shows how similar discourses of gendered respectability and, just as importantly, gendered political discourse, divided men and women workers within the mill setting. Ultimately, this helped lead to a consolidation of a masculine political prerogative born out of shop-floor struggles, that did not exclude working women's concerns outright, but relegated them to lower levels of the hierarchy

[16] Catherine Hall, *White, Male and Middle-Class: Explorations in Feminism and History* (New York: Routledge, 1992), 75.
[17] Ibid., 95-96.

of labor's concerns. These social relations on the shop floor extended outside of the workplace, defining a dependent role for women mill workers.[18]

While middle-class ideology of the family was class-specific, it also tended to obscure class relations. By assuming this highly factitious arrangement was in fact a natural one, a middle class ideal became the only moral choice for women within British society, one ostensibly obtainable by anyone pure of heart and intention. Hall astutely points out how middle class ideals tended to bleed into more general beliefs about women's roles and capacities. In reality, the wages of working class men were often insufficient to keep a family afloat, and women's incomes, rather than being merely supplemental, were key to their own and their family's economic survival. The concept of irresponsible women "flaunting" their freedom to make pin money in a factory job was not one that mapped to social reality, but one that nonetheless captivated public imagination throughout the nineteenth and twentieth centuries.

The central opposition that developed between the ideals of masculinity and femininity in the nineteenth century, one that carried over into the twentieth century, became the property of having or being dependent. While popular discourse increasingly defined women as economically dependent in the nineteenth century, this ideal of economic dependence in turn tended to reshape the developing and solidifying structures of industrial capitalism. The "increasingly polarized form which sexual relations took," Hall notes, "affected the forms of capitalist social relations and capitalist accumulation"

[18] Kathleen Canning, *Languages of Labor and Gender: Female Factory Work in Germany, 1850-1914* (Ithaca: Cornell University Press, 1996). Canning's study shows how working class politics created gendered work within and outside of the factory that was remarkably similar to British ideals. Instead of focusing on moral cleanliness through behavioral attributes, however, German concerns turned instead to the potentially unhealthy nature of factory work. An issue for state regulation throughout western Europe and in Great Britain in the nineteenth and twentieth centuries, it took on a different resonance in Germany due to the influence of the eugenics movement.

by ensuring that women's work and wages, where allowed, were viewed as only supplementary. [19]

Women therefore lacked the right to a wage on which they could live, whereas men were ideally entitled to a family wage that could support a wife as well as children. In this way, women's paid labor became persistently lower-paid, short-term, and less well insulated from economic downturn. The corollary support of these economic and legal arrangements, the institution of marriage, codified feminine dependence and subsumed a wife's legal and economic identity under that of her husband.

1.2.3 Out of the Home and into the Office

This century-long construction of women as ideally domestic and dependent limited the professions into which middle-class women, or working class women with middle-class aspirations, could enter. Even as gendered constraints on women's work loosened in the twentieth century, first for single women who were not yet in a dependent role and then increasingly for married women as well, the moral burdens of nineteenth-century womanhood continued to form the background to women's working lives. The idea of extending the concept of meritocracy to women, or "the rate for the job" rather than the rate for the worker, grew in fits and starts within industry and the government service.

Office work, so prevalent in the public sector, became not only the cultural laboratory for the concept of state-supplied meritocracy, but also the repository of middle-class Victorian notions regarding women's proper role within society. As Meta Zimmeck has shown in her study of office work from the mid-nineteenth century to

[19] Hall, *White, Male, and Middle-Class*, 97.

World War I, clerical work began to be consciously redefined from a male to a female-coded occupation during the late Victorian era, as a result of the need for respectable jobs for middle class women. While ideally dependents, growing numbers of single, middle-class women had to maintain themselves before marriage, while holding jobs that would not impair their class position or hinder their marital eligibility.

During the latter half of the nineteenth century, the number of workers employed as clerks exploded: from 1851 to 1911 their numbers increased nine fold, from 95,000 to 843,000, making clerks nearly 5 percent of the total British workforce. Male clerical workers increased sevenfold, while women's numbers increased by eighty-three times, boosting their proportion of the total clerical workforce to 20 percent by 1911.[20] In the following decades, women's numbers would continue to increase, until they made up 60 percent of all clerical workers in the 1950s, and more than 70 percent in the 1970s.[21]

This large pool of female labor did not, however, mesh seamlessly into the modernizing office.[22] Instead, offices were made to comport with the changing shape of the British labor market. Women were carefully segregated from men at work, taking different entrances and stairwells in and out, and dining in separate lunchrooms. The idea that these young, exclusively single women might encounter male colleagues by chance

[20] Meta Zimmeck, "Jobs for the Girls: The Expansion of Clerical Work for Women, 1850-1914," in *Unequal Opportunities: Women's Employment in England 1800-1918*, ed. Angela V. John (New York: Basil Blackwell, 1986), 153.
[21] Jane E. Lewis, "Women Clerical Workers in the Late Nineteenth and Early Twentieth Centuries," in *The White-Blouse Revolution: Female Office Workers since 1870*, ed. Gregory Anderson (Manchester, UK: Manchester University Press), 34.
[22] Meta Zimmeck, "The 'New Woman' in the Machinery of Government: A Spanner in the Works?" in *Government and Expertise: Specialists, Administrators, and Professionals, 1860-1919*, ed. Roy MacLeod (Cambridge: Cambridge University Press, 1988), 185-202.

was so unseemly that until 1911 the London post office forbade its female workers from leaving the premises at lunch.[23]

This physical segregation mapped onto the work process as well. Certain office work became gendered feminine while other work remained a masculine preserve. As middle-class and middle-class-aspirant women leapt at the chance to work in offices—in 1874, the post office received 700 applications for just five woman clerk posts—management developed the idea that machine competence was a feminine attribute. Employers, within the civil service in particular, constructed women's work as mechanical, to differentiate it from the intellectual work done by male clerks. The alignment of women with office-machine work quickly took firm hold, and by the 1930s the "Machine Grades" of the civil service employed women almost exclusively.[24] Indeed, women clerical workers became synonymous with those who used office machines.

1.2.4 Accounting for the Total Labor Force

The peculiar, temporary nature of middle-class women's work meant that women's dependence was taken for granted well into the twentieth century. Susan Pedersen has investigated how this widespread expectation of economic dependence for women, even in the face of labor-force data to the contrary, continued to powerfully inform the shape of Britain's economy and political life in the twentieth century. Through her detailed comparison of British and French family allowance debates between the two world wars, Pedersen shows that "family policy is often wage policy in another guise."[25] Both British and French family welfare policies were modeled on protecting an idealized

[23] Zimmeck, *Jobs for the Girls*, 160.
[24] Ibid., 164.
[25] Susan Pedersen, *Family, Dependence, and the Origins of the Welfare State: Britain and France, 1914-1945* (New York: Cambridge University Press, 1993), 413.

nuclear family that relied on a single, male breadwinner wage. Women's wages, meanwhile, were thought to be rendered unnecessary by the institution of state welfare measures for families.

As the British government moved towards instituting social, health, and welfare services for the good of all citizens, the patriarchal relations of the family began to explicitly extend to the relations between the state and its citizens in new ways. Family allowances and benefits aimed at bypassing the power of fathers within individual working-class families, for the betterment of women and children, instead brought the state into the position of patriarch, and gave it the role of establishing which families did and did not properly conform to the government's expectations.

The effects of the two world wars began to undo this relation: married women's labor force participation before World War I was as low as 10 percent in Britain owing to "custom, prejudice, and even organization," yet it skyrocketed to between 40 percent to 60 percent in many factories during the war. Meanwhile working women's numbers as a whole increased 13 percent by the war's end.[26] Their numbers also spiked during World War II, leading to the destruction of the British government's regulation against employing married women in the public sector.

Following World War II, many labor unions and conservative Members of Parliament viewed the social services brought in under Prime Minister Clement Attlee as, in large part, a balm for women's special problem as unpaid domestic workers. Seen as benefiting from the welfare state to a much greater extent than men, whose employers still shared a significant burden of their health and old-age pension maintenance, women in the latter half of the twentieth century were direct descendents of the very model of

[26] Ibid., 90-91.

dependence consolidated in the economic and political culture of mid-nineteenth century Britain.

The recommendations of the 1942 "Beveridge Report" on social insurance attempted to improve women's collective position by offering "recognition of housewives as a distinct insurance class of occupied persons, with benefits adjusted to their special needs."[27] Wives not adequately cared for by their husbands were now offered a state safety net, yet this tended to institutionalize women's position in the economy along the lines of domesticity and dependence. Like the government, employers took for granted that women would marry and leave the workforce, stranding those women who did not conform between categories, with relatively few economic options.

As agitation for equal pay continued in the twentieth century, activists found their claims weakened by the widespread assumption that the welfare state now met all of women's needs, undercutting the claim that equal pay was necessary for survival. The welfare state's provisions, in attempting to account for the contours of women's and men's lives, enacted a wide-ranging political and economic reconstruction of family dependence that reconstituted the heteronormative family within new state institutions.[28]

1.2.5 Mindless Machine Minders and the Machinery of Government

These social, economic, and political constraints combined to further the association of working women with low-skill, high-turnover, mechanized work. Throughout the twentieth century, this alignment of women with machine work in offices persisted through waves of upgrades to mechanical and electromechanical systems aimed

[27] Sir William Beveridge, *Social Insurance and Allied Services* (London: HMSO, 1943),15.
[28] Women working-class reformers, like the Fabian Women's Group, tried to reclaim the notion of "work" and apply it to the labor unwaged women performed within the home in the early 20th century. Theirs was a marginal discourse, however, and the idea of wages for housework was not part of their agenda to shift the cultural understanding of the economic role of homemakers. Pedersen, *Origins of the Welfare State,* 44.

at further automating the work of bureaucracy. As a result, women's work in offices throughout industry, and particularly in the civil service, where such divisions were codified into bureaucratic "grades," was not firmly within the realm of white-collar office work, but rather constructed as liminal to the real work of offices.[29]

In her groundbreaking study of the gendered imperatives used to shape the early computing workforce for the ENIAC, Jennifer Light shows how early computer programming presented a quandary. Located outside the realm of technical experts due to the applied nature of the work, it nonetheless still required advanced training in mathematics, an understanding of electronics, and a host of other skills. In the United States, owing to wartime shortage and the expectation that this would be low-level, temporary work, these jobs were defined as suitable for educated women.[30] After the war, however, computing work steadily professionalized into a men's job. The army, in particular, sought to offer not only jobs but careers in computer programming and operation work to young men.

Nor did contemporaneous office management experts in Britain see anything unusual about the association of women with increasingly complex machines. As one organizational expert pointed out, in response to the ever-growing numbers of women "mechanicals" in the 1950s and 1960s, many women workers who would have

[29] Both James Cortada and Alistair Black et. al. discuss this process in pre-electronic offices. See Cortada, *Before the Computer* and Alistair Black et. al., *The Early Information Society: Information Management in Britain Before The Computer* (Aldershot: Ashgate, 2007).

[30] The women who programmed the ENIAC, wrote the operating manual, and trained others how to operate the machine had to possess a talent for analytical, sequential thinking later understood as one requirement for a good programmer. In addition, they needed the ability to work backwards from schematic diagrams in order to learn how to operate, program, troubleshoot, and repair the massive ENIAC, whose programs had to be set up through the hardware, using plugboards, rather than by using a programming language. In this way, the "feminization" of ENIAC programming labor presents a conundrum: it was seen as suitable for women, even though it traded on categories of skill and training more commonly associated with, and possessed by men in the Anglo-American context. Light, "When Computers Were Women."

previously gone into factory work had sought work in offices as the manufacturing sector contracted: "jobs involving the use of office machinery now closely resemble the sort of light production work that these entrants might have done on the factory floor," he noted.[31]

Indeed, the technological and gender dynamics of modernizing offices powerfully echo those in factory contexts throughout the nineteenth and twentieth centuries. Automation's expansion within the hierarchies of factory work also led to an association, sometimes specious, of women with low-skill work. In her study of deskilling and British autoworkers, Laura Downs shows the importance of labor's cooperation with a particular deskilling regime for its success.[32] Women workers at the Rover Factory, upset at the fact that their work was classified as unskilled, instead of semi-skilled like men who were on similar work, refused to concede to the Rover plant's attempts to further taylorize the assembly-line process. Instead, these workers leveraged the traditional status of women as potentially highly-cooperative machine-minders to hold out for equal pay, and an acknowledgement of the skilled nature of their work, in exchange for compliance with the new system.[33] Their pay concerns were met, but the description of their work did not change, showing management's savvy in taking a long-term view of shop floor reorganization.

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[31] "To Train or Not to Train?" *Office Methods and Machines*, September 1967, 17. On the flip side, women's representation in manufacturing work for new technologies also continued to grow; through the 1960s IBM UK measured its production times for computer internals in "girl hours" rather than "man hours" to highlight the composition of their high-skill but low-cost hardware assembly and testing workforce. See: Interdepartmental Study Group on Application of Computer Techniques to Clerical Work: 1956-1957, T 222/1314, The National Archives, London (hereafter TNA).

[32] Laura Lee Downs, "Industrial Decline, Rationalization and Equal Pay: The Bedaux Strike at Rover Automobile Company," *Social History* 15, no. 1 (1990): 45-73.

[33] Laura Lee Downs, *Manufacturing Inequality: Gender Division in the French and British Metalworking Industries, 1914-1939* (Ithaca: Cornell University Press, 1995).

In her study of the French and British metalworking industries in the early twentieth century, Downs has also shown how management used the redefinition of work along gendered lines to bring more women workers into the previously male strongholds of the metalworking industry. Earlier, labor union leaders had attempted to shut women out of certain factory jobs because of the perception that women's arrival presaged or encouraged deskilling and the depression of wages overall. Yet focusing on management decisions as concerned with economy above all else, tends to support a historical model that privileges a fictive rational actor; one who acts only in his or her best economic interest, even in the aggregate, while enmeshed in complex and often obfuscatory socially-constructed value systems.

Rational economic choices by management cannot account for all of the changes of modernizing workplaces. Labor's expected or implicit intransigence can strongly shape management goals, sometimes leading to disastrous decisions, financial loss, and the reshaping of an industry's standards over a short period of time. David Noble's study on automatically-controlled machine tools, for instance, shows the failure of management automation attempts that removed skilled workers' control over the process of production. [34] Noble gives compelling evidence to suggest that the transfer of power from labor to management was not simply a side effect of automation, but actually a prime motivating factor in management's decision to automate. In this example, technology became not only a tool of industry and capital, to effect higher efficiency and productivity, but also a tool of social control whose effects explicitly extended beyond the workplace. At the same time, it showed that workers themselves have a measure of

[34] David F. Noble, *Forces of Production: A Social History of Industrial Automation* (New York: Knopf, 1984).

agency in changing technical regimes, even as they operate within large sociotechnical systems that construct their available choices in line with the goals of a managerial class.

In the decades following World War II, women's labor in factories and offices became widespread. Both male and female trade unionists began to address the problems associated with the growing utilization of a labor force that seemed to go hand-in-hand with increased automation. The hallmarks of job feminization—low pay, high turnover, short career ladders—threatened to extend to more and more traditionally men's jobs as well.

1.2.6 Computing and the Government

In 1951, the business computer development project financed by the British Lyons Tea Shops and Bakery conglomerate came to fruition. Lyons used the computer for calculating daily nationwide inventory levels for all of its locations, as well as for costing and payroll.[35] Great Britain now had the distinction of having invented the first dedicated business computer, adding to their invention during World War II of the first digital, electronic, programmable computer—the top-secret Colossus. Three years later, when Lyons incorporated their computer division as a separate company, the government granted equal pay to its women workers, with the exception of those who worked with machines; operators of typewriters, accounting machines, tabulators, and electronic computers continued to receive lower rates of pay. As administrative computing began to form a viable option to electromechanical calculation, equal pay in the public sector left the majority of potential computer operators on a lower pay scale than their male counterparts.

[35] Lyons based its design on the Cambridge EDSAC.

Government organizational experts came to believe, as early as the 1956 when they went on fact-finding missions to the major corporations in the American electronic computing industry, that machines, and the workers who operated them, would become an exponentially greater part of a successful government bureaucracy, affecting the project of political governance itself.[36] Yet machine workers were still amongst the lowliest of government employees. The formal bifurcation of the office workforce into machine and non-machine workers just after the war solidified within the nominal meritocracy of the civil service as a result of equal pay provisions. The assertion of lower value for all machine work meant that transferring between clerical work that used machines, and that which did not, became a near-impossibility. In industry, these divisions were less formal, though just as deeply institutionalized, through pay scales and hiring practices.

In his investigation of the British government's deployment of electronic computing devices, Jon Agar has argued that the apotheosis of the British civil servant was the computer; the machine civil servants were trained to operate, program, and adapt their work processes towards.[37] Agar deftly highlighted the relationship between managerial and technological systems within the government, showing that cadres of management and organizational experts leveraged automation to centralize control and deny agency to lower-level workers.

Agar stopped short, however, of interrogating the differences within the masses of labor that made up the government's giant bureaucracy. The government's "machine"—a

[36] M. A. Wright, "Study of Use of Computers for Clerical Work: A Report on Visit to US," 1956, T 222/773 National Physical Laboratory, TNA.
[37] Jon Agar, *The Government Machine: A Revolutionary History of the Computer* (Cambridge, MA: MIT Press, 2003), 3.

system that Agar rightly shows as composed as much of people as actual machinery—employed and extended gendered hierarchies to resolve multiple conflicts over what workers would do, and how they could be controlled. Electronic computing systems gave individuals ever more power as a result of their ability to wield tools exponentially more powerful and versatile than the ones previously applied to office and administration work. Government ministers struggled to keep that potential under their own control.

As a result, computing impelled certain kinds of workers into the highest levels of the government "machine." Those whose work was touched by electronic computing had a brief opportunity to join the upper echelons of government as much-needed management technologists. Low-level operator and programmer tasks metamorphosed from machine-class work into management-class work during the 1960s and early 1970s as a result of the government's desperate attempts to maintain the centralization of authority. The workforce performing these tasks, however, significantly changed in composition during the process.

1.3 The Missing Masses in Computing

As Bruno Latour has argued, segregating the impacts of machines from the impact of people and institutions, or denying the agency of even relatively simple machines and tools to mold, and in some cases, remake human behavior and society, results in a flat, imperfect understanding of how power operates within technological systems and modern societies. So critical are machines to our understanding, Latour believed, that he dubbed these "nonhuman actors" the "missing mass" of modern society, defining its shape, properties, and rate of expansion just as dark matter does for our universe.

The modern, Western, industrial state, in particular, cannot be understood without explaining the power relations between the state, labor, and the tools and machines that are integral to the functioning of any modern society.[38] Yet within the historiography of computing, labor itself has been something of a "missing mass." It has been considered as a variable that follows the contours of automation rather than significantly influencing them. As Nathan Ensmenger argued in his article, "Toward a Social History of Computing," management's understanding of labor is the necessary connective tissue between the political, economic, and technical facets of computing history. "Who has the power to set certain technical and economic priorities," Ensmenger points out, is "fundamentally [a] social consideration that deeply influences the technological development process."[39] For this reason, the history of massive state computing projects offers critical insight into the social agendas that activate complex developments in modern states and postindustrial economies.

British government ministers from the highest levels down understood—albeit imperfectly—this relationship, and struggled to control not just computing's applications within government, but every facet of the technological system. From the design of machines, and the shape of the companies who made them, down to the specific people who would be chosen and groomed to operate them, the government machine used computing to extend its reach throughout the nation, and to construct the late twentieth-century British state.

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[38] Bruno Latour, "Where are the Missing Masses? The Sociology of a Few Mundane Artifacts," *Shaping Technology/Building Society*, ed. Wiebe E. Bijker and John Law (Cambridge, MA: MIT Press, 1992), 225-258.

[39] Nathan Ensmenger, "Power to the People: Toward a Social History of Computing," *IEEE Annals of the History of Computing* 26, no. 1 (2004):94-96.

1.4 Chapter Summary and Conclusion

The effects of changing technologies and techniques reverberate powerfully throughout society. The reverse of this process, in which social expectations powerfully inform how technological changes are considered, described, and instituted plays an equally important role. In the case of the British government's use of early computing technology, these social constraints hobbled the construction of a high-skill, public-sector labor force, which in turn resulted in a public sector ill-suited to deal with the complexities of institutionalizing electronic computing. Attempts to solve the problem through centralization affected the shape of the civil service's computing projects and defined the goals of the pseudo-nationalized computing industry.

Government records and records of the nationalized industries provide the details of this institutional, technological, and labor history, complemented by the records of British computing companies. Labor union records provide perspective on the government's computing projects and their symbiotic relationship with the public sector's labor force. Census data, oral interviews, and media from the mainstream press and trade journals are used to analyze this largely hidden class of workers who nonetheless determined government management policies and captivated the public imagination from the late fifties through the early seventies.

In chapter two, I investigate the creation of a pre-electronic computing underclass in the civil service and nationalized industries along the lines of gender. The gendering of automated computing work in offices prior to World War II led to the connection of women with digital computation equipment used in the top-secret codebreaking projects during the war. For the women who operated and programmed the world's first digital,

electronic, programmable computers, the British-designed Colossi, these gendered aspects of machine work opened new opportunities rather than foreclosed them.

That chapter argues that job conscription during the war led to mandatory job opportunity for women. While women remained associated with particular types of work due to pre-war categorizations, in the realm of automated computing work the crisis also allowed women to have more interesting and responsible jobs than ever before. After the war, when the crisis had passed, these job opportunities vanished, and women returned to a system in the public sector that tried to taylorize their work into lower-skill compartments, even when such categories were counterproductive to the efficient completion of the work at hand. The experiences of the war, however, did materially change the gendering of public-sector jobs in a broader sense; in 1946, the marriage bar, which made mandatory the dismissal of women upon marriage, crumbled as a result of worker pressure from married women who had served during the war. While not altering the gendering of specific jobs, the war did begin to shift larger expectations about gender, and consequently altered women's, and therefore office machine workers' place in British society.

In chapter three, I discuss the continued shift in the abstract perceptions of women's work, while the material perceptions failed to change. Women's workforce participation continued to expand, and feminist and union activists attempted to leverage wartime service to argue for women's equal pay. Meanwhile, the "mechanical ceiling" of public-sector work for the majority of women became all the more onerous as a result of the government's creation of the "Machine Grades," from the old "Women's Grades," in 1948. This "re-grading" of the work in the civil service and nationalized industries

attempted to subdivide automated accounting and computation work further, in order to make laborers more interchangeable. It also had the result of creating the perception—often inaccurate—of work that was deskilled.

In this chapter, I argue that through nominally de-gendering machine work—the grades were renamed using a gender-neutral term, even though hiring practices and expectations had not changed—the government permanently institutionalized women workers at a lower level by isolating them from what was considered the real work of government offices. The hard-won Equal Pay Act of 1954, which equalized men's and women's pay in the public sector, excluded the machine grades. The government argued that the near-total majority of women in these classes meant that this work was indeed less valuable, and thus did not deserve to be raised to the men's pay scales. As a result, the majority of women workers in the civil service did not benefit from equal pay. The gendered hierarchy of machine work made this result all but inevitable. I argue that once these divisions had become even more deeply institutionalized as a result of the uneven Equal Pay Act of 1954, they became nearly intractable throughout the public sector for decades.

Yet, the rise of digital, electronic, programmable business computers for office work promised to change all this. As discussed in chapter four, gendered work hierarchies seemed to be breaking down as women made early gains in the lucrative and upwardly-mobile fields of computer operation and programming thanks to their existing association with machine work. Yet, these strides were made during the economic crises and high-tech labor shortages of the mid 1960s. By the time the crisis had passed, the government returned to previous plans to make a new management-stream class of

computer operators and programmers, and women's gains in better computing jobs were erased through turnover.

I juxtapose the experiences of three computer operators who worked in government and industry during this period with contemporaneous media to illustrate the impact of the trends discernable from government hiring records and self-conscious changes in management practice. Gendered discourses at work in popular imagery reconstructed women's role within this new technological society as glamorous and cutting-edge, while simultaneously downplaying the actual content of the work. While office computerization in government did not produce the promised savings in outlay for staff, the Labour Party proclaimed a "technological revolution" to save the British economy and reconfigure the entire social system. Labour's platform promised a technologically-reskilled, classless meritocracy to supersede Britain's old hierarchies within industry and government. I argue that the focus on computing's revolutionary potential ignored the gendered hierarchies of the work, while the neo-imperialist overtones of this revolution similarly revived older categories of social power instead of undoing them.

Prime Minister Harold Wilson, who exemplified the ideal of the lower-middle-class, state-school-educated boy who had made good, promised his "White Hot" technological revolution would burn up the inequalities of birth that held Britain back in the new global economy. The archaic class system, Labourites argued, had allowed amateurish men of privilege, rather than talent, to lead British industry. Technology, properly deployed, could undo these destructive patterns. Therefore, it could be a tool for economic revival as much as social justice. By distributing power and responsibility more

equitably throughout society, technology could undo the negative effects of gentlemanly amateurs at the highest levels of industry and government.

Ironically, Labour's technological revolution had nearly the opposite effect. Chapter five discusses the flip side of Labor's glowing technological-revolution rhetoric. Within government, the divisions between the old machine grades and the higher grades of the civil service were used to argue for the restriction of computer work to executive-level workers. Computing was deemed so important to the very power structure of government that it could not be left in the hands of machine grade operatives—not because they lacked the technical aptitude, but because they were seen as incapable of exploiting the managerial benefits of computing. Labor shortages, however, continued within government, as the civil service and nationalized industries could not pay the going salaries for these scarce workers. As a result, they focused on the internal recruitment and training of executive-level civil servants with no computing experience, despite revelations that machine workers were better suited to these jobs, and they centralized computing operations as much as possible, with multiple mainframes in each installation, in order to keep strict control.

Simultaneously, led by Wilson's new Ministry of Technology, the government took control of the critical high-technology venture of the nation; the computing industry. In 1968, MinTech forced a merger of the diverse field of British computing manufacturers into one large corporation that could provide the government with the type of large mainframes it needed and hopefully compete with IBM. This pseudo-nationalization and consolidation of the computing industry was an extension of the computing centralization policies within government. The merger was heralded as the

best choice for government as much as for the computing industry. This reconfiguration took a dire toll on the computing industry, however, and hindered the government's very ability wield computing technology in ways best suited to their interests.

Chapter six follows Labour's technological revolution to its end, as the starry-eyed visions of British computing supremacy were dashed, and a coldly technocratic model that leveraged computing technology to dominate the labor force began to replace Wilson's socialist technological revolution ideal. As Britain became engulfed in strikes and labor unrest, the remaining non-management computing labor force became perceived as increasingly unruly. As a result, the remnants of the characteristics of the old machine classes were reasserted. Operators became deskilled workers with no room to advance, while advancing micro-computing technology changed the very shape of the work. At the same time, programming, systems analysis, and other computing jobs now required higher levels of education, plus management potential, becoming firmly gendered masculine.

For Great Britain, the computing revolution offered a final chance to reclaim the power of a fading empire along similar lines of overseas patronage as in the past. Both Conservative and Labour governments during this period agreed on the need for more state action in the realm of high technology to effect this end. As a result, the British government put a premium on the effective use and production of cutting-edge business computing technology, and the organizational models that it would enable. In the main, this was not an issue of short-term efficiency or labor cost savings, even though it was often publicly explained as such, even to the House of Commons. Upgrading the farrago

of older data-processing and office automating machines promised benefits of control, not price.

In this context, the machine labor force holds equal importance with the technology itself for understanding the reasons for British failure. A strongly centralized model initially worked well with the existing labor force; one that had been constructed as a taylorized, feminized class of workers perceived to have little or no intellectual ability, management potential, or capacity to benefit from long-term training. As computerization extended, however, the government's computer projects suffered as a result of being made to accommodate the contours of this labor force, resulting in attempts at further centralization and the related consolidation of the computing industry. But this enhanced control came at a significant price. The government's techno-managerial computing revolution resulted in large, unwieldy computerized systems, under-staffed projects and under-skilled computing and management professionals, and ultimately destroyed the very industry it had sought to nurture.

The full extent of the waste of human and technical resources in the public sector, which grew to absorb more than 40 percent of the gross national product in the 1970s, can only be surmised.[40] One thing remains clear, however; management and governance philosophies encouraged a systematic squandering of the potential of the vast majority of the government's technically-minded labor force. In so doing, they created a juggernaut that all but ensured the failure of Britain's designs for computing in the public sector and the nation as a whole.

[40] John Child, "New Technology and the Service Class," in *The Changing Experience of Employment*, ed. Kate Purcell et al. (London: Macmillan, 1986), 136.

2. From Colossus to the Machine Operator Grades: Women's Work in Times of Crisis and Stability, 1940-1948

> "The accounting machine represents the logical progression from the era of the typewriter and adding machine as separate entities,"
> -*Office Machinery* magazine[1]

> "Mrs. Arrow and I visited the Admiralty today. They have 180 [machine] operators, some established, but the majority temporary, and these girls are kicking up something of a fuss...."
> -Treasury Memo[2]

2.1 Introduction

In the decades prior to World War II office work had steadily feminized. In 1881, only 2.7 percent of all clerks were women. By 1921, this figure had skyrocketed to over 46 percent.[3] Within office work in both the private and public sector, women clustered in low-level jobs. Often this work was referred to as "subclerical," or below real clerical work, an idea echoed by the contemporary construction of "pink collar" categories of labor.

A key marker of this subclerical work was the usage of office-automating machinery in its performance. Machines represented the incursion of manual, vaguely industrial work into the supposedly intellectual sphere of office work. As such, the clerks who performed this work suffered from a perception that their labor was not integrated with the real work of offices as a result of their association with machine techniques. Yet, offices of the early twentieth century relied on machine workers in order to fulfill both immediate and long-term tasks, as well as to maintain the structure of bureaucracies and gradually expand their reach and power.

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[1] *Office Machinery*, July 1958, 555.
[2] Treasury, Letter to Mr. Pike Lees, "Teleprinter Operators," 31 December 1941, T 162/942, TNA.
[3] Jane E. Lewis, "Women Clerical Workers in the Late Nineteenth and Early Twentieth Centuries," in *The White Blouse Revolution: Female Office Workers since 1870*, ed. Gregory Anderson (New York: St. Martin's Press, 1988).

As a result of the increasing automation and feminization of office work that began in the late Victorian era, notably aided by the typewriter, hiring managers came to see young, middle-class women as ideal office machine operators in the pre-electronic age. An emblematic document, prepared for government and business users to compare the features of Hollerith and Powers-Samas punched card accounting machinery, described the operators of the machines as "girls from fifteen to eighteen or twenty years of age, who receive perhaps thirty or forty schillings a week for their work, and in some cases much less."[4]

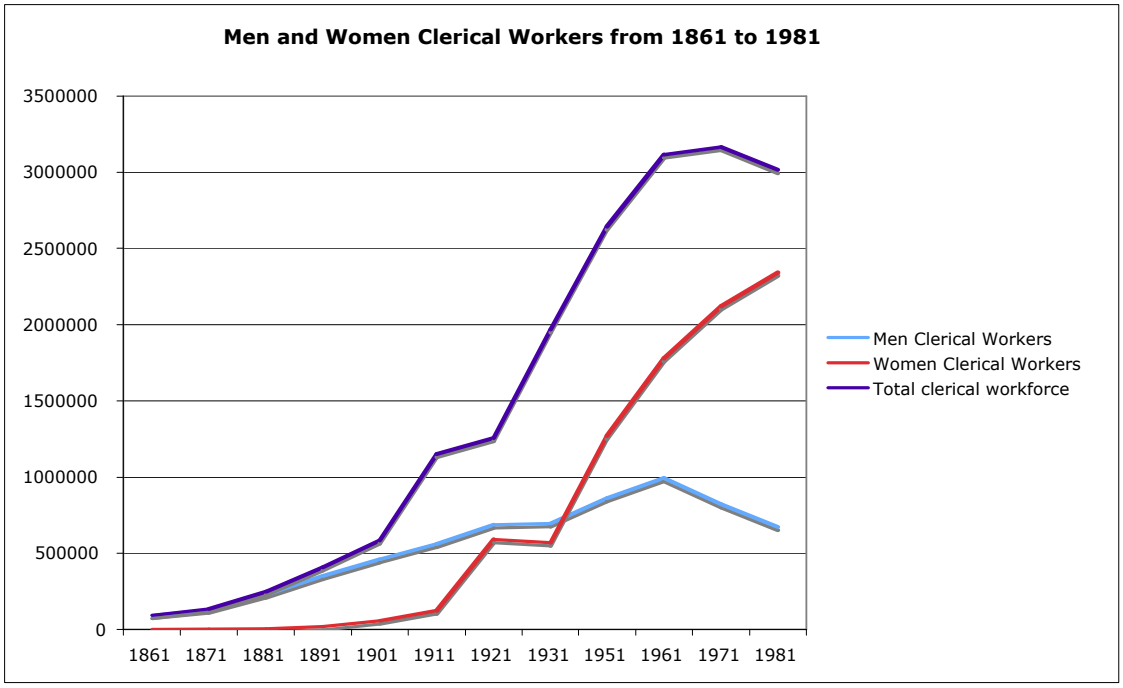

Table 1: Men and Women Clerical Workers from 1861 to 1981.

Jane E. Lewis, "Women Clerical Workers in the Late Nineteenth and Early Twentieth Centuries," in *The White Blouse Revolution: Female Office Workers since 1870*, ed. Gregory Anderson (New York: St. Martin's Press, 1988), 34.

[4] Equivalent to £1.50 to £2.00. L.J. Comrie, Superintendent of HM Nautical Almanac Office, *The Hollerith and Powers Tabulating Machines, based on a Lecture delivered to the Office Machinery User's Association of the London School of Economics and lectures delivered at University College London*. Reprinted in 1933 for private circulation, British Library, London (hereafter BL), 5-15.

Accounting machines formed a major component of this work, but typewriter-like, keyboarded, desk-top accounting machines were not the machines upon which most of the government's nonscientific computation was done. Room-sized punched-card installations handled the most complex and important work of office administration and accountancy. From payroll and pensions, to the compilation of census statistics, punched card systems defined how much data the state could manipulate and how fast it could produce and utilize new information.

Punched card systems not only transformed the state's use of data, but also the job opportunities available to middle class women and those who aspired to the middle class from the late nineteenth to the mid-twentieth century. Women's job opportunities during World War II, especially the work of the Women's Reserve Naval Services (WRNS) with the top-secret Colossus computing project, owed a major debt to the pre-war association of women with electromechanical tabulating machines in offices.

In times of crisis, an association of women with machine work strengthened and extended. On the one hand this opened up opportunities; working with the first digital electronic, programmable computer the world had seen was but the most intriguing. On the other hand, these wartimes opportunities failed to translate directly into postwar gains for women in the labor force, leading neither to greater access to jobs nor equal opportunity with men.

In peacetime, the association of women with machine work in offices continued, expanding along with the ever-feminizing clerical labor force, particularly in the civil service and nationalized industries. Yet, in contrast to the expansion of mechanized information work during the war, the postwar expansion of this work was accompanied

by the continued consolidation of a deskilled identity for office machine workers. Rather than expanding opportunities, as during the war, this produced a winnowing of the categories of work seen as suitable for women. More importantly, it led to the codification of formal categories designed to keep women workers in those jobs. In this way, peacetime work redoubled the power of discourses, altered during the war, that regulated women's inferior, supporting role in the postindustrial British economy.

The mandatory nature of women's wartime work created a short-term situation where women workers were able to excel. Particularly in the public sector, where married women had previously been banned from working, women flooded into better-paid and more responsible jobs than ever before as a result of the crisis. Crucially, this twentieth century pattern wherein crises catalyzed women's advancement in the paid labor force was not limited to military crises. As will be discussed in later chapters, economic crises that threatened to reconfigure the shape of the British state and Britain's role in the world in a less immediate fashion compelled similar upgraded opportunities for women, albeit temporarily. These later crises did not allow women's opportunities to grow in a stable, predictable, and durable way. Rather, they engendered a similar dynamic as had World War II. Once the immediate crisis had passed, women workers retained few of the gains they had accrued, and their association with deskilled work tended to revive as a result of the restabilization of social and economic hierarchies.

2.2 Wartime Computing Work: Short-Lived Opportunity or Springboard to Lasting Gains?

In the first year of World War II, many professional women workers lost their jobs as a result of the efforts to rationalize labor in industry and government. At this stage, the government had no plans in place to utilize women workers at any level for the

war effort, nor facilities in place to retrain them. Shocked by this wasting of labor power, an organization of women members of Parliament and businesswomen stepped in to bring their concerns about the underutilization of women's skills to the government's attention.

Concerned with the health of the war effort, the committee was also attuned to the potential benefits women workers and policy makers might reap from skillfully navigating wartime home front politics.[5] In line with a long tradition of British feminism dating to before World War I, this self-titled "Woman Power Committee" sought to offer women's labor to the state in a manner that would expand the range of options open to women during and after the crisis.

In late 1941, the government began registering, and then calling up, all British women between the ages of eighteen and sixty, married or single, for compulsory service on the home front. The government made assignments irrespective of locale, and warned: "You must be prepared to leave home unless this would mean exceptional hardship." [6] Women's home front labor would soon form the nucleus of the British war machine.

By 1943, 90 percent of single women and 80 percent of married women between the ages of twenty and thirty-one were employed in the war effort.[7] Service assignments fell into two categories: conscription into the Women's Auxiliary Services, or an assigned job in a war-related industry. The former jobs often took the form of administrative or data-gathering and data-processing work in the military, while the latter could be any civilian job. Usually, these jobs were located in manufacturing. A third

[5] U.S. Department of Labor Women's Bureau, *Womanpower Committees During World War II, United States and British Experience*, September 1951, 49, LAB 8/1795 U.S. Department of Labor Women's Bureau, Womanpower Committees During World War II, United States and British Experience, TNA.
[6] *Times* (London), "How the 'Call-Up' Affects Women of Britain," 24 February 1942.
[7] Women's Bureau, *Womanpower Committees*, 49.

category of jobs was created owing to the large numbers of workers who needed to be uprooted and temporarily moved to new areas; near a factory making supplies for the war effort or at a home-front military installation. These jobs involved orchestrating transportation and living arrangements for other women war workers. Finally, any woman who already held a civilian job was legally bound to stay in that job unless explicit government consent allowed her to leave it.

Wringing maximum productivity from all workers soon became crucial to the nation's stability. Using every citizen capable of working become a necessity, even those seen as comprising an imperfect, green, reserve labor force. During the war, workers endured a variety of hardships on the home front, from death and dismemberment to grim rations that sometimes led to malnutrition.

Yet, simultaneously, women workers were faced with a massive range of new job opportunities and training, along with the physical and social freedom required to pursue new opportunities. In the aggregate, women were initiated into a new level of work responsibility and privilege. Though these changes were temporary, they provided the basis for political remobilization after the war as campaigners once again tried to demand equality of work opportunities for women and change women's accepted role in the British economy.

2.2.1 Conscription: Mandatory Job Opportunity

From 1942 on, all young women were required to seek jobs only through the Women's Employment Exchange.[8] The government set up this bureau in an attempt to channel prime workers into essential industries. These women not only worked jobs that

[8] Women between the ages of twenty and thirty-one.

would have been unavailable in peacetime, but also traveled and lived in ways that ran counter to peacetime social and familial mores. Most worked unusual hours or swing shifts, and either traveled far from home alone, or relocated to spartan, communal dormitories set up by the Ministry of Labour. Some of the women working at the heart of Britain's intelligence establishment in Bletchley Park were housed in the servants' quarters of a nearby country manor, with four bunks filling each small room beyond the intended capacity.[9]

For the most part, all women were seen as suitable replacements for men's labor, although single or childless widowed women between the ages of twenty and thirty were regarded as the most portable and dependable, followed by married women without children. Married women who had children under the age of fourteen escaped conscription or industrial reassignment, and instead were encouraged to volunteer.

Although all jobs became suitable for re-trained women workers during the war in theory, gendered ideas about the suitability of certain jobs for certain workers did not evaporate. To an extent, these ideas were sustained by the government's labor rationalization practices throughout the war, despite the disappearance of their practical applicability.[10] Government documents noted that all training centers had been filled with women by 1942, and that the shortage of manpower required a total reliance on women trainees from then on.[11] Now women were eligible for all general engineering courses,

[9] B. Jack Copeland, ed. *Colossus: The Secrets of Bletchley Park's Codebreaking Computers* (Oxford: Oxford University Press, 2006), 161.
[10] Ruth Milkman has discussed the "idiom of sex-typing" during World War II in American manufacturing. In *Gender at Work: The Dynamics of Job Segregation by Sex during World War II* (Urbana: University of Illinois Press, 1987), Milkman argues that although the work women did during the war expanded enormously, employers maintained gendered job categories in order to validate prewar job segregation and maintain traditional ideas about the suitability of types of work according to gender.
[11] Memorandum, "Training of Women," February 1942, LAB 79/32 Woman Power Debate, TNA.

including draftsmanship, fitting, inspection, instrument making, machine operating, panel beating, sheet-metal working, welding, and electrical installation, among many others.

Yet, a Ministry of Labour report noted that only women who "show[ed] promise" would be "treated in the same way as men" and retained for a longer training course. The rest were given an abbreviated training period of a few weeks and sent out to work. Women were still perceived as a poorer training investment in particular fields unless they were exceptionally capable. In addition, stereotypes about which jobs were best suited to each sex persisted: "For certain occupations, such as inspection and viewing or *machine operating*, women are particularly suitable in preference to men." (Italics mine.)[12] The report goes on to say that:

> "For a very limited number of other occupations, e.g. ships' fitting in the centers situated in ship-building and marine engineering areas, men are allocated to the [training] classes, but, by and large, women are regarded as suitable for practically all the training trades in general engineering and are to be found in greater numbers than the men…. The broad position is, therefore, that women are eligible equally with men for all the training… as regards the actual curriculum of training, the same course is available to men and women, and it has been found that women prove to be equally apt pupils."

Nevertheless, the same document described the setting up of a training course for canteen cooks and canteen managers that was only open to women trainees. The quality of the work assignments given also differed by gender. Although all temporary civil service posts were to be open to men and women during the war, in actuality, this rule was not followed.[13] Some jobs and training continued to be earmarked for the scant number of men still available. Somewhat schizophrenically, the government clung to gendered divisions even as it insisted the divisions had lost their utility. That such

[12] Ibid.
[13] Women's Bureau, *Womanpower Committees*, 54.

divisions hindered the state's ability to make the best use of women trainees who were just as capable as men, and far more plentiful, was not lost on Ministry of Labour officials.

The government also attempted to make the most of the available labor by making industry adapt to the living patterns of married women and women with children. The Ministry of Labour urged factories to set up more training programs to fit the needs of women who could only work part time, believing them important enough to the war effort to warrant the waste and logistical inconvenience associated with rearranging training schedules and configuring shortened shifts. Creative solutions to the manpower shortage had to be sought for the production of munitions in particular.[14] Much more so than in peacetime, the government recognized, and tried to mitigate, the "double shift" effect that accrued for married women who working both inside and outside the home.[15]

Yet many women were still unemployed or underemployed during the war. The extra-governmental Woman Power Committee served as a self-appointed clearinghouse for the concerns of the expanding female labor force, fielding complaints about unequal treatment by the government's job placement bureaus and training centers. The biggest problem for both workers and the state was that many women who had registered for work with the Women's Employment Exchange had not been given any work. As this was the only legal way to find a job during the war, these women were stuck in a state of unemployed limbo; they were not allowed to seek work on their own even though the government had not called them up.

[14] Memorandum, "Training of Women," February 1942, LAB 79/32, TNA.
[15] *Times* (London), "Factory Accidents To Women Big Rise During The War, Sir W. Garrett's Report," 8 October 1942.

At the same time, the government was still wanting for workers. The Auxiliary Territorial Service alone was short at least 200,000 recruits. Not only did these inadequacies in the Ministry of Labour's placement system affect women's ability to survive, they also hindered the success of the wartime industries. Some factories, desperate for more workers to meet production goals, saw their machines sitting idle on the night shift as the government forbade them to independently recruit women, even the many older women who were searching for work as a result of not being in the prime call-up group.[16]

Despite the failure to fully maximize the use of women's labor, the war did completely transform the British workforce. In the first months of 1942, over 150,000 women flowed into industrial placements each month. The Armed Forces survey for the year ending in June projected that over 700,000 men and 350,000 women were needed. Additionally Civil Defense and home front services like nursing, the Women's Land Army (farming), and the NAAFI (Navy, Army and Air Force Institutes who provided canteens and laundry services) required another 100,000 women. Munitions factories required 350,000 men and 650,000 women.

Altogether this meant the armed forces and munitions industries utilized over 1.1 million men and 1.1 million women during that year.[17] Adjusting for the close to three-quarters of a million men in these statistics who were sent to fight in this time period, this meant that women workers held a sizable majority on the home front. By 1942, the Ministry of Labour estimated that 80 percent of all single women between fourteen and

[16] *Times* (London), "Idle Machines In War Works Lack Of Women Operatives, Ministry's Veto," 19 March 1942.
[17] Cover letter and Report, "Woman Power Debate," 3 March 1942, LAB 79/32, TNA.

fifty-nine, 41 percent of wives and widows, and 13 percent of mothers with children under fourteen were at work or in uniform with the auxiliary forces.[18]

The scale of labor conscription and redirection hints at the great variety of work that became available to women during the war. Yet, one critical sphere of women's work remained hidden until the 1970s, kept highly classified under the Official Secrets Act. This wartime endeavor reflected gendered ideas about office automation work from before the war, even as it broke with the past technologically.

2.2.2 Colossus: Britain's Secret Technological Pride

In December 1943, a British team under the direction of Tommy Flowers finished production on the world's first digital, programmable, electronic computer at a post office research installation in Dollis Hill, London. The machine was disassembled and sent to Bletchley Park, where codebreaking operations, most famously using Alan Turing's room-sized electromechanical "bombe" device, an adaptation of the Polish *bomba*, had been successfully underway since 1940.[19] By war's end, two hundred of the massive bombes, built by the British Tabulating Machine Company, were in use, joined by a host of other machines and a young, female machine workforce.

Over 10,000 women and men worked at Bletchley Park during the war.[20] Like most home front industries, the makeup of the workforce was overwhelmingly female. In addition to being largely overlooked as a group in the history of codebreaking at

[18] John Costello, *Virtue under Fire: How World War II Changed Our Social and Sexual Attitudes* (Boston: Little, Brown and Co., 1986), 156.
[19] The first bombe was installed at Bletchley in March of 1940. Each bombe reproduced the action of several Enigma machines at once. With each rotor being spun by a central electric motor it was able to step through all possible code settings at a faster rate. Combinations that were not logically inconsistent were examined further by the cryptanalysts, to see if a longer string deciphered with that setting produced German.
[20] Michael Smith, *Station X: The Codebreakers of Bletchley Park* (London: Channel Four Books, 1998), 175.

Bletchley, the female operatives were fairly anonymous at the time. They focused on machine codebreaking with the aid of an eventual ten Colossus computers, three Heath Robinson machines, three Tunny machines, and a variety of smaller electromechanical machines in addition to the bombes.

Most of the women working at Bletchley came from the Women's Royal Naval Service (WRNS), and were commonly referred to as "wrens," as recorded in wartime documents. The nickname "wren," or "wrens" in the plural, was both a transliteration of the acronym for the Women's Royal Naval Service and a pun on the slightly condescending British slang term "bird" used to refer to women, especially those who were young and single.[21] Most of the WRNS members fit into these categories: "96 percent of those who came were between the ages of seventeen and a half and twenty" one report noted, "though a few of the earlier wrens were rather older and more experienced."[22]

The WRNS members used a number of different machines for codebreaking. Tunny, the name given to the secret German code and the machine that produced it, had stronger encryption than the more well-known Enigma code. The machine used to encode Tunny utilized twelve wheels to set the code, instead of the Enigma machine's three. As a result, breaking Tunny code was far more difficult, time consuming, and labor intensive. The prevalence of certain letters in certain languages, along with attempts to guess "cribs" of likely text, guided the theory behind the complex statistical analysis the WRNS

[21] "Bird" was similar in connotation to the American slang term "chick." Because of the familiar, slightly disrespectful connotation of the slang term "wrens," I have referred to WRNS members by their more formal appellation throughout the text, with the exception of quotations.
[22] I. J. Good, D. Michie, and G. Timms, *General Report on Tunny With Emphasis on Statistical Methods*, 1945, 278, HW 25/5 General Report on Tunny, TNA.

members performed on the composition of each intercepted code in order find to the encryption settings for that day's messages.

At Bletchley, work on the electromechanical Tunny consisted of trying different wheel settings and repeatedly resetting the plug boards with settings taken from the runs on the Heath Robinson machine, the functional precursor to the Colossus. "Tunny was plugged up just like an old fashioned telephone exchange," noted an early operator, "it used to give me electric shocks as I put in the plugs."[23] Tunny machines also had a paper tape reader, that would take input from the Robinson machine, although somewhat imperfectly.

The Heath Robinson machines, named by the WRNS members for the British cartoonist who drew comically complicated machinery, used electronic circuitry and high-speed paper tape to compare ciphers.[24] The Robinson machines, however, perpetually broke down, mangling the tapes for the Tunny. In addition to setting and running the machine, operators had to perfect the art of how to keep the tapes intact through the machine's high-speed runs which often stressed the media to the breaking point. As a last resort, glue would be used to repair the tapes when they broke, sometimes flying all over the room if they had been spinning at a high speed. Handling the input and output of the machine, in addition to designing their runs and programming them, was a delicate and non-straightforward process.

When the Colossus arrived in early 1944, it took over the role of finding the proper patterns and settings for the Tunny machine wheels. The Colossus was designed to be able to electronically emulate the different wheel and pin settings of the encryption

[23] Copeland, *Colossus*, 162.
[24] The American analogues to Heath Robinson's creations were those of cartoonist Rube Goldberg.

machines, and was programmed by the WRNS members using switches and plug boards. Because of the complexity of the encrypted code, each Colossus was employed in finding how to break a different level within the encryption. Working on the Colossus entailed efficiently and repeatedly setting and re-setting the machine and managing paper tape input and output for each run. Performing this precise work under extreme time pressure could be arduous, particularly in a small, hot machine room. Each Colossus had more than a thousand vacuum tubes that were never switched off in order to preserve their longevity, since most valve breakages occurred shortly after startup when the machine was warming up. "There was a great deal of jubilation when we broke one particularly important link," recalled one Colossus operator, "to celebrate, someone decorated the room with daffodils."[25]

Yet machine codebreakers often did not even know which arm of the German military had produced the codes they broke.[26] Most workers at Bletchley could only guess what was going on in other sections of the park; they were atomized by the structure of the projects for security and efficiency. One WRNS worker recalled that when issued her security pass on arrival, she was instructed to protect it with her life, while being made to sign the Official Secrets Act. Forbidden to speak about their work or location under penalty of imprisonment, no one at the park was allowed to ask anyone in another Bletchley unit what he or she did. "We would wear no category badges, and if

[25] Copeland, *Colossus*, 163. Less flattering portraits of the WRNS recruits was often related in the memoirs of lower-level cryptanalysts, who sometimes worked alongside them. One recalled how he fell asleep while checking punched sheets. When he made a breakthrough shortly thereafter, he noted, "the young ladies were jealous." (F. H. Hinsley and Alan Stripp, *Codebreakers: The Inside Story of Bletchley Park* (Oxford: Oxford University Press, 1993). His implication that, even while napping, he outclassed the WRNS recruits intellectually was not uncharacteristic of lower-level male cryptanalysts, who sought to separate themselves from the women workers. Another Bletchley story blames a Colossus operator, distracted while applying lipstick, for a machine room fire.

[26] Lorna Cockayne, Interview by British Computer Society. Quicktime, http://www.bcs.org/upload/mp3/lorna-cockayne-enigma.mp3 (accessed 9 February 2009).

anyone asked us what we did, we were to say that we were secretaries," recalled one of the hundreds of WRNS members who worked in codebreaking.[27]

These extreme security measures continued to influence the historiography of technology and labor at Bletchley for decades after the war. One high-speed wireless operator and Morse slip reader in the telecommunications wing of Bletchley worked only "steps" away from the Bombes and Colossi, yet like most of the world she did not know of their existence until information began to trickle into the British press in the late 1970s. Conversely, the codebreakers knew nothing about the vital information transmission that allowed them to break codes. Well into the 1990s, curators of the Bletchley Park museum were unaware of the existence of her telecommunications unit or the critical nature of this data transmission work in the codebreaking information chain.[28]

The codebreaking workforce at Bletchley in April 1943 consisted of only two cryptanalysts, and sixteen members of the WRNS. A year later, the numbers rose to seven, and sixty-eight respectively. But by April 1945 there were a total of 325 workers, the lion's share of these being 273 WRNS members, followed by twenty-eight maintenance and construction engineers, and twenty-four cryptographers and administrators.[29] At any given time, the number of women working at Bletchley Park far exceeded the number of men; on average, over 80 percent of the workforce there was female. And most of these women fell into precisely the same demographic as pre-war machine operators: young, single, and middle class.[30]

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[27] Copeland, *Colossus*, 161.
[28] Doreen Luke, *My Road to Bletchley Park* (Cleobury Mortimer: M. & M. Baldwin, 2003).
[29] Good et al., *General Report on Tunny*, 276.
[30] One wartime report even pointed out that it was important for WRNS members to have "good social recommendations." Ibid., 278.

The typical work shift utilized seven cryptographers and sixty-seven WRNS members, with one or two men in charge of supervising teams. Most of the WRNS members on a shift would work as Tunny or Colossus operators, about twenty for each type of machine, while two would operate Robinson machines and seven functioned as registrars. Registrars were the people who recorded the work assignments and kept the problems to be solved on the machines in order and flowing at a constant rate. As such, they were critical to successful, efficient codebreaking: "details of Tunny Room and Colossus jobs were left to the operators concerned, but the jobs were ordered by the registrars and returned to them on completion," noted a report on operating procedure.[31] As such, the WRNS members who worked as registrars had some of the most responsible work at the park.

Operation work occurred around the clock, in three eight-hour shifts, alternating shifts on a weekly basis. Contaminated water, poor heating and noisy living quarters, along with mandatory morning drilling for WRNS members, whose supervisors were unaware of the skilled, non-physical nature of their work, resulted in the physical deterioration of many of the workers. Each was allowed to leave only one weekend a month.

Interestingly, the male supervisors of the machine work were present less to facilitate the Tunny and Colossus work or give guidance to the operators, and more for their own benefit. The men came up with better theoretical insights when they alternated their cryptographic research work with practical, applied work like supervising runs on the machines.[32] Machine work, and the theory that went into it, was an integral

[31] Ibid., 30.
[32] Ibid., 278.

component, both functionally and intellectually, of the codebreaking process. This was a relationship some supervisory cryptanalysts worked hard to maintain. One WRNS member who worked under Max Newman, a lead cryptanalyst, recalled that on arrival he decreed that everyone working under him call each other by their first names, successfully fostering a spirit of egalitarian teamwork.[33]

Chosen for Bletchley by interview, all WRNS workers had passed secondary school mathematics exams, while 9 percent of them had been to University. Over a fifth had a Higher Schools Certificate, 22 percent had had some previous training, and 28 percent had previous work experience.[34] The relative youth of most, however, meant that many had not been out into the workforce yet.

Training agendas also reflected the integral, rather than liminal nature of the machine work performed by WRNS members. Arriving members of the WRNS were given two weeks training in binary math, the teleprinter alphabet, sight-reading punched paper tapes, and the structure and workings of the Tunny and Colossus machines.

More importantly, when not operating the machine, WRNS members were included in the park-wide program of further education for all workers. Published and oral lectures were organized by a team of one or two cryptanalysts and several members of the WRNS. "It was the policy of the section that all its members should be encouraged to interest themselves in all its activities and to improve their theoretical knowledge," the official report of the Colossus section noted, because "in practice it became increasingly hard for wrens to get a complete picture of an organization in which they might only have

[33] Yet this uncharacteristic level of familiarity could cut both ways. Another WRNS member, cooling off with co-workers outside the boiling hot Colossus machine room, recalled it being "suggested that we went topless," but, "we did not take up the offer." Copeland, *Colossus*, 160, 163.
[34] Good et al., *General Report on Tunny*, 278.

done one job." By 1945, regular lectures were organized in order to aid WRNS workers in becoming better codebreakers as the war drew into its final, grueling stage. The report characterizes these theoretical, mathematical lectures and seminars as "a complete success" for the Colossus operators, and notes that the exact same training would be given to new young men before they began codebreaking work or learned to operate the Colossi.[35]

The official report of the work at Bletchley Park, kept secret until 2000, stated that several members of the WRNS "showed ability in cryptographic work."[36] Despite this, none were promoted to cryptanalyst positions.[37] The rest possessed "cheerful common sense," and some were trusted enough that they "were trained by the engineers to undertake routine testing of the machines."[38]

While the official report recorded that, "wrens (unlike men) were organized in fixed watches and given fixed jobs in which they could become technically proficient," the accounts of the WRNS members themselves differed from this characterization. Noted one, "we had to be versatile." Initially operating Colossus under the direction of a cryptographer who gave them the settings required for the run, they soon took responsibility for doing the settings themselves, "freeing the cryptographer for more important work." Another Colossus operator noted that she was taught to operate the machine by a fellow member of the WRNS, rather than a supervisor.[39]

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[35] Ibid., 279.
[36] Copeland, *Colossus*, 267. One WRNS member, Helen Currie, recalls typing up this official history of Bletchley Park while still on site after VE day, yet she did not write her own account until sixty years later. Her job had been to operate the Tunny decoders.
[37] One biographer of the Bletchley Park cryptographers simply attributes this to what he described as the normal mode of operation in "those deeply sexist times." Copeland, *Colossus*, 159.
[38] Good et al., *General Report on Tunny*, 278.
[39] Copeland, *Colossus*, 162-3.

WRNS members needed to understand the Tunny machine and Colossi well enough to be able to fix minor breakdowns, both for reasons of convenience and because of the shortage of male maintenance engineers. The gendered nature of apprenticeship to engineering maintenance work seems to have strongly influenced the dire shortage of maintenance engineers for Bletchley's machines as the war wore on. In line with the sex-typing of the jobs women were never considered as possible candidates for maintenance work. At the same time, a special nationwide program of recruitment for engineering trainees was established for sixteen to nineteen-year-old boys, as they were seen as better suited to learning engineering work than the women working on the home front.[40]

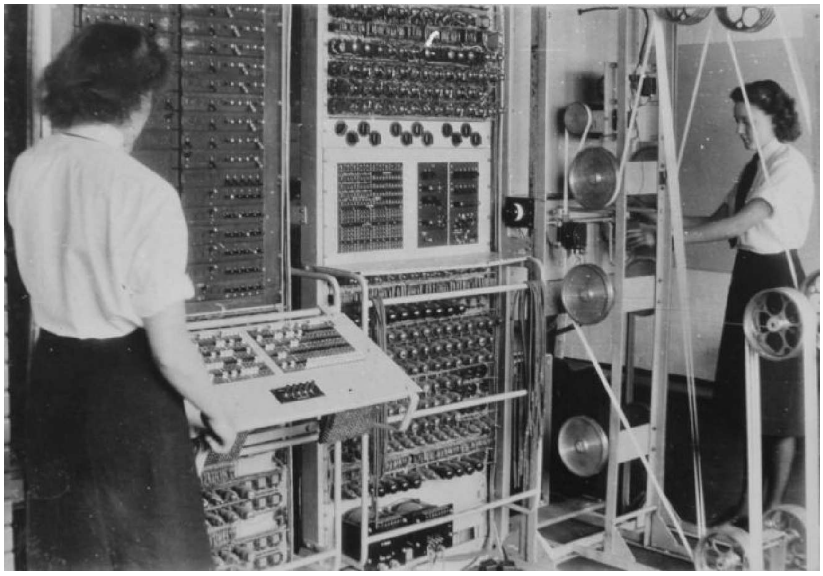

Figure 1: WRNS members working on a Colossus, from I. J. Good, D. Michie, and G. Timms, General Report on Tunny With Emphasis on Statistical Methods, 1945, 332, HW 2/25, TNA.

2.2.3 War's End and the Shifting Ideals of Women's Work

Despite their apparent ability, Colossus operators were immediately made redundant at the war's end along with the majority of wartime women workers. While

[40] *Times* (London), "To Fathers of Boys," 4 November 1942.

some Bletchley men continued in similar lines of work after the war, this was not an option for most of the women. They faced a labor market with few postwar employment opportunities of a similar level of complexity or responsibility. In essence, their wartime training became completely wasted.

An especial sting was added due to the need to keep all wartime intelligence work completely secret: "My emotions were confused. I knew how privileged I had been," said one Colossus operator, but, "my great sadness is that my beloved husband died in 1975 without knowing what I did in the war." She recalled her final "sad job" at Bletchley, having to help break down all but one Colossus into "pieces no bigger than a man's fist" on Winston Churchill's order, after which she was again made to sign the Official Secrets Act.[41]

Another former member of the WRNS, who worked in the wireless transmission section at Bletchley, decided to make a career in industry after VE day. She was well-qualified, having been given over a year's training as a high-speed wireless operator while in the Women's Auxiliary Air Force. Her plans to continue in this line of work evaporated, however, when she applied to the main cable company and found to her surprise that they were now only accepting men.[42]

The London press had often reflected derisive attitudes towards stand-in women workers in the wartime industries. Women's wartime training and experience was not considered on the same level as other industry experience. One skilled aircraft worker, for instance, proffered a plan for breaking down the building of bombers into small, skill-less steps so that they could be effectively mass produced, claiming that while "women,

[41] Copeland, *Colossus*, 171-172.
[42] Luke, *My Road to Bletchley Park.*

runs of the industrial commonplace, are unsurpassed for repetitive, unskilled work," it was not prudent to expect they could perform to a higher standard.[43] Popular accounts of women's work in wartime industries alternated between lauding and downplaying the skills required for the work they had done.

Throughout industry, many women found themselves made redundant in anticipation of the return of men from the front. The resolidification of a masculine ideal for jobs women had been doing during the war threw gendered work differences into sharp relief once again. The temporary reprieve from many gendered job classifications that the government's conscription programs had given women was now over.

Temporary workers also compounded the problem of women civil servants after the war, since "perhaps as much as 50 percent to 100 percent of the established [permanent] complements" had been replaced by temporary women workers due to emergency hiring during the war and postwar reorganization.[44] Long-term temporary staff was another problem: "There were instances of unestablished [non-pensioned] staff with seventeen years of unestablished service, and it was simply not feasible to dismiss such people nor let them continue to age sixty without establishment."[45] Yet the government would only agree to allot 15 percent of all vacancies to retain temporary women staff hired during the war in the postwar reconstruction of the service. The staff negotiating body asked for a general examination to allot who would get the permanent

[43] *Times* (London), "War Output: Use of Skilled Labor," 6 January 1942.
[44] F. Bath, Memo to Mrs. Arnott, T 162/942, TNA.
[45] Memo from Department Head to Mrs. Johnstone, 11 March 1947, T 162/942, TNA.

posts during reconstruction, but the government refused, instead giving the responsibility of choosing candidates to the department heads.[46]

During the war, women workers were a suitable alternative, but as a head of the TUC Women's Conference observed after the war, "One of the by products of unemployment… was a recurring demand that such jobs as were available should be reserved for men, and women should go back to the home, whatever that might mean. What it in fact meant was that women were regarded as a sort of auxiliary force which, to use a military term, was expendable in time of crisis."[47] Interestingly, for women workers, the time of "crisis" in which they became expendable was peacetime rather than during the war. Women trade unionists, in particular, bristled at the prospect of losing the work opportunities afforded to many of them by World War II.

The end of the war produced a sudden change in material conditions for working women. Many returned to feminized spheres of work and were removed from jobs seen as more suitable for returning soldiers. In the abstract, this change in fact cleft to larger gendered ideals that had held fast during the war. The front-versus-home front divide recreated traditional gendered ideals in a nationalistic wartime context; the home front became coded as feminine, despite the major danger involved in living and working in British cities during the war.[48]

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[46] Treasury, "National Whitley Council Committee on Structure of the Post-War Civil Service: Future Establishment of Temporary Staff," 29 May 1946, T 162/942, TNA.
[47] Anne B. Godwin, "Chairman's Address, TUC Women's Congress," *Report of the Annual Conference of Representatives of Trade Unions Catering for Women Workers*, 1955, 20, GB0152 MSS.292/4/12/1-17, The Modern Records Center, University of Warwick (hereafter MRC).
[48] Over 50,000 Britons were killed on the home front during aerial bombing raids. For 1940 and 1941, the years of heaviest civilian casualties, civilian deaths accounted for nearly one-third of all wartime deaths. Micheal Clodfelter, *Warfare and Armed conflicts : A Statistical Reference to Casualty and Other Figures, 1500-2000* (Jefferson, N.C.: McFarland, 2002), 583; and, Great Britain, Central Statistical Office, *Statistical Digest of the War* (London: HMSO, 1951), 11, 37, 40.

This meant that the sudden shift in the gendering of many jobs was downplayed in the popular press since the jobs took place under the conceptual umbrella of a feminine-coded home front. Rhetorical tropes in the popular press constructed valor and ruggedness as the key elements of the wartime masculine ideal, as opposed to a wartime feminine ideal of stoic sacrifice.

Furthering this conceptual divide was the fact that women's home front work was regarded as diligent and necessary, rather than exceptional. Moreover, the attitude with which women performed their work, like the WRNS members lauded for their "cheerful common sense," was constructed in popular discourse to be just as important as the work itself.[49] A 1941 *Times* article, entitled "Cheerful Women of Britain" underscored this point and stressed the need for women to make both public and private sacrifices. "The miners' wives who pushed their bit of meat across the table to the man of the family, to sustain him in his hard work," reflected this ideal of heightened private sacrifice as many women, their labor conscripted, faced a double workload inside and outside the home.[50] Women had to be not just reserve labor, but reserve morale.

The ideal of feminine sacrifice in wartime, reconfigured for British women's labor on the home front, reflected a long-standing, ostensibly commonsense notion that women both needed less and contributed less than men in work and public life, in the aggregate and as individuals. Their sacrifice, and therefore their work, was constructed as passive, rather than active, despite their major contribution to the wartime industries. Women's war work became categorized as a valorized, extreme form of the idea that women played a supporting, secondary, and dependent role.

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[49] Good et al., *General Report on Tunny*, 278.
[50] *Times* (London), "Cheerful Women of Britain," 8 August 1941.

Separate women's pay scales throughout industry and government continued to economically reinforce these assumptions. Equal pay campaigners, working since before World War I, were unable to give the government enough compelling reasons to enact a moral abstraction of equality which many assumed would be economically and culturally disadvantageous in practice. As a result, the war left the economic and legal structures that institutionalized women's dependence, and their limited opportunities in the labor market, largely intact.

2.3 Serving the Nation in Peacetime: Government Meritocracy and Equal Pay

In 1944 by the wartime Woman Power Committee and affiliated groups of women workers mounted a major push for equal pay in the civil service.[51] The payment of equal injury claims to women who had sustained war injuries was high on their agenda. Since women were paid only a percentage of men's wages, the government likewise only gave them a percentage of the men's payment for wartime injuries. The Woman Power Committee hoped to point out the absurdity of paying men and women different amounts for the same injuries.

At the same time, the government was under increasing pressure to raise wages in order to return workers to a pre-war standard of living, and to equalize women's pay with men's by finally enacting the principle of equal pay conceded by successive governments since 1919.[52] While the services rendered by British women during the war reinvigorated the equal pay movement, lending strength to their argument that men's and women's work output and skills were of equal worth, the effects of the war, and the austerity that

[51] This was not unusual, as trade unions had not suspended pay claim negotiations during the war either. Women's Bureau, *Womanpower Committees*, 49.
[52] Equal pay was ratified as Article 427, The Peace Treaty of Versailles 28 June 1919, and a resolution for equal pay was passed in the Commons in 1920, 1921, and 1935.

followed it, also revived to the government's perennial argument that the country could not afford to grant equal pay.[53] Recasting the debate as one of economy and productivity, rather than social justice, the government was able to repeatedly postpone the issue. Proponents of equal pay highlighted the mercurial nature of these financial arguments, noting that there was a "lack of proportion in the use of this argument against the application of equal pay when other recent commitments undertaken by the government are taken into account. Against these the estimated cost of implementing equal pay throughout the government services appears very modest."[54]

It was not until over a decade after World War II that British feminists were able to mobilize a campaign to effectively turn public opinion in favor of limited economic equality for public sector workers. Using women's wartime work experience, equal pay campaigners argued that women had proven themselves full and equal citizens in a time of crisis, and deserved equal pay and equal opportunity in peacetime as a result. This was the first prong in a dual attack on unequal pay; the second was the persistent effort to reskill jobs that were designated as women's work both before and after the war.

Equal pay campaigners first focused their claims for equal pay on the civil service for both symbolic and pragmatic reasons. The government had already conceded equal pay in theory, though not in practice, immediately following World War I. It had never been granted on the grounds that the expense would impair the then-struggling British economy. Since the government had previously conceded the validity of their claim, equal pay campaigners felt that half of their work was already done. In addition, succeeding in getting the government to give equal pay to its workers would send a

[53] United Kingdom, *Parliamentary Debates*, Commons, 5th ser., vol. 438 (1947), cols. 1069-1075.
[54] T. Cazalet Keir, Letter to Chancellor of the Exchequer, 23 April 1952, Folder B/17/4, 6/EPC Equal Pay Campaign and Evidence to the Equal Pay Commission, The Women's Library, London (hereafter WL).

strong message to industry and strengthen unions' claims for equal pay in the private sector.

Perhaps most importantly of all, the civil service already claimed to be a true meritocracy; one that ignored the class distinctions and other prejudices woven through British society and industry. The civil service used exams to promote workers through a detailed hierarchy of government-wide job classes. This structure allowed for the exact comparison of jobs and pay scales in a way that was not possible in industry, where unequal pay could always be excused on the premise of slight differences in job responsibilities.

In this way, equal pay was already twinned with the prospect of equal opportunity to a much greater extent in the public sector than in the private sector. The civil service also employed a high proportion of women, doing work that could not be regarded as peculiarly suited to men.

These considerations made the civil service fertile ground for the equal pay campaign. Yet, the significant institutionalized discrimination in the gendering of job classes would prove to be an impossible hurdle for equal pay to overcome. Before tackling equal pay, however, the more significant problem of women's right to work had to be solved.

2.3.1 Repealing the Marriage Bar: Rethinking Women's Dependence

Though the rule barring married women from working in the civil service was relaxed during World War II, the end of the war saw its swift re-institution. One reformer, Baroness Seear, who worked on women's labor issues in government and industry throughout the twentieth century, recalled that in the civil service at the war's

end, “those women had to be out of the men’s departments at the speed of light. Not because there was the slightest danger that men wouldn’t get their jobs back, there was absolutely no excuse for it…. It was just sheer status quo. And back these women had to go.” The fact that women workers, atomized by a largely male trade union movement, were not able to present a united front along gendered lines meant that practical gains made during the war would have to be re-won well after the war. At the time, observed Seear, “the women themselves accepted a great deal of this. The national agreements had two rates, one for women and one for men… They took it for granted.”[55]

Prior to the war any woman who married was required to resign her civil service post.[56] Many women complied with the regulation, but a difficult-to-measure minority did not. Some of these women got around the restriction by not obtaining a formal marriage license. Others tried to travel a middle route. In bustling London, whose population peaked at 9 million people after World War II, the anonymity of the crowd sometimes meant that well-qualified women workers with opportunities in front of them could hide their marriages.

Enid Hutchison, a government worker and lifelong feminist, recalled that "there was always this thing, that if you married, then you had to have babies surreptitiously, as people did, be married surreptitiously as people could do in the London area… You had to live a life where you couldn't really be known."[57] Yet, at twenty-seven, and “getting on in years,” she decided to marry her longtime companion, also a government employee,

[55] Baroness Beatrice Nancy Seear, Interview by Betty Scharf, February 1991, 8/NLS/4, WL. Seear also moved the first successful national equal pay bill in the House of Lords in 1972.
[56] Marriage bars in the private sector continued, both formally and informally, for decades afterward. Barclay’s Bank, a major employer in London, did not repeal their official marriage bar until 1963.
[57] Enid Hutchison, Interview by Betty Scharf, February 1991, 8/NLS/4, GB 0106 7/DME: Papers of Dorothy Elizabeth Evans, WL.

who was too well-known to hide his engagement. Despite her female supervisor's reluctance to lose a capable, trained employee, Hutchison was fired in accordance with regulations when she refused to resign upon marriage.[58]

Given the large numbers of civil servants who were women, this variation in treatment according to gender undercut the government service's meritocracy in the broadest and most complete sense. Some women were allowed to come back to work in the civil service after being forced to resign, but they were only allowed to return as temporary workers, at the lowest pay and skill grade. It was usual for women who had worked their entire adult lives to find themselves downgraded to the lowest rung on the career ladder after marriage, with no pension rights or other benefits, in both the public and private sectors.

During the early years of the war, the marriage bar was temporarily, but reluctantly, suspended. Hutchison, who started in "the lowest possible job that it *was possible to have* in the Ministry of Labour, a *temporary woman clerk III*" (emphasis in the original) lost her job in the civil service upon marrying, went to private industry, and then back to the government during the war. With exasperation, she recalled:

> "It was back again to the Temporary Woman III grade at the bottom of the heap. Once more you go to the bottom of the heap. But this is an interesting sidelight on the attitude to married women. I went to see the man in charge of the Assistance Board Offices, because I knew I could get a job straightaway there, really. And he said 'The trouble is, you're married.' … And I said: "does that still operate? Isn't there a war on?" So he rang up his headquarters and he was told he could employ a married women. Within a few months, all the staff were married women, and he was lucky to get them. But that was the regulation. The regulation had not been changed!"[59]

[58] Ibid.
[59] Ibid.

Against economic reason, skilled labor was forced to the bottom of the promotion structure while investment began anew in preparing green labor to do the jobs. The flipside to this seeming irrationality was that married women who left were either replaced with much cheaper, younger labor, or forced back to the bottom of the pay scale themselves if they found another job. One woman trade unionist observed that "it was not for any high moral principles that [industry] was getting rid of their married women… they wished to employ cheap labor," and often "seized on any opportunity to worsen the conditions of employment" for married women, on the assumption that a married woman already had the needed level of income through her husband.[60]

Many married women did not receive an adequate wage through their husbands, and others were raised in a tradition of working, politically independent women whose reaction to the marriage bar was the opposite of what was culturally expected. Hutchison, raised in the weaving county of Lancashire, came from an area where women traditionally worked and only took time off temporarily to have children. After finishing her university degree she was determined not to go into nursing or teaching, the jobs usually "meted out" to women in the early twentieth century. Fortunately she had been mentored by women who had achieved relatively high positions in the civil service and industry owing to the demographic shifts created by World War I. Yet, even careerists like Hutchison found themselves subject to the same career limitations as women who had been raised to expect an early reprieve from the paid workforce.

[60] TUC Women's Congress, *Report of the Annual Conference of Representatives of Trade Unions Catering for Women Workers*, 1953, 25, GB0152 MSS.292/4/12/1-17 Women Workers (Report of the Annual Conference of Representatives of Trade Unions Catering for Women Workers), 1953-1970, MRC.

2.3.2 The Origins of the Campaign Against the Marriage Bar

In the immediate aftermath of World War I, Parliament passed the Sex Disqualification (Removal) Act of 1919, which aimed to eliminate exclusion from jobs on the basis of sex or a woman's marital status.[61] This act, along with the 1918 Representation of the People Act that gave the vote to a limited number of British women for the first time, was viewed by many as a reward for women's dedicated war work on the home front during World War I, as well as a move to pre-empt the revival of the violent and disruptive tactics of the pre-war suffrage movement.

The 1919 act, while broad and ambitious, was unevenly applied and enforced. It contained no specific enforcement machinery, and one of the earliest legal claims brought under the act, against the practice of firing married teachers, was denied outright. The government argued that although the act said marriage did not preclude employment, it did not guarantee that married women would be allowed to keep their jobs.[62] Aristocratic women did not necessarily fare better than working women in the application of the law. In 1922 the daughter of Lord Rhondda fought an unsuccessful battle to be allowed to take the place in the House of Lords bequeathed to her by her father.[63] Middle class women made uneven gains: the legal profession and accountancy opened their doors to women at this point, but the civil service cleft to a system of barring married women from continuing their careers.

Long heralded as a "fair field with no favor,"[64] the civil service required women to resign on marriage, thereby mandating inequality of opportunity, until 1946. Although

[61] Sex Disqualification (Removal) Act, 9 & 10 Geo. 5, c. 71.
[62] Harold L. Smith, ed. *British Feminism in the 20th Century* (Amherst: University of Massachusetts Press, 1990), 52-53.
[63] United Kingdom, *Parliamentary Debates*, Lords, 5th ser., vol. 152 (1922), cols. 1012-1036
[64] Civil Service National Whitley Council Committee, *The Marriage Bar in the Civil Service* (London: HMSO, 1946), 4.

married women were drafted back into work in the government and nationalized industries during the exceptional case of World War II, the impression of the government from just after World War I, that "girls and women have regarded their work as incidental rather than as a main purpose of their lives"[65] was echoed again in the Equal Pay Report of 1946:

> "it seems sensible to assume that virtually all men are and always have been and always will be in the market for employment. But experience shows that the proportion of women seeking employment is variable within limits in response to the influence of social forces. Ignoring the fluctuations due to war, the spread of feminist ideas has operated in recent decades both to enhance the demand for women's labor and to expand the supply."[66]

Women's work, although becoming steadily more widespread and acceptable, still remained perceived as largely "incidental" rather than as economically or socially necessary. This image conflicted with the changes brought by the World War II: the proportion of women in the main civil service clerical union immediately after the war was over 66 percent.[67]

When the bar was considered by the 1929-31 Tomlin Commission, general opinion held that it should not be removed in the lower job classes, but perhaps in the higher classes.[68] As with the later institution of equal pay in the civil service, treatment became more "fair" the higher one was able to rise through the ranks of the service. The Tomlin Commission failed to remove the bar, given the relatively divided opinion within labor unions at the time. In 1946, another civil service commission examined the question, in light of married women's wartime service. Their agitation to keep their

[65] Royal Commission on Equal Pay, *Royal Commission on Equal Pay, 1944-1946* (London: HMSO, 1946), 119, quoting the Atkin Report, *Women in Industry* (London: War Cabinet Committee, 1919).
[66] Royal Commission on Equal Pay, *1944-46 Report*, 118.
[67] Whitley Council Committee, *The Marriage Bar*, 13.
[68] Ibid., 4.

wartime posts was now fully supported by the main clerical union, in which women workers held a majority owing to wartime labor shifts.[69]

The 1946 commission surveyed a variety of organizations, including city and local government offices, the nationalized industries, and private companies. The Bank of England, while making provision for married women whose husbands had died during the war, returned to their overall practice of not employing married women, as did the four main railway companies, Cadbury and Rowntree Co., and a number of city and county councils.

The BBC, London County Council, and Boots Drug Company, were among those who removed the marriage bar after the war, stating that no major disadvantage could be found in their record of employing married women. Amongst the other governments surveyed, the USA and USSR stood out in strong opposition to a marriage bar, along with Sweden, Denmark, and Finland, while the Dominion countries, Canada, Australia, and South Africa enacted a return to their pre-war ban on married women workers. [70]

The government's expectation that women would resign on marriage aligned with their general perception of women workers as an elastic and incidental labor force. The idea that most women only needed a wage until marriage, the explanation commonly attributed to the operation of the bar, masked a more complex situation. Women in government were seen as a temporary workers who did low-level jobs that were neither desirable or likely to lead to eventual career paths. That these jobs were aligned with the usage of office automating machinery was not coincidental. Women's jobs in the public

[69] Whitley Council Committee, *The Marriage Bar*, 13.
[70] Ibid., Appendix I.

sector were constructed to follow the automating tools available, and even when these associations broke down in practice, the organizational ideal was upheld.

2.3.3 The Trap of the Typing Grades

Yet this perception belied a far more complex reality. In January 1937, the Civil Service Arbitration Tribunal heard a request brought by the Civil Service Clerical Association on behalf of the all-female typing grades. Since 1929, any civil servant in the typing grades who was required to take on the work of a higher post due to the absence, illness, or overwork of a higher civil servant would be entitled to extra remuneration for doing so, but only after doing the job for a period of six months.

The treasury's initial reasoning behind this was to provide a "qualifying" period for the temporary post holder, but they balked at the idea of shortening that period because six months was the time limit for an absent employee to take paid leave. In this way, the government was able to use low-level women workers to fulfill the duties of higher civil servants without any added outlay. The key to the government's argument against paying the stand-in employee more, or shortening the break-in period, had little to do with the perceived skills of the typing grade workers.

Rather, the idea that "double payment ought not to be made for the same post" directed their reasoning.[71] As long as the former post holder was still drawing a salary, the treasury resisted paying the current post holder for that work. Most stand-in employees would never attain the higher wage, nor any of the potential promotion opportunities attached to the higher post, as temporary leaves rarely lasted more than six

[71] Arbitration Awards of the Industrial Court, "Arbitration Tribunal Ruling on Clerical Assistants, Grade I, Established Typists and Shorthand Typists and Clerical Officers in the General Clerical Class: Extra Remuneration when performing duties of a higher post—Qualifying period," 27 January 1937, 4, 6/NCS box 279 Civil Service Cases, 1937-1940, WL.

months. The arbitration tribunal heard the complaint, and quickly ruled in the treasury's favor, preserving the current mode of operation. Employees who were hired into the machine-oriented subclerical grades rarely had the opportunity to get out, event though they were informally substituted for higher civil servants on a regular basis.

The typing grades and other machine-grade work classes were in fact defined by their reliance on turnover, rather than promotion, to cycle new workers in and older workers out. The Whitley Committee that cautiously recommended the marriage bar's abolition in 1946 elucidated the disruptive effect the change would have on normal operating procedure:

> "A decision to remove the marriage bar would also have complications of the utmost importance as regards the turnover of staff in the large routine grades which are inevitably required in the civil service. The amount of routine work is so great—and will continue to be so, in spite of increasing mechanization—that the civil service staff 'pyramid' is bound to have a very broad base, and promotion to higher ranks cannot come to all."[72]

In the past, this problem had been solved by the marriage bar, because "a large number of women civil servants never enter the field of competition for promotion, since they resign on marriage after only a few years' service." The retention of these women after marriage, however, would vastly reduce the proportion of available promotions in comparison to workers, and would not "be welcomed by their colleagues whose prospects would thereby be worsened." In fact, the report conjectures, the effects of removing the marriage bar might be "violently resented" by male staff. [73]

While the Marriage Bar limited the career options available to women as well as encouraged managers to view women civil service exam applicants as black holes for career training regardless of their scores, the removal of the bar did not automatically

[72] Whitley Council Committee, *The Marriage Bar*, 15.
[73] Ibid.

mean better prospects. Most women, as the report pointed out, would remain on the same low-level work for their entire careers since there was no promotion structure in place for them. In this way, the marriage bar was constructed as a kindness to women civil servants rather than a hindrance: "It may be argued that the disadvantage to other members of the staff is counterbalanced by the advantage to the married women themselves being able to continue their employment after marriage; but even this advantage is questionable where the employment is monotonous routine work."[74]

The Whitley Committee feared that the removal of the bar would negatively impact large swaths of lower-level workers doing machine work, with potentially harmful overall results: "staffs in the routine grades will be condemned to longer periods of monotonous work than if the marriage bar had been enforced." Being trapped in this routine work was thought to be so demoralizing that changing the rules of the civil service in a way that could keep workers there indefinitely could hurt the very workings of the state. "Any general worsening of promotion prospects among the large bodies of staff engaged on routine work would, by its adverse effect on staff morale, be against the interests not only of the staff themselves but of the public service,"[75] warned the marriage bar committee. The very machinery of the government bureaucracy relied on these temporary, relatively low-paid workers remaining as such.

The uncongenial work and poor promotion prospects of the women's grades were seen as such a liability that if marriage no longer functioned as a turnover mechanism for these grades, the labor situation was expected to become grim. Yet, the bar's continued operation created a self-fulfilling prophecy of deskilled and expendable female workers.

[74] Ibid.
[75] Ibid.

Since normally women would resign on marriage, "and as the time and expense spent on training of those resigning is lost to the service, women as a whole are, for this reason amongst others, less valuable than men as a whole."[76] Seen as less valuable workers, women repeatedly became so as they were passed over for training and more responsible work, and confined instead to gender-segregated, partially-automated work.

An earlier Commission on the Civil Service remarked on this system of widespread job segregation, explaining that it flew in the face of the ideal of job "aggregation" that allowed civil service employees to navigate the meritocracy: "While in some Departments women are employed on the same duties and work side by side with the men, in others they are employed in separate branches and have separate avenues of advancement…. The latter system, if rigidly observed, amounts to the reservation of certain posts to men and women respectively,"[77] the report concluded.

The effects of the bar's repeal depended wholly on the number of married women who would actually want to continue in the civil service after marriage.[78] A decade after the marriage bar had been repealed, most women continued to leave the civil service on marriage. A women's union cartoon from the era depicts a woman, chained to her desk, declaring her intention to marry in order to escape "a boring and ill-paid job."[79] Despite the removal of the marriage bar, the position of women, in the aggregate, within the civil service's meritocracy did not transform, due to the absence of equal opportunity and equal pay.

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[76] Ibid., 14.
[77] Royal Commission on Equal Pay, *1944-46 Report*, quoting the *1929-1931 Commission on the Civil Service Report*, 9.
[78] Whitley Council Committee, *The Marriage Bar*, 14.
[79] Mavis Tate, M.P., Equal Pay Campaign Committee Pamphlet, "Equal Work Deserves Equal Pay," 1954, 8, 6/EPC Box 262, WL.

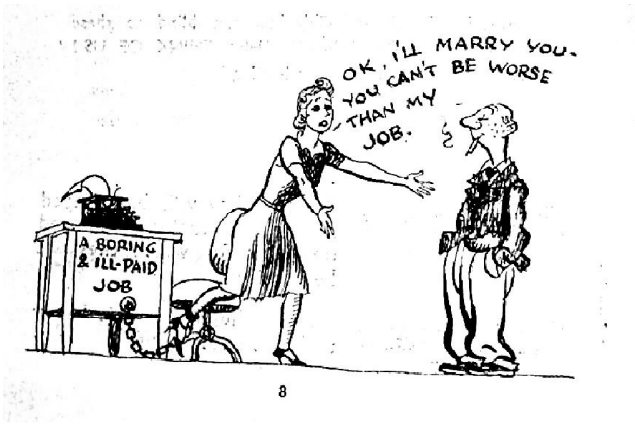

Figure 2: Cartoon from Mavis Tate, M.P., "Equal Work Deserves Equal Pay" Equal Pay Campaign Pamphlet, 1954, 8, 6/EPC Box 262, EPCC Pamphlets/Leaflets Folder, Women's Library, London.

The issue of maternity leave also became a key financial and operational problem for the government to address in considering the removal of the bar. If women were to be allowed to keep their jobs while married, then maternity would have to be accommodated. Although other disadvantages to employing married women, such as higher expected absence rates owing to home responsibilities and taking care of dependent children were entertained as possible "outs" for dismissal of a married woman "as an inefficient employee (not as a married woman)," the committee noted that it would "be impossible, if married women are to be employed at all, to apply this argument to absence due to childbirth."[80] As such, the removal of the bar would force the government, as an employer, to absorb the expense and diminution in efficiency attendant on maternity leave. This expense would become a critical point of contention in the later decision to withhold equal pay from the feminized grades of the civil service.

The government rightly conjectured, in repealing the marriage bar, that the agitation for equal pay and promotion prospects would increase once women's working

[80] Whitley Council Committee, *The Marriage Bar*, 14.

careers were lengthened by the removal of the bar. Additionally, they feared that the lack of turnover and promotion outlets in the routine, feminized job grades could ignite a powder keg. As a result, the government changed the very structure of the civil service two years after the repeal of the marriage bar.

2.3.4 The Machine Grades: Formalizing Women's Association with Automation

In 1948, the government instituted a new civil service category meant to consolidate women workers in various lower grades into one general category.[81] The Machine Operator Class, comprised of several different machine grades, became an official women's class employed on what was considered to be subclerical work. Instead of coming into the civil service as temporary clerks or Clerical Assistants, many women would now have one aspect of their clerical work—machine operation—expanded to signify their entire jobs. This tactic both limited advancement for the grades subsumed into the new category, and ensured that later female civil service applicants would be held to lower standards and given less robust training than clerical officers.

Non-temporary women would enter at the level of Machine Assistant, rising to Machine Operator in their mid twenties, and then Senior Machine Operator in the later twenties or early thirties. At this point, promotion and pay increases would cease, at a much earlier age than workers in clerical jobs. In large part, this was an artifact of the idea that women should leave by this point to get married and take care of a home, but it was also partly due to the idea that this was all their labor was worth.

Due to the specialized nature of this new class, there was virtually no hope of transferring out in search of promotion. As with all other feminized work grades, career

[81] OS 1/656, Duplicator Operators and Machine Operators (Clerical) 1943-1956, TNA.

opportunities beyond the limited promotions available within the grade were often explicitly denied. Attempting to undo such divisions through trade union action presented difficulties. After peaking in 1944, women's membership in the national Trades Union Congress (TUC) declined until 1947. From 1951 to 1952, over 98,000 women joined the TUC, in response to a massive recruiting campaign on the part of women trade unionists to appeal to women workers on the basis of issues specific to them.[82] Yet, labor organization along gendered lines was difficult and inexpedient for women, and within the larger unions, men held most positions of power.

In the government, the women's union was not a part of the larger union. Women civil servants were faced with the option of joining the larger, more powerful union run by men, or the smaller, all-women's union. The women's union was more interested and involved in fighting for the rights of women workers, but it was repeatedly squeezed out of labor negotiations. Conversely, working for equality within the more powerful union led by men was destined to fail, as that union prioritized issues that often went against the interests of the women's grades. Adding to the difficulty was the fact that the pre-war government commission that set up a system of tribunals and labor negotiating machinery for the civil service, the National Whitley Council, refused to arbitrate any complaints about women's unequal treatment: "no claim, however based, may be taken to arbitration if it includes a demand for the same rate for men and women."[83]

[82] TUC Women's Congress, *Report of the Annual Conference*, 1953, 1, 10-13.
[83] Royal Commission on Equal Pay, *Royal Commission on Equal Pay, 1944-1946* (London: HMSO, 1946), paragraphs 142, 224-8; United Kingdom, *Parliamentary Debates*, Commons, 5th ser., vol. 438 (1947), cols. 1069-1075; Council of Women Civil Servants, "Notes on 'The Rate for the Job'," 6/CCS Box 258 Folder: Correspondence between Equal Pay Campaign Committee and Council of Women Civil Servants, 1948-1956, WL.

In this way, the institutionalization of the association of particular types of jobs with women became increasingly problematic as civil servants attempted to work towards equality of pay and opportunity in the decades following World War II. The increasing introduction of faster and more complex office automating machinery aligned with these new grades solidified their position within the government hierarchy and helped produce economies that the government was extremely unwilling to lose.

2.4 Conclusion

The early acceptance of women into the field of electronic computing during World War II was not surprising given the context of women's earlier, and later, skilled work in calculation using machines. Wartime labor emergencies played a crucial part, but with computers, as with earlier mechanized tabulating machines, women were the natural choice for the job of operator, having long been preferred to provide labor on a variety of office machines and light industrial machines.

Despite holding a clear majority of clerical jobs by World War II, women did not enter into all categories and levels of those jobs in similar proportions. Indeed, they had a liminal relationship to other clerical work, since they were seen as more technical than clerical. The stratified civil service job classes from which computer operators would later be drawn was both shaped by the work flow on the enormous array of electromechanical punched card machines and accounting machines that preceded electronic office automation, and by the gendered nature of the machine grades.

Within offices, women disproportionately did the jobs that were most expendable, having short training periods, young intakes and high turnover. The single largest category within this class of jobs were machine operator jobs. In the civil service, these

jobs were not always poorly paid, but women's lower pay, and the lower pay maxima available to them through promotion aided in making these jobs undesirable for the long-term. Efforts to reskill the jobs were often met with resistance, and pay negotiations were bedeviled by the fact that many women workers were part-time, non-union workers. In addition, women were seen as especially well-suited to manual, repetitive work. Other factors, like the idea that women neither needed, nor deserved, as much pay as men, especially when married, and the assumption that they would, or perhaps more accurately *should*, permanently drop out of the work force at a young age in order to marry and have children, made them poor candidates for investing training in, and unsuitable for careers.

Though capable of performing similar work to men in the civil service and in industry, women as were viewed quite differently as a labor force for both cultural and economic reasons, and funneled into specific types of jobs. The dynamics discussed in this chapter are important for contextualizing the later widespread use of women as high-turnover, tractable, low-cost, labor that would complement further automation within government offices. These were the class of workers who would later provide the crucial input and operation labor that allowed expensive office computers to perform the faster, more accurate, and higher-value work for which they were purchased.

Before the introduction of the Machine Operator Class, and the attendant taylorization of these jobs, many machine operator jobs required critical thinking and knowledge of the entire work process, as well as training in fields like mathematics, physics, accounting, or drafting. At the same time, women in these jobs garnered lower wages than a young man might have gotten, and they were not expected to require careers or training. Social mores and cultural assumptions worked in tandem with economic and

technological systems to construct the members of the WRNS as the ideal Colossus operators, just as young women after the war were constructed to become the civil service's Machine Operator Class. Given the broader tradition of associating women with machine work, the jobs women did on the Colossi, as well as the ones they would later hold operating electronic office computers, were actually far more of an evolution rather than a break with the past.

This is not to say that the Colossus operators' jobs were deskilled, but rather to point out their functional similarities with other women's jobs that were taken for granted as women's work both before and after the war. The government's perception of what work was most suitable for women tended to discount the diversity and complexity of work that utilized automating machinery. When armed forces women returned to the civilian workforce after World War II, the jobs that they held as machine operators were part of a labor lineage that included codebreaking jobs during the war.

Far from upending ideas about women's work and the aptitudes and characteristics necessary for it, the secret intelligence work at Bletchley positioned itself along axes of social and labor hierarchies that solidified in the early twentieth century and continued through the decades after the war. In the case of office work, women were not simply put into deskilled jobs that already existed. Rather, the jobs were co-constructed by the availability of women's labor and the prior association of feminized workforces with office automating technology.

Women's wartime computing work at Bletchley did not have a direct effect on women's work in the postwar period, due to the complete secrecy in which it was conducted. This war work does aid in unpacking how women's work was used and

viewed in the years after World War II, however: virtually any job could be packaged as women's work. The undesirable nature of women's grade jobs, and their low status and pay was not solely contingent on the nature of the job. Rather, the status of these jobs was constructed by women's lower status as workers becoming transferred onto the work that they did. The fact it was exclusively women who were hired into certain jobs, both drew on a pre-existing idea that the work was of little importance, and simultaneously reconfirmed the idea. This premise became ever more important as both the role of automation and women workers expanded, and key aspects of this low-status work began to attach to many other types of office work. The expectations and patterns that resulted from this intermingling of women's labor and automation would soon become a major stumbling block for the government as it tried to upgrade the data-processing systems on which the public sector relied.

The patterns of labor established by these earlier machines not only prefigured those of early office computers, but also established expectations for the composition of the computer operator labor force. An association of feminine labor that arose with electromechanical machine operators transferred largely to new machines, drawing on decades-old ideals. At the same time, other clerical jobs and higher computer work were seen as unsuitable for these workers according to the same line of reasoning.

Despite privations, violence, and economic uncertainty, World War II offered benefits for working women providing both the opportunity and the need for women to step into new work roles. In times of crisis, women's work was no longer conscripted to the domestic sphere and lower-level jobs. However, war work did not form any continuous trajectory with postwar work, especially in computing, where the projects

were kept entirely secret and most physical evidence destroyed. The postwar era saw women's wartime work devalued as support work, and women found themselves reluctantly returning to lower job classes or put out of work altogether.

Yet, wartime opportunities were significant in a political sense: they began to erode the model of dependence upon which women's role in the labor force was predicated. The destruction of the marriage bar in 1946 began to shift the position of women in the civil service and nationalized industries in a way that threatened to undo the long-term association of women with low-skill machine work, by extending their working lives. Because this would mean an increased pressure for career-long advancement and promotion for many more civil servants than ever before, the government recognized that a significant reconfiguration of their machine workforce was required. This reorganization, and the long-term changes in the civil service labor force that it institutionalized, would form the basis for the government's electronic computerization projects, but only after a process of further deskilling that reduced the utility of machine grade labor.

3. From the Machine Operator Grades to the Excluded Grades: Equal Opportunity and Equal Pay in the Government's Office Machine Workforce, 1948-1958

> "Personally I attach the utmost importance to our being able to produce, not by exploitation, of course, but certainly economically."
>
> -Evidence from the Representative of the British Employer's Confederation to the Royal Commission on Equal Pay[1]

> "This heavy burden on the Exchequer and local rates would be increased, as equal pay extended… with the result of a further increase in production costs, without any assurance of a compensating increase in production."
>
> -Chancellor of the Exchequer, Hugh Dalton[2]

3.1 Introduction

After World War II, a flagging national feminist movement attempted to reinvigorate the campaign for women's equal pay in the civil service. Meanwhile, the atmosphere created by the catastrophes of World War II highlighted governmental responsibility for wide-ranging social problems. The 1943 Beveridge Report's recommendations laid out a broad new system of social services that would allow the construction of a comprehensive postwar welfare state. Beveridge had been assigned "to undertake, with special reference to the inter-relation of the schemes, a survey of the existing national schemes of social insurance and allied services, including workmen's compensation, and to make recommendations."[3] The report attempted to make recommendations that modeled the state's new welfare structures on existing economic and social patterns, rather than modifying them.

Women had flooded into paid work during the war, their numbers increasing exponentially in public sector occupations, as well as in industry. Both equal pay campaigners and the postwar Labour and Conservative governments recognized the

[1] Royal Commission on Equal Pay, *Royal Commission on Equal Pay, 1944-1946* (London: HMSO, 1946), 196.
[2] United Kingdom, *Parliamentary Debates*, Commons, 5th ser., vol. 438 (1947), col. 1070.
[3] Sir William Beveridge, *Social Insurance and Allied Services* (London: HMSO, 1943).

growing need to deal with the ever-growing labor relations problem created by unequal pay.[4]

Yet, while the expansion of a female labor force enhanced pressure for equal pay, this same growth swelled the government's potential expenditure if they conceded the point for their own workers. Operating with the aid of American-backed reconstruction loans and stung by the 1949 devaluation of the pound, the government struggled to enhance productivity and lower costs, and considered the issue extremely reluctantly.

Attlee's 1945-1951 Labour government considered itself unable to muster the estimated £13 to £25 million for equal pay[5] while spending hundreds of millions of pounds laying the foundations for the creation of new social services,[6] and even upwards of £40 million on such fanciful and abortive colonial enterprises as the Tanganyika groundnut scheme to grow nuts for rationed cooking oil in wildly unsuitable areas of east Africa.[7] The estimated outlay for the entire civil service itself in 1948 was nearly £2 billion; the maximum cost of equal pay placed it at barely more than 1 percent of the budget.[8]

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[4] Harold Smith, "The Problem of 'Equal Pay for Equal Work' in Great Britain during World War II," *Journal of Modern History* 53, no. 4 (1981): 652-672.
[5] United Kingdom, *Parliamentary Debates*, Commons, 5th ser., vol. 438 (1947), col. 1069-75.
[6] Beveridge, *Social Insurance*, 122-125. The chart on page 123 refers to "Housewives" as including married women who are gainfully employed, yet does not include these 1.4 million women in either the "gainfully employed" or the "otherwise employed" categories of analysis, highlighting that married women had always previously received benefits through their husbands. In the new system of social services they were covered under the "Housewives Policy" and were not considered to be "persons depending for their maintenance upon remuneration received under a contract of service."
[7] Council of Women Civil Servants, "Gradual Scheme for Equal Pay," 14 August 1947, 6/CCS Box 258 Council of Women Civil Servants, WL; United Kingdom, *Parliamentary Debates*, Commons, 5th ser., vol. 524 (1954), col. 1916; and, Letter from Conservative Candidates, 1951, 6/NCS Box 258 Parliamentary Elections, WL. For Groundnut Scheme see Alan Wood, *The Groundnut Affair* (London: The Bodley Head, 1950), and Minister of Food and Secretary of State for the Colonies, *The Future of the Overseas Food Corporation*, Command Paper 8125 (1951).
[8] Great Britain, *Estimates for Civil Service for the Year Ending 31st March, 1948 (48), Annual Report 1946-47* (London: HMSO, 1946), iii.

Viewing work compensation in the light of need and social welfare, the government remained highly reluctant to accede to the idea of a "rate for the job" that would be paid to all holders of a given post, irrespective of their social role. The findings of the Beveridge Report, which was to be the model for a progressive, postwar society, strengthened the long-standing connections between wage policy and social services.

In 1944, the government commissioned a panel to reconsider the worth of the work performed by white collar women, with the eventual goal of equalizing men's and women's wages in a way that would require the least outlay. The Royal Commission on Equal Pay undertook a massive re-appraisal from 1944 to 1946, not just of women's and men's work, but also of the very definition of work's worth and value in the civil service.

The research of this commission, and other industrial research, impressed upon government officials the need to stabilize women's wages in all-female job categories at their current rates, rather than allowing them to rise to the level of men's wages. This dovetailed with the need to find a long-term solution to keeping down the overall wage bill for the civil service. As a result, a highly unequal Equal Pay Act that maintained depressed wages in feminized, semi-automated clerical work was passed nearly a decade after the war's end, alongside ever-increasing automation of government offices.

Throughout the decade and a half following World War II, women's labor was increasingly integrated into an ever-more mechanized public sector on the grounds that this labor was explicitly suited to machine work. By using equal pay legislation in the public sector to divide the workforce into clerical workers who deserved equal pay, and machine operator workers who did not, the government instituted a formal division between the feminized classes of workers who performed the critical calculation and

tabulation work of the government's bureaucracies, and the higher classes of workers in which men and women both performed other clerical work, without the aid of machines.

By the early 1950s, increased efficiency and productivity became one of the highest concerns of the British state. Needing both to recover from the war, as well as subsidize the enormous, ambitious welfare state project, the British government's intense interest in enhanced productivity was reflected in the many reports commissioned from the Department of Industrial Research and the reluctance to grant wage increases for the civil service following devaluation.[9]

The drive to hold down labor costs and enhance productivity was twofold: unequal pay stabilized current salaries, while new automation solutions were sought to stem the need for more civil servants. In the late 1950s, further automation of work that had already been partially mechanized accelerated in response to early reports of business computers' successful use in industry. Throughout this period, the government took steps that led to the consolidation of a feminized underclass of machine workers, a category codified by civil service rules and promotion structures created just before the establishment of equal pay in the public sector.

3.2 Reclaiming A High Standard of Living

After the war's end, and through the mid-1950s, British civil servants faced a situation made harsher by government wage restraints designed to bolster the economy

[9] Civil Service Clerical Association, Circular "Statement of Case for the Revision of the Pay of the Clerical Class," 1950, GB0152 MSS.415/CPSA Box 76 CSCA Circulars, 1961-1969, MRC. Major government committees and reports on productivity in industry and government from roughly 1946 to 1953 are too numerous to consider individually, but include the reports of the Anglo-American Council on Productivity (1947-52), The Committee on Industrial Productivity (1948-50), The British Productivity Council (1952-56), Committee on Industrial Productivity: Panel on Technology and Operational Research (1948-1950, T 222/409 Committee on Industrial Productivity: Panel on Technology and Operational Research 1948-1950), and the European Productivity Committee (1953-1960).

and stave off inflation. While rationing and shortages lingered on, the government undertook an "Economy Campaign" within the civil service, reducing the numbers of civil servants and cutting hundreds of thousands of pounds out of government expenditure. The Foreign Office, a typical civil service department, saw £200,000 slashed from its spending, through a mixture of staff and spending cuts.[10]

As wartime gave way to postwar austerity, Britons faced living conditions that had not been vastly improved by the coming of peace. Rationing of food, fuel, and consumer goods stretched on through the early 1950s, making a return to pre-war standards of living impossible. Particularly in London, where the largest numbers of government workers were concentrated, shortages of fuel led to disaster in the winter of 1952, when the high sulfur content from the available low-quality home heating coal combined with weather conditions to create a deadly week-long smog that produced thousands of fatalities.[11] Civil servants in London mourned for the "many more victims of 'nutty slack', or whatever it is which is carrying off the over-fifties" in their annual departmental reports that year.[12]

Far from accepting these cutbacks as necessary to national vitality, civil servants saw the increasing difficulty of their working conditions as emblematic of a larger problem of government devaluation of their work: "It can safely be stated that the government's declared policy of wage restraint finds little sympathetic echo among civil

[10] Foreign Office, Departmental Whitley Council Staff Side, *Annual Report 1953*, 1954, 1, Folder A7/1, 6/NCS Box 279 NAWCS General Reports for the years 1933-1958, WL.
[11] Kelly BéruBé et al. "London Smogs: Why Did They Kill?" *Proceedings of the Royal Microscopical Society* 40 no. 3 (2005): 171-183.
[12] Whitley Council, *Annual Report 1953*. Cheaper than ordinary house coal, "nutty slack" was available, unrationed, from the National Coal Board from December 1, 1952. Its negative effects led to the Clean Air Act of 1956. *Times* (London), "National Coal Board: Nutty Slack Off the Ration (Advertisement)," 25 November 1952; *Times* (London), "Nutty Slack An Abomination," 2 October 1953; and, *Times* (London), "Clean Air Act Urged by Beaver Committee," 26 November 1954.

servants, many of whom reflect a trifle bitterly that had they 'listened to their Dads,' they might all have been good little, rich little coal-miners on a five day week." [13] While workers in national industries like coal gained improved hours and wages, government office workers found themselves stuck on the same "emergency" work week of 45.5 hours and no overtime instituted during the war.[14]

The continued attendance for a half-day on Saturday prompted civil servants to see their lot as worse than workers in private industry: "How pitying, too, the remarks of outside employees who regard civil servants as 'the poor souls who traipse up to town every Saturday' and how galling for the poor souls themselves, who often suffer two hours traveling for three hours work!"[15] Civil servants had long considered themselves at the top of the working hierarchy; non-manual, professional workers and life-long government employees. They now found themselves struggling to maintain the standard of living they had grown accustomed to before World War II.

For women workers, who made up 48 percent of the civil service in 1944, these privations were even more acutely felt.[16] The repeated concession of equal pay in theory, though not in fact, deepened the hardship of a large number of civil servants, while underscoring the unfairness of government wage controls and inculcating a distrust of the pay negotiating tribunal, the National Whitley Council. Deprived of the right to take industrial strike action, government workers relied on the National Whitley Council to negotiate their terms of employment. The government, particularly the treasury, had

[13] Ibid.
[14] NAWCS, *Annual Report 1950*, 7, 6/NCS Box 279, WL.
[15] Foreign Office, Departmental Whitley Council Staff Side, *Annual Report 1954*, March 1955, 1, Folder A7/1, 6/NCS Box 279, WL.
[16] Royal Commission on Equal Pay, *1944-46 Report*, 8. Before the rise caused by the war, women made up about a quarter of the civil service, and after the war surge their proportion stabilized at about a third of the workforce.

significant control over the nominally impartial proceedings, however, and repeatedly refused to negotiate about equal pay on the grounds that it was not a pay claim but a matter of national policy.[17]

While many women workers found their employment ended or discounted at the end of the war, wartime experience was held up as proof that women were not inferior workers.[18] Equal pay reformers, who had begun the decades-long equal pay campaign before World War I, were determined to leverage the impact of World War II in a way reformers had not been able to do successfully after World War I. The equal pay campaign heated up again immediately after World War II, with organizers actively mobilizing their forces even before VE day.

The public sector's rigid hierarchies and exam-based meritocracy allowed equal pay reformers to gain traction in a way that would have been impossible in the private sector. In "meritocracies" like the civil service, women's rights activists had an opportunity to hold the system accountable for the practical injustices that conflicted with the government's proclaimed standards. This method, however, could only scratch the surface of institutionalized inequality. Parts of the system that had gained enough precedent and momentum would remain unchanged, as the government used such precedents to support their contentions about the value of certain jobs, workers, and methods of organization. Feminized machine workers, and the technological system in which they were enmeshed, had acquired just such momentum.

[17] United Kingdom, *Parliamentary Debates*, Commons, 5th ser., vol. 524 (1954), cols. 1906-1907
[18] Royal Commission on Equal Pay, *1944-46 Report*, 188. "Morning after a blitz" repair is referred to women's work, alongside childcare and household duties.

3.3 The Mechanical Ceiling

The machines used by the government's machine operator grades were placed into four general categories: desktop accounting machines; punched-card collators, tabulators and punchers; typewriters; and printing machines. The machines were mechanical and electromechanical, their forms ranging from desktop-sized for typing, punching, and certain accounting machines, to furniture-sized for punched-card tabulators, collators, and output or reproduction machines. Operators doing data input would generally work seated, in large pools, overseen by one female supervisor, while tabulator and collator operators would work standing, sometimes overseen by multiple supervisors who were men or women.

Punched-card equipment formed the backbone of data handling within the civil service before the advent of electronic computing. Cards were usually divided into forty-five to eighty columns having twelve punch positions, with each column representing one character.[19] Cards were made of a high-quality stock that could make several hundred passages through sorting and tabulating machines. Until the 1930s, British companies imported all cards, being unable to produce cards of a sufficient quality locally. Female data librarians kept the cards organized and filed for storage when a data set was not in use for a job.

In order to process information, data was transferred onto the cards from written lists or slips through the use of punch machines with a numeric keypad and a spring-loaded knife mechanism. Automatic advance and ejection, and in some cases automatic feed, enabled punchers to attain incredibly fast regular speeds of 300 to 400 forty-five-

[19] 80 column, 12 row cards were based on the IBM standard that gained influence in the 1930s.

column cards per hour. Many workers could punch six holes per second, at an error rate of under three percent.[20]

Once the data was punched onto cards, an operator loaded them into a sorter, feeding in a specific series of control cards that contained instructions on how to sort and manipulate the bulk of the cards. Cards were sorted at a rate of hundreds per minute, making sorting machines distractingly noisy. They were then fed in batches into an electromechanical tabulator, which stored amounts in counters before recording the output to punched cards, paper tape, or in some cases a printer. Employees rotated between tasks on punched-card installations, with the exception of the largest installations, where dedicated data-input staff was kept separate from the rest of the data processing chain, working in factory-like conditions.

Demobilization after World War II and women's return to peacetime work meant the return of many middle-class women to these jobs. This came alongside renewed agitation for equal pay and a far-reaching clerical union campaign to try to raise the status of office machine operator jobs. This ultimately unsuccessful attempt sought to situate machine operators firmly within the bounds of white-collar clerical work.

By 1952, an estimated one third of all working Britons, close to 7.5 million people, were women.[21] (See Table 2.) The numbers of women in the British civil service approximated their proportion in industry. Young, middle-class women gravitated to the higher-status, cleaner, and often better-paid work available in offices, shunning work as

[20] L.J. Comrie, Superintendent of HM Nautical Almanac Office, *The Hollerith and Powers Tabulating Machines, based on a Lecture delivered to the Office Machinery User's Association of the London School of Economics and lectures delivered at University College London*. Reprinted in 1933 for private circulation, BL, 12

[21] TUC Women's Congress, *Report of the Annual Conference of Representatives of Trade Unions Catering for Women Workers*, 1953, 10, GB0152 MSS.292/4/12/1-17, MRC.

domestic servants or the factory jobs associated with working class manual labor.[22] Because the entry to skilled trades was primarily reserved for boys—in 1951, only one in fifteen girls entering employment was apprenticed to a skilled trade, whereas for boys the figure was one in three—clerical work was one potential path to a relatively good career.[23]

A significant number of would-be office workers favored the higher-paying, more prestigious positions in the government service. In addition to serving in the civil service proper, government clerical workers also provided labor for the bureaucracies of the nationalized coal and steel industries, and the post office, which controlled the majority of British telecommunications through 1981. The expanding agencies of the British state, such as the National Health Service, also required significant clerical labor. The jobs available in the civil service encompassed a large range of functions: one could hold nearly any office job available in industry, and then some, within the civil service.

The necessity of taking qualifying exams for entry into each grade was an important aspect of civil service work. Long described as "a fair field with no favor," a key principle of the service was to combat preference based on social standing through a skills-based, examination-mediated meritocracy.[24] Yet, there were different examinations, and different jobs to be examined for, depending on whether the applicant was a man or a woman.

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[22] So prevalent was domestic service work in women's range of career options that the Women's Congress of the TUC believed "raising the status of the domestic worker meant raising women's status in general." TUC Women's Congress, *Report of the Annual Conference*, 1953, 16, GB0152 MSS.292/4/12/1-17, MRC.
[23] Ibid., 24.
[24] Civil Service National Whitley Council Committee, *The Marriage Bar in the Civil Service* (London: HMSO, 1946), 4.

In 1951, the British government employed some 720,000 workers in the civil service, well over double the numbers employed just two decades earlier, and this number continued to rise quickly in the decades following World War II.[25] Although many of these workers were women, they were not evenly distributed throughout the civil service. At least a handful of women worked in most grades of the civil service, other than the very highest permanent secretary job classes, but the vast majority of women were confined to lower clerical posts, temporary positions, and machine operator jobs.[26] The all-women typing grades, for example, held no room for advancement after the age of twenty-eight.[27] Typing was perhaps the best known of the machine operator jobs during this period, and shorthand typists were seen as the pinnacle of machine operator jobs before the advent of the business computer. Women operated a wide variety of machines, however, from accounting machines to punched card tabulators, printing presses to teleprinters.

Ascending the job grade pyramid showed gender to be an important attribute for dividing workers: Among temporary workers, 57 percent were women, and among the lowest clerical category, Clerical Assistants, 55 percent were women. The higher, Clerical Officer grade by contrast had only 34 percent women in its ranks, while the next grade up, Higher Clerical Officer, had 37 percent. This anomaly might be best explained by the large numbers of women who entered the workforce during, and directly after World War I, and stayed in the workforce, unmarried, owing to the war's toll on their generation's male cohort. This generation would have reached the Higher Clerical Officer

[25] Royal Commission on the Civil Service, *Royal Commission on the Civil Service Report, 1953-1955* (London: HMSO, 1955), 3, 10.
[26] Equal Pay Clippings Folder, 6/CCS Box 258 Council of Women Civil Servants, WL.
[27] In 1951, roughly 30,000 women worked in this consistently-expanding job class. Equal Pay Clippings Folder, 3, 10, 6/CCS Box 258, WL.

grade at the time these statistics were compiled in the early 1950s. Continuing up the job pyramid, the number of women declines to 20 percent in the Executive Class, and then to less than 8 percent in the Administrative Class.[28] In industry, the gender stratification in low-level and high-level jobs was even more extreme than in the civil service, with few women ever making it to the ranks of even middle management.

A section in the exhaustive report on equal pay in the civil service explained the divisions between men and women in this ostensibly "fair field" by expounding on the needs of working women, rather than their employers. It stated that women's needs were:

> "Highly various and unstandardized; so that they do not in practice eventuate the presentation of a claim for additional income comparable in uniformity and precision with the claim of the typical man to receive the wherewithal to prepare for and to assume the moral responsibility, backed as that is by the sanction of law, for founding and maintaining a family group. The *claims* of women as a whole—and it is claims that count upon the market—are governed by the *needs* of those women who have themselves but only themselves to support—even this result having only been secured in relatively recent times and with the intervention of the law."[29]

The long-held management folk wisdom that women were effectively a waste of training because they would leave to have children also played a role. An industrial research report from the early 1960s asserts "It is evident to common sense that women workers do not regard their career as offering an alternative career to marriage and motherhood."[30] One divorced woman applicant to the post office in the 1960s recalled that she would not have gotten her job if she had not convinced the hiring managers that she did not intend to have children.[31]

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[28] Royal Commission on the Civil Service, *1953-1955*, 93,115, 123-124.
[29] Royal Commission on Equal Pay, *1944-46 Report*, 117.
[30] Department of Scientific and Industrial Research, *Money For Effort: Report on Problems of Progress in Industry*, (London: HMSO, 1961), 21.
[31] Cathy Gillespie and Ann Sayce (Government Computer Operators), Interview by the Author, 5 January 2006, London.

Assumptions about women's ideal life and career patterns, as much or more than perceptions of their potential acumen, ensured that most women never joined the ranks of management or more skilled workers. In describing the grades of workers in one of the engineering draftsman employment classes, the commission relates that there were:

> "Drawing office assistants, whose function is to relieve the skilled draftsman of routine work which does not require the full qualifications of the grade of architectural and engineering draftsman. Establishment in the grade of drawing office assistant is confined to women. Men are employed only as temporaries and only if the employing department is satisfied that there is scope for them to acquire the qualifications for entry to the draftsman grade."[32]

As this passage makes clear, not only were women workers put on work with the least room for advancement, and effectively restrained career-wise, but men were simultaneously placed on the surest paths to promotion and management. This was a major goal of effective industrial and governmental organization; ensuring that those viewed as the most promising candidates, who were nearly always men, were given opportunities to succeed, on the assumption that effective reproduction of the current hierarchy would keep the organization strong.

Popular press in the form of books and newspapers mirrored and reinforced these de-facto sex hierarchies in the workplace. A supposedly empowering 1960s ladies' novel about a young woman with a knack for engineering shows the capable main character navigating a male-dominated field by repeatedly asserting her incompetence in comparison to her male peers, and graciously allowing her beau in the company to take credit for her major breakthrough.[33] The novel sent a clear message to its readers that being a successful working woman depended upon an ability to pretend to play a

[32] Royal Commission on the Civil Service, *1953-1955 Report*, 152.
[33] Louise Morley Cochrane, *Anne in Electronics* (London: Chatto & Windus, 1960).

submissive role while simultaneously working hard to advance. The novel ends with the young woman marrying an engineer and keeping her job, attempting to juggle her support of his career and her domestic responsibilities with her own career, having been told by her pastor "that's as it must be." [34]

As new technologies reconfigured the modern office, gendered assumptions were re-fitted for advancing technological systems. Institutionalizing certain work divisions within expanding technological systems entrenched and extended the reach of institutional discrimination. Indeed, the effects of the Equal Pay Act cannot be fully understood without an investigation of the history of technology that constructed women's place in British government offices.[35]

3.4 The Machine Operator Grade: Grassroots of the Equal Pay Campaign

Longtime feminization of tabulating and other office machine work led to the formal institution of this work as women's work following World War II. In 1948, the government created the Machine Operator Class, a specialized category encompassing several job grades for machine operators who worked in large data-handling sections of fifty machine operators or more. "The duties of the class will cover all work on calculating, punch card, and accounting machines and will range from the simplest to the most complex work. The class will be introduced only where large blocks of staff are regularly engaged on machine duties," announced a service-wide memorandum.[36] In

[34] Ibid., 137.
[35] Meta Zimmeck, "Jobs for the Girls: The Expansion if Clerical Work for Women, 1850-1914" in *Unequal Opportunities: Women's Employment in England, 1850-1914,* ed. Angela V. John (Oxford: Blackwell, 1986).
[36] Treasury, Circular To All Civil Service Departments, "Establishment Officers Circular No. 1/48, Special Measures for Establishment of Machine Operators," 2 January 1948, OS 1/656 Duplicator Operators, and Machine Operators (Clerical), TNA.

practice, however, this last criterion broke down. Machine operator grading was soon applied wherever women were employed on automated or partially-automated work.

Standards put in place at the grade's creation aided in heightening the discontent of its members. Office machine workers lacked privileges like pensions and career long promotion as a result of the self-conscious reorganization and codification of this work as feminized. The great mass of women workers referred to in the report on the marriage bar as doing the "monotonous routine work" that made up the broad base of the civil service "pyramid" were absorbed into the Machine Operator Class in 1948.[37] The makeup of this government grade was similar in industry: office machine manufacturers and management consultants regularly referred to machine operating staff as "girls" ranging in age from fifteen to their early twenties. In the civil service, machine operation jobs were now explicitly given exclusively to women, usually young and single.[38] What had once been an informal practice had become formally institutionalized.

3.4.1 Constructing the New Grade

Although the work was generally assumed to be deskilled, government reports and enquiries into the machine operation grades repeatedly contradicted these characterizations, showing how machine workers required many of the same skill sets of higher clerical workers and how machine operation jobs were performed best by higher-skill, more educated workers. Yet, the new machine job grade became entrenched, its workers cut off from the rest of the civil service's career and promotion opportunities,

[37] Whitley Council Committee, *The Marriage Bar*, 15.
[38] The government files supporting this point are too numerous to mention. Emblematic files containing language on the makeup of the grade throughout the 1950s and 1960s include: T 215/1595-1599; NSC 22/68 Clerical Assistant Grade; BA 22/319 Pay and Costing Implications of Machine Operator Grading 1970; AIR 77/384 Recruitment and Retention of Machine Operators; and, AN 171/398-399 Equal Pay, Equal Work: Shorthand Typists and Machine Operators, TNA.

despite government studies on the interchangeability of machine operators and clerical workers that concluded the two kinds of work were intellectually similar.[39] Even machine workers dealing with narrowly specialized calculations possessed similar skills. "The lower grades of the technical part of the engineering field and the [scientific] Assistants are both fairly close to the Clerical Class in many respects," related a treasury report. [40]

Training and time to reaching maximum efficiency on the accounting, punching, addressograph and printing machines varied from a month to six weeks, processing hundreds of characters per hour to thousands depending on the machine's design. The operators for each machine job were far from interchangeable, both due to training and innate skills. Certain machines required workers with particular aptitudes, often referred to as "temperaments" in government documents on the selection of female employees: "Care is and has always been taken in choosing suitable officers to operate overprinting machines, the officers selecting being required not only to be manually dexterous, but to be of a calm, steady nature and willing to undertake the duty, in fact temperamentally suited to get the best results from the machines."[41] Punchers, meanwhile, had to be able to tolerate noisy, boring, and monotonous work while remaining fast and accurate.

A government-wide inquiry in 1945 sought to find out if the lack of manual dexterity tests in the civil service exams for young women candidates had caused the government to be "embarrassingly let down by getting girls who were naturally left

[39] Clerical staff switched onto machine operation work gained extra pay for attaining proficiency on certain machines. Post Office, "Machines and Machine Operators in the PTO," 1917-1954, PT 1/102 Machines and Machine Operators including Mechanisation in PTO, TNA.
[40] F. Bath, Memo to Mrs. Arnott, "Future Establishment of Temporary Staff," 29 January 1947, T 162/942 Establishment of Temporary Staff in Professional Scientific and Technical Classes, TNA.
[41] Post Office Savings Dept., Memo, 17 April 1945, NSC 22/68, TNA.

handed or otherwise not trainable to machine efficiency."[42] In addition it compiled information on which machines were in use, the average speed of the operators, the average error rates, and the length of training required for maximum efficiency.

Although the focus of the inquiry had been on basic tests of manipulative dexterity, the treasury was surprised to find that young women with better secondary educations, those who had attended the academically-oriented grammar schools rather than the more vocational secondary schools, actually made much better machine operators, even down to being able to produce consistently more characters per hour on punching machines. "Oddly enough," wrote one accounting department supervisor, "the brightest manually, as well as mentally, came from the Harrowgate and Knaresborough grammar schools whereas girls coming from shop counter experience and from the council schools were less adaptable. The utterly useless from a machine point of view were not so numerous that they could not be absorbed into general low level clerical duties."[43]

The inquiry also revealed that there were no good methods in place to ascertain which young women would make good machine operators: "some take readily to machine work and most can be persuaded to persevere at it with varying degrees of success," but "there were several cases where Clerical Assistants proved to be definitely allergic to machine duties and it was found almost impossible to turn them into mediocre operators." Not surprisingly, clerical women workers resisted being downgraded to machine operators, particularly the hectic, unforgiving job of punch machine operator.

[42] Personnel Dept. General Post Office, Letter Savings Department, "Enquiry from Headquarters About Experience With Open Competition Clerical Assistants as Machine Operators," 15 March 1945, NSC 22/68, TNA.
[43] Letter from Mr. Ramsey to Miss Hudson, 22 March 1945, NSC 22/68, TNA.

The government established machine work as inferior even while the finding that better-educated girls were "brighter manually as well as mentally," something that seemed to "disprove the theory that machine operating is inferior work."[44]

Since machine work was widely regarded as the lowest category of work in the civil service, workers who proved unable to master machine operations were essentially promoted by being moved onto clerical duties. This situation would later result in arguably lower-skilled and less adaptable clerical workers gaining the pay benefits associated with the Equal Pay Act, while machine operators did not.

In addition, machine operators were largely ineligible for the pension benefits available to civil servants until the mid 1950s.[45] "Establishment" examinations, successful passage of which determined pension eligibility, were given only every five years after creation of the Machine Operator Class in 1948, leading one supervisor to complain that "the whole grading appears to be rapidly assuming a 'temporary' aspect, and it is thought that this latter, if pursued further, will detract from efficiency and output."[46]

The impression that workers in this class were only temporary led, in part, to the withholding of opportunities for machine operators to gain pensions and other privileges of full-time career workers. Yet, as the supervisor's impression quoted above shows, this temporariness was induced in the grade by depriving members of certain privileges, thus defining the jobs as transient.

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[44] Letter from Miss Hudson to Mr. Shaw, 26 March 1945, NSC 22/68, TNA.
[45] Treasury, "Establishments Circular No. 19/54: Establishment of Machine Operators," 21 April 1954, STAT 14/632, TNA.
[46] Statistical Office Minutes, "Establishment of Machine Operators," 19 October 1950, STAT 14/632 Machine Operating Class in Stationery Office, Establishment of Machine Operators, TNA.

In certain cases, there was a conscious, gendered dimension to removing workers from lower grades via arbitrary promotion. “Male subclericals are a nuisance in several ways” noted one supervisor, expressing a representative opinion. As such, a treasury document advised departments during the postwar reconstruction of the civil service to hire men only as Clerical Officers, instead of the lower grade of Temporary Clerks. It added, “for women, there might well be a separate selection and a separate quota” for both the lower clerical assistant grade and, conversely, “it might be thought advisable on that account to fix either a maximum proportion for women or a minimum proportion for men in the Clerical Officer Selection.”[47] Statements like these underscored the fact that men were not only expected, but encouraged through formal regulation, to take the majority of permanent posts in career-oriented civil service grades.

Selecting women for lower jobs and men for higher posts tended to enforce the construction of women as less expensive labor, something that one women’s union leader called a “persistent feature” of the separation of men’s and women’s work. There “has been the practice of fixing the rate for a job and applying it to male workers only, as though they alone were the genuine workers on the job,” she argued, a practice which depressed women’s wages.[48] While marking women as second-class workers, this also meant that their labor was in high demand when employers prioritized productivity enhancement through cutting labor costs.

[47] Treasury, “National Whitley Council Committee on Structure of the Post-War Civil Service: Future Establishment of Temporary Staff”, “Comparison between the work of Teleprinter Operators and Typists,” 29 May 1946, T 162/942, TNA.
[48] Anne B. Godwin, “Chairman’s Address, TUC Women’s Congress,” *Report of the Annual Conference of Representatives of Trade Unions Catering for Women Workers*, 1955, 20, GB0152 MSS.292/4/12/1-17, MRC.

3.4.2 Raising Productivity Through Lowering Costs, and the Limits of Scientific Management in the Office

In some cases, women were considered a suitable "less expensive alternative," receiving only 75 percent and 63 percent of the men's rate in London government offices and provincial government offices respectively. But they were not used for all jobs where cost savings could accrue—even in machine operation. In one case, for example, it was decided to use men for the new teleprinter jobs in the admiralty, on the grounds that they would be more interchangeable on overnight shifts.[49] Yet, the job was defined by more than time of work. Teleprinter transmissions to "highly paid Cable Company male operators at the other end of the circuits" meant that the "work should be regarded as being in a much higher standard than that of a typist," and therefore women should not be employed.[50]

While it was easier to attain the required standard of speed for teleprinter operation than for typing, and while it required less training than shorthand typing, it was nonetheless better paid. In times of labor shortage, especially during and after the war, women who were taken from typing duties and put on teleprinter duties were reluctant to return, but were made to on the basis that it was easier to train new staff for teleprinter operation rather taking "excellent typists" and "squandering [them] on teleprinting."[51] In the case of teleprinter operation, the status of the technology as newer, and the immediacy and expense of the communications transfer, contributed to employer perception of teleprinter jobs as requiring a higher level of responsibility. This, in turn, shaped ideas about which staff held the ideal characteristics for the job.

[49] P.D. Proctor, Staff Memo, 6 April 1939, T 162/942, TNA.
[50] Ministry of Information, "Comparison Between The Work of Teleprinter Operators and Typists," c. 1940, T 162/942, TNA.
[51] Treasury, Memorandum to Mr. Pike-Lees, 31 December 1941, T 162/942, TNA.

In other cases, however, machine operation jobs replaced women's jobs in semi-feminized job categories that had higher responsibility and better pay scales. As government departments struggled with the 1948 changes that had instituted the Machine Operator Class, some department heads became unwilling to continue to pay and train women as anything other than machine operators, when they could instead have men. As a result of the institution of the Machine Operator Class, women were given less interesting and responsible work so as to aid in an institutional reorganization aimed at achieving ever-elusive productivity enhancements. In some cases, however, this attempt to further taylorize office work for greater labor savings backfired. The Ordnance Survey Department provides a classic example of this dynamic.

After 1948, women's draftsmen and surveyor posts changed into machine operator jobs in the spheroidal trigonometry section. The head of the section saw the change contributing to an inflexibility and diminution of responsibility for his employees, because they now were required to have a much narrower scope and less expertise and understanding about the whole range of the work.

Although he had originally favored the idea as a way to get more (female) staff, he now argued that the standards set out for machine operators are not "closely connected with the work our women do. I feel therefore that the decision to regrade our women as machine operators was an ill-advised one." By deskilling the women in the department who did machine-aided calculation, work actually became far less efficient, he claimed. "We have experienced more and more disadvantages of having these women as machine operators rather than as Surveyors, Draftswomen, or Computers… Our work is at every stage closely linked with and dependent upon a full understanding of the technical

process," that machine operators, with their limited job mandate and different training, "could not be expected to participate in."[52]

In effect, the jobs had been cut up into smaller pieces in the process of making them more suitable for a women's grade. Ironically, it was predominantly women who had been doing the work in the first place. This situation elucidates the difference between work feminization and work that is simply performed by women. It also highlights the potential differences between levels and intensities of feminization. The earlier female surveyor, drafting, and calculating jobs had been feminized inasmuch as they lacked certain of the rights and privileges men had in similar jobs, including equal pay. Yet the later machine operator jobs in the department were feminized on the level of requiring less skill, and receiving less training on account of specifically being created for women workers. Job feminization requires not simply that women predominate, but that their predominance leads to lower standards, lower prestige, foreclosing of opportunities, and taylorization of work; or, in some cases, simply the appearance of each of these things. Feminization, in other words, requires that work become perceived as less valuable and less difficult, leading it to be devalued and underpaid.

The head of the spheroidal trigonometry section opined that the new system of using machine operator grade organization was like having two men balancing a ledger, with one man adding the shillings and pence column and then verbally telling another man what number to carry over to add to the pounds column. When a mistake arose, no one knew who was accountable or where it went wrong. He argued that all new female employees should "be either draftswomen or surveyors, so that they can undertake any

[52] Department Head, Spheroidal Trigonometry Division Minutes, 29 May 1951, OS 1/656, TNA.

work for which draftsmen and surveyors are normally employed" rather than being confined to more limited machine operating work.[53]

In response he was told by his superior: "I appreciate fully the points you have made… but I am not absolutely convinced that it is not possible to arrange the work in your Division [so] that there is adequate [work] to keep a staff of Machine Operators employed on duties appropriate to that class and thus enable a great proportion of your male staff to be employed on outside surveying duties. This point has, however, been argued backwards and forwards for a number of years, and I do not think there will ever be complete agreement on the issue."[54] By constructing the problem as one of organization on the level of the department's work, rather than a problem with the inherent structure of the machine grades, he was able to throw the problem back to the section head who had complained, and demand that low-level, sub-departmental organization rectify what was in fact a problem created by the organization of work service-wide.

Ironically, the Machine Operator grade had been applied in the Ordnance Survey in an effort to gain permission from the treasury to hire more staff. The request was couched in terms of the current male computers not being able to fulfill their potential because labor shortages had required them to aid in the Department's predominantly female computing work:

> "The functions of our trigonometrical and leveling Division involve considerable volume of complex computing work which calls for the use of hand and electric machines... Most of these posts are now filled by women temporary clerks, but owing to heavy pressure of work and difficulty in recruiting suitable operators, we have to employ a number of male technical Civil Assistants on the work. These men are admittedly

[53] Ibid.
[54] Ordnance Survey Departmental Minutes, 10 July 1951, OS 1/656, TNA.

> employed on the more difficult problems but a good proportion of them could be replaced by women, if we could get suitable candidates, and if these candidates could be offered something in the way of a career."[55]

The Ordnance Survey head appealed to the treasury's ongoing drive to hold down costs, suggesting that these men could be replaced by women, but noted that the only way to get "suitable" women workers would be to offer some kind of career opportunity. If given Machine Operator status, his department could immediately employ 35 percent more women and "release technical men for more appropriate survey duties." In making this calculated gamble to get more staff, the department head realized he was taking a risk of the work being deskilled and tried to impress upon the treasury the "special character" of the work his female employees performed: "It includes reductions of theodolite observations, adjustments of triangulations by least square methods and the computation of coordinates from minor trig and traverse observations etc…. These, I think you will agree are more difficult and call for more training than the use of the punching machines referred to specifically [in the circular publicizing the grade's creation]."[56]

The treasury's opposing agenda to keep down costs was clearly displayed in their replies: "How many of the male Technical Civil Assistants could be replaced by women?" began the initial response.[57] The treasury only wished to institute the grade, and authorize additional posts, if it meant a reduction in labor cost relative to output. Women workers were lower in cost not only because of their lower pay, but also due to their high turnover due to marriage. Even the lifting of the Marriage Bar in 1946 could not undo the widespread cultural practice of resignation on marriage, and many women left the workforce before attaining the maximum of their pay scale. Further reducing their long-

[55] F. G. C. Bentley in the Ordnance Survey, Letter to Treasury, 16 February 1948, OS 1/656, TNA.
[56] Ibid.
[57] Treasury, Response to F. G. C. Bentley, 8 March 1948, OS 1/656, TNA.

term cost, women were not allowed to maintain their government pension benefits once married. These abbreviations of working women's privileges were mirrored in the complaints and priorities of their civil service labor unions, though rarely effectively addressed.

Certain Ordnance Survey Department supervisors remained convinced of the need for future Machine Operators to be brought up to the level of surveyor, as in the past, so "they could be put on similar work to the male surveyor computers alongside whom they work but cannot now be allowed to fully cover [for] since it would be too technical for Machine Operators to do." This was impossible given the rules of employment and training for the Machine Operator Class. Managers at the highest levels of the civil service had created a new structure in order to better manage and control both the growing cohort of women's labor and the use of automating machinery, and they would not be swayed by examples that seemed to belie their plans.[58]

The delimiting of skill and opportunities in the expanding class of machine jobs assigned only to women had the effect of cutting short women's careers, despite the repeal of the marriage bar. One supervisor wrote that several of his senior machine operators had hit their pay and promotion maxima and had nowhere to go. Yet, their pay and promotion level did not match their skills and experience. Indeed, if they were to leave, they would not have been replaced by machine operators but by workers from higher classes: "The four Senior Machine Operators employed in Trig Comps are unsuitable for employment in Level Comps now as their much greater skill would be wasted in Level Comps. Should they ~~marry~~ leave for any reason it would be necessary to

[58] Department Head, Spheroidal Trigonometry Division Minutes, OS 1/656, TNA.

replace them by well-qualified male or female surveyors with a good mathematical background who could then become efficient machine trig computers" (as in original).[59]

As a result of the new Machine Operator Class, some high-skill women workers were placed in conflictingly low-skill jobs . When they left the workforce, they were inevitably replaced by a combination of less well-educated machine operators and better educated young men who were favored for many jobs. The former solution meant that departments lost skilled workers and were encouraged to taylorize their work further, while the latter undid any potential cost benefits of the reorganization.

3.4.3 Gender Trouble in the Unions

Labor organization along gendered lines was often difficult and inexpedient for women, yet within gender-integrated unions, men held most positions of power. After peaking in 1944, women's membership in the national Trades Union Congress (TUC) declined until 1947. Yet from 1951 to 1952, over 98,000 women joined the TUC, in response to women trade unionists' massive recruiting campaign to appeal to women workers on the basis of issues specific to them.[60]

In the civil service, however, the women's union was not a part of the main clerical union. Women civil servants were caught in a catch-22: they could either join the main clerical union, which had more power in pay negotiations but regularly ignored the concerns of the women's grades, or they could join the smaller, all-women's union, which was far more involved in fighting for the rights of women workers but was repeatedly squeezed out of labor negotiations. Adding to this problem was the fact that the pre-war government commission that set up a system of tribunals and labor

[59] Ordnance Survey Departmental Minutes, 21 August 1952, OS 1/656, TNA.
[60] TUC Women's Congress, *Report of the Annual Conference*, 1953, 1, 10-13, GB0152 MSS.292/4/12/1-17, MRC.

negotiating machinery for the civil service, known as the National Whitley Council, refused to arbitrate any complaints about unequal pay on the basis of sex: "no claim, however based, may be taken to arbitration if it includes a demand for the same rate for men and women."[61]

The reconfiguration of women's work in the pubic sector, in tandem with increasing automation, inflamed union sentiment in both the women's and men's civil service associations, although for different reasons. On the one hand, women workers were often confined to low-level jobs. On the other hand, women could do many government jobs as well as men and for less money. When the high cost of the civil service pension, something most women did collect, was factored in, the government believed it gained economically by replacing lower-skill men with women. This led to an antagonistic relationship between the National Association of Women Civil Servants (NAWCS), and the mixed, but male-dominated Civil Service Clerical Association (CSCA).

The reconstruction of the civil service after World War II resulted in the dismissal of most of the women brought in as temporary workers during the war. As a result, the gender balance of the main clerical unions shifted back to having a majority of men. The 1948 re-grading also threw into sharp relief existing labor union tensions regarding feminized grades. The Civil Service Clerical Association levied repeated complaints against the Ordnance Survey department for a variety of issues related to machine operators' work. Most contentious for the CSCA was the use of a limited number of

[61] Royal Commission on Equal Pay, *1944-46 Report*, paragraphs 142, 224-8; United Kingdom, *Parliamentary Debates*, Commons, 5th ser., vol. 438 (1947), cols. 1069-1075; Council of Women Civil Servants, "Notes on 'The Rate for the Job'," 6/CCS Box 258 Folder: Correspondence Between Equal Pay Campaign Committee and Council of Women Civil Servants, 1948-1956, WL.

female Senior Machine Operators as supervisory staff, particularly when those supervised either included, or could potentially include, male workers.

A heated series of letters from the CSCA began by relating that "clerical and technical employees using machines appear to be clashing badly, e.g. one clerical (female) is in charge of Class II personnel. Definite lines of demarcation [are] needed to avoid serious repercussions."[62] The CSCA complained that they had been assured by the government that the Machine Operator grades would include no supervisor posts, even at the highest rank of Senior Machine Operator.

In order to placate the main union, the government acquiesced to these demands and in fact went a step beyond. The government decided to also prevent the few female Executive Officers in the managerial classes of the service from leading sections where it was felt their supervision might be especially resented by men. "If it is proposed to put a female Executive Officer in charge I think it may cause trouble," wrote a treasury official in reference to the skirmish with the CSCA, noting instead that "under paragraph 14 a man may be in charge."[63]

This downgrading of female civil servants so as not to anger male civil servants was also reflected in the application of pay scales. Though male machine grade operatives were extremely rare in the 1950s, the CSCA nonetheless negotiated a men's pay scale for the grade. The senior machine operator scale for men in 1953 started at £460, eventually rising to £570, while women started at £385 and grew by smaller, less

[62] Staff Side National Whitley Council Representative, Question in Circular C.R. 14589, and letter from CSCA to Ordnance Survey "Senior Machine Operators – Female Supervisor," 6 March 1953, OS 1/656, TNA.
[63] Ordnance Survey, "Circular EOC 69/48," October 1948, OS 1/656, TNA.

frequent, increments to £460.[64] The lowest amount a male operator could earn was the women's pay maximum. Women Senior Machine Operators were also held back from quick promotion on the grounds that it would be improper for a woman to become a Senior Machine Operator before she was twenty-eight to thirty, since then she would be making as much as a Clerical Officer who was twenty-eight. Since this was a higher-prestige grade, officials worried that any comparability in pay would engender resentment.[65] The treasury's desire to delay promotion to lower outlay, knowing full well that most Machine Operators would resign before the age of thirty, was yet another reason to limit women's pay and promotion prospects.

These tactics to restrain operators' promotion worked almost too well; few operators were able to attain the rank of Senior Machine Operator since this required that a current Senior Machine Operator vacate her post. Making promotions available within the grade in a more regular fashion became crucial for some departments to maintain their skilled staff. Machine Operators often had to be willing to move to wherever a vacancy was available, and their current department would have to endorse the loss of a well-trained staff member. For this reason, civil service departments, as well as unions, pressed the treasury to create more Senior Machine Operator posts where they were needed. The treasury was reluctant to do so, creating long back-and-forths in which each side haggled to make their management vision into reality.[66]

Meanwhile other departments found themselves with Machine Operator redundancies and had to put their operators on non-machine clerical tasks. In these cases, women gained more favorable working conditions. But the opposite also occurred.

[64] Treasury, "Establishments Circular 21/58 Revised Salary Scales," 28 August 1953, OS 1/656, TNA.
[65] OS 1/656, TNA.
[66] Ibid.

Higher-level female civil servants were sometimes demoted onto machine work simply because the amount or composition of departmental work changed, necessitating more machine work. One union complaint from the Institute of Professional Civil Servants sought redress for the fact that several women who had been at the rank of Higher Technical Officer had been forced onto machine work for over a year.[67]

The separatist women's civil service union, the NAWCS, had opposed the institution of the new machine operator grades. They foresaw that this categorization would condemn women clerical workers to poor career prospects by separating them from the promotion opportunities available in the rest of the civil service. At their annual conference that year, "concern was expressed at the creation of a further women's grade to undertake routine work," and a contingent was sent to the treasury to argue against the plan in order to safeguard women's promotion prospects. The NAWCS noted with alarm that the treasury's plan contained another barb: while men were not to be employed on a permanent basis in this women's grade, pay scales were provided for temporary male workers at the level of Machine Operator and Senior Machine Operator, but not at the lowest grade of Machine Assistant. That grade was to be exclusively female, even in theory, with no possible comparison to a male wage.[68] Machine Assistants, at the lowest end of the scale, earned only £80 to £300 in the early 1950s.[69]

3.5 Automation and Its Discontents: Closed Shop and the Reskilling Debate

A female Machine Operator would usually earn in the area of £300 per year during her early twenties, making this job a high-paying position at the lower end. Past

[67] Ibid.
[68] *National Association of Women Civil Servants (NAWCS) Annual Report*, 1948, 11-12, 6/NCS Boxes 279-282: NAWCS General Reports for the years 1933-1958, WL.
[69] "Pay Scales for Machine Operators (Calculators, Accounting, and Punched Card Machines) 1951," OS 1/656, TNA.

the early career stage, however, the job became less attractive. It was on these grounds that the NAWCS attempted to rally the Machine Operator grades to "protect and promote their grade interests." A pamphlet from the early 1950s stated the women's union policies as: providing for complete interchangeability between the machine grades and the more highly regarded clerical grades; pursuing pay equality and equality of opportunity between men and women; and, ensuring no subclerical grade was confined solely to women. "You are a women's grade," declared the pamphlet, and "we are a women's association with your interests at heart," as it attempted to sell the NAWCS to potential union members.[70]

The women's union had spent the interwar and war years agitating for increases in pay and benefits, the mandatory placement of young men into the lowest all-women's grades, and the privilege of an earlier pensionable age for the all-female Typing Grades. A major stumbling block proved to be the obstruction of the more powerful CSCA. During 1948, for instance, the government agreed to open certain all-male grades in the post office up to women after informal negotiations with the NAWCS.

Unfortunately, the CSCA, which had negotiating rights for those grades, refused the offer, continuing a pattern of antipathy towards equal pay and equal opportunity reforms from before the war.[71] The CSCA felt that opening these grades to women threatened the integrity of those workers and jobs. They were also angered by the fact that the NAWCS continually went against what they felt should be a closed-shop negotiating situation with the government. A similar situation occurred with the Typing Grades, even though in that case, the NAWCS had formal negotiating rights; CSCA

[70] NAWCS, "Pamphlet for Machine Operators", 1950, 6/NCS Box 282 Pamphlets Folder, WL.
[71] *NAWCS Annual Report*, 1948, 3; Meeting Minutes, 16 December 1935, 6/NCS Box 279 Folder A6/1, WL.

leaders refused to agree to many changes for typists, instead trying to secure pay raises for other job classes to benefit men. This delayed long-awaited pay raises for typists for another several years.

Even once this had been achieved, the unions continued to argue over the issue. The CSCA issued a vituperative report, which they reprinted in the office journal sent to all civil servants, insisting that the typists' pay claims had been won as a result of their efforts, rather than the efforts of the NAWCS. The pamphlet, "Who Did the Job? A History of the Recent Typing Structure Negotiations with Documentary Evidence" was a scathing indictment of the NAWCS which the CSCA alleged had no power as a negotiating body and had willfully misled women unionists.

As women flooded into more civil service jobs, the CSCA realized how dangerous the NAWCS could be if it successfully convinced all female civil servants to join together in separate pay negotiations. Arguing that the NAWCS was guilty of "misrepresentation added to incompetence" the CSCA inaccurately claimed to negotiate for typists. In fact, the CSCA had attempted to convince the treasury only to negotiate with their union, and expressed disdain for the fact the treasury insisted on informing the NAWCS of the current proposals.[72] Aside from the vocal in-fighting between the unions, the long-overdue and unusually large £40 annual raise granted to the Typing Grades in 1950 was perhaps the clearest possible signal that something was very wrong with how

[72] They go so far as to reprint a letter from treasury executives stating that the treasury is prepared to negotiate with the CSCA as well as the NAWCS, yet somehow draw the opposite conclusion from the text, as confirming their claim to closed-shop negotiations. Civil Service Clerical Associations (CSCA), "Who Did the Job?" 6/NCS NAWCS Box 282, WL.

feminized work was judged and remunerated in government, and hinted at women's limited access to the pay claim negotiating process.[73]

While the NAWCS argued for opening more opportunities for supervisory work to machine grade workers in the early 1950s, the CSCA simultaneously sought the enforcement of job descriptions for female Senior Machine Operators that expressly forbade them from supervising workers in non-feminized grades.[74] After the problems in the Ordnance Survey department, the CSCA continued to police other departments' uses of Senior Machine Operators. The protection of higher-paying men's jobs influenced this complaint, but in large part the CSCA's apoplexy on the issue betrayed the strong social prohibition against women supervising male workers that lingered in the civil service for years afterward. Senior Machine Operators should not have even been allowed to supervise others in their own grade, the CSCA felt, as this would take a supervisory position away from one of the male dominated grades of the civil service.

The growing number of female machine workers, however, had already begun to transform the structure of the entire civil service, something that both the NAWCS and CSCA apprehended. The NAWCS, in particular, followed developments in government automation closely, noting, for instance, in its 1957 annual report that there were ten electronic computers for mathematical and statistical work in the government with another five on order.[75] Although these electronic computers had not yet begun to replace the electromechanical tabulating machines used for most of the work of government administration, the NAWCS recognized that they would shortly expand into

[73] This would have amounted to roughly a ten percent raise for the year, when normally pay raises were on the level of 2 to 6 percent.
[74] CSCA, "Senior Machine Operators-Female Supervisor," OS 1/656, TNA.
[75] *NAWCS Annual Report*, 1957, 11, 6/NCS Boxes 279-282, WL.

administrative work. Indeed, just one year later, the post office installed its first electronic computer for administrative purposes, and in the following five years, twenty-five more were installed.[76] (See Tables 3 and 4.)

The prospect of faster, more complex machines being used to automate office work might provide a long-awaited opportunity to reskill women's work, the NAWCS reasoned. On the other hand, it could also produce the opposite effect, deskilling work further and extending the difficulties that had developed for female civil servants as a result of women's work being synonymous with machine work. For both of these reasons, the NAWCS-allied International Federation of Business and Professional Women devoted their annual conference to the topic of "Automation and the Individual" that year, presaging things to come.[77]

Despite the many problems that followed the institution of the machine operator grade, the highest levels of government supervision in the civil service remained deeply invested in the idea, and were joined by some departmental heads in support, even as the section supervisors just below complained bitterly in some cases. Once the change had been made, however, it was impossible to revert back to previous organizational model.[78] By the end of the 1950s, the institution of the 1948 machine operation grades had lead to a firm association of women with jobs perceived to be low-skill throughout the entire civil service.

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[76] The government records their first dedicated administrative computer as being the ICT 1201 installed in the London Post Office in September 1958. Of the administrative computers that followed in the next five years, 64 percent were ICT, 12 percent were LEO, and 24 percent were IBM. Central Computing Agency, "Schedule 1A: Computers for Administrative Purposes, Installed in Departments up to 30 December 1968," 22 October 1968, HN 1/67 Consultations with Civil Service Staff Associations About ADP, TNA.
[77] *NAWCS Annual Report*, 1957, 11, 6/NCS Boxes 279-282, WL.
[78] Ordnance Survey, Minutes, 2 February 1948, OS 1/656, TNA.

The existence of machine workers on the borderline of established clerical work was made clear by the perpetual wrangling over which machine operators deserved "non-manual" status, and the benefits, like pensions and potential promotions to Executive Class jobs, that went along with it.[79] The institution of the machine grades also caused a larger division to develop between the all-women's civil service union that had developed parallel to the men's union and encompassed most machine workers. Unfortunately, the new grading structure allowed machine worker complaints to be further pushed to the periphery by the main union.[80]

Most important to women's jobs and the civil service as a whole, however, was the fact that the new machine grading structure interacted with later equal pay provisions to institutionalize an underclass of feminized machine workers. The differing valuation of machine workers versus the rest of the clerical and managerial labor force in the government's service would continue for decades, shaping the entire public sector. Only by re-institutionalizing the association of low-level workers with office machines could the government hope to maintain its current mode of operation. The arguments over equal pay and equal work threatened to reshape the strategies and goals of the government's massive automation projects farther down the line, as the government's increasing usage of electronic computing solutions contributed to a redefinition of their ideal worker.

[79] MH 108/564 Application of the Regulations, Interpretation of the Terms 'Administrative, Professional, and Clerical. Subclerical Grades: Punch Card Operators, TNA.

[80] The NAWCS formed in the early 20th century when women were not allowed into the main union, and it dissolved in March of 1959, several years after equal pay was granted in the civil service. With its official reason for existing gone as of 1954, and the perception of women's equality in the service, the union was not able to recruit enough new members to sustain itself into the 1960s.

3.6 Defining Equal Pay: Equal Work versus Equal Value

Delivered just after World War II, the Equal Pay Commission Report (1944-1946) requested by the government took pains to evaluate the concept of pay equality in light of the civil service's particular hierarchies. Staying within the bounds of broader expectations about men's and women's work while trying to produce a socially equitable result made the commission's work difficult. Added to that, however, was explicit pressure from the government to institute equal pay in a way that would save as much money as possible.

The government's refusal to grant equal pay to its workers in the face of exponentially growing pressure in the late 1940s and early 1950s hinged on the idea that equality of pay was something the country could not afford after World War II. The institution of new welfare state projects, in particular, took up an enormous amount of funding and simultaneously seemed to guarantee a system of social fairness and freedom from want. In this context, successive governments came to see equal pay for public sector workers as not only expensive, but as unnecessary for social justice.

Yet equal pay was in fact only one part of the equal pay campaign. Equal opportunity to training and jobs were a major, but often overlooked, portion of the equal pay campaign's platform. The NAWCS, though often ineffective as a union, proved to be an effective pressure group during the last decade of the campaign for equal pay, but the position of most of its members underscored the problem of granting equal pay without focusing on institutional structures that produced inequality of opportunity.

In 1950, four years before equal pay was granted in the civil service and nationalized industries, including teaching, the NAWCS teamed with the National Union of Women Teachers (NUWT) to raise over £4000 from their membership for the purpose

of commissioning a film on equal opportunity. The film, directed by feminist Jill Craigie, was rented out to campaigners and even played along with newsreels in some London theaters.[81]

Focusing on women employed in the government's service, office workers and teachers figured prominently in the narrative, in addition of female councilmen and MPs. Throughout, the film emphasized the difference between nominal pay equality, and a fuller concept of work equality grounded in equal opportunity and gender-neutral training and hiring. It also attempted to show the hidden distinctions between people in the same workplace. It began by contrasting the elevated status of certain white collar jobs with the relative drudgery engaged in by many women office workers. It portrayed the chasm between the image and the reality of the urban, white-collar female clerical worker.

Attempting to gain favor with working-class men, the film pointed out that various industrial processes had led to women workers taking men's jobs, in poorer conditions and at lower wages, given the absence of equal pay: "In the old days, glass was mostly hand-blown, glassmaking was a man's world. today it's manufactured, and the glass industry is largely a women's world. For women are cheap labor. If men are employed in this factory, they must be paid about a pound a week more – so men are *not* employed if it can be avoided."[82] In this way, equal pay and opportunity became the concern of every worker trying to protect his or her job. Women's influx into certain professions as a result of deskilling also applied to non-manual work, the film pointed out, as the clerical labor force continued to feminize. It took pains to show that the influx

[81] NAWCS, *Annual Report*, 1950, 4, 6/NCS Boxes 279-282, WL.
[82] *To Be A Woman*, directed by Jill Craigie (N.p.: Outlook Films, 1951). Joan Scott's work on the glassmaking industry in 19th century France discusses an earlier instance of deskilling in this field. Joan Scott, *The Glassworkers of Carmaux: French Craftsmen and Political Action in a Nineteenth-Century City* (Cambridge: Harvard University Press, 1974).

of women into the workplace in low-level jobs was not the same thing as equality of opportunity, and that it in fact hindered women's equality in the workplace.

Culminating with the specter of international opprobrium coming to Britain as a potential result of their continued refusal to deal fairly with all workers, the film reminded that Britain had signed the UN charter on human rights that had guaranteed equal pay for equal work in the nations of signatories. Britain's international stance on equality and its domestic stance, however, were motivated by different concerns.

3.6.1 The Case Against Equal Pay: Inflation, Devaluation, and Industrial Productivity

The government's agreement to the UN Charter aside, it continued to actively resist paying its own men and women workers equally well into the 1950s. In large part, this was justified by economic reasons; the idea that the nation could not afford equal pay. But in fact, the claim that the government was unable to afford the outlay for equal pay masked other economic concerns.

The main one was that the evaporation of the cost-cutting benefits allowed by hiring women workers would create a snowballing long-term wage bill. In this way, the government was motivated to argue against equal pay because granting it would remove one of their most effective tools for keeping the cost of their burgeoning public sector under control. By 1954, when equal pay was finally granted in the civil service, the treasury had already come to feel that using electronic computers for administrative work was "likely to be the most important development in the field of government," both for reasons of control and cost.[83] The civil service alone comprised nearly three-quarters of a

[83] Treasury, Internal Letter, 17 February 1954, T 222/964 Possible Use of Computers for Electronic Payroll Work 1954-1958, TNA.

million workers by 1955.[84] Local government authorities already devoted 60 percent of their outlay to wages and salaries, and the treasury recognized that since they could "no longer cut rates of pay… one should think increasingly in terms of cutting down the number of workers by mechanization."[85]

That social and industrial convention combined to create in women a low-cost, high turnover workforce was regarded alternately as a happy accident and normative state of affairs that should not be changed, lest it negatively impact the nation as a whole. In 1947, after the delivery of the Royal Commission on Equal Pay's report, the Commission was grilled in the House of Commons on why equal pay represented not simply a social advance, but the best economic bet for the nation.

The Chancellor of the Exchequer attempted to excuse the government from any duty for equal pay by highlighting other avenues of government spending: "The government are now pressing forward with important developments of the social services and with plans for redistributing more justly the purchasing power of the people. Family allowances have been introduced, a National Health Service is being established, new schemes of national insurance and public assistance are being brought into effect." [86] The creation of the welfare state, in other words, was the government's chosen method of enacting socio-economic justice. The treasury's final statement on the matter underlined this point: "In making proposals to Parliament for incurring additional expenditure and

[84] From 1931 to 1955, the civil service grew from 340,000 workers to 720,000. This did not include the nationalized industries or the NHS. Royal Commission on the Civil Service, *1953-1955*, 11.
[85] Treasury, Internal Letter, 17 February 1954, T 222/964, TNA.
[86] United Kingdom, *Parliamentary Debates*, Commons, 5th ser., vol. 438 (1947), cols. 1069-1070.

for extending the social services, the government must be the judge of priorities."[87] Equal pay was not a social priority or a viable economic strategy in the government's view.

This treatment of equal pay as a socio-economic addition to welfare state provisions, rather than as an issue in its own right, had a long history within British public discourse. The assertion that Britain could not afford equal pay was not particular to the period of austerity that lasted from the end of World War II through the early 1950s. Earlier, the same argument had been given for refusing equal pay in the decades after World War I. Yet these economic arguments were always enmeshed in a larger discourse of women's dependence within society, as the arguments over the passage of the Sex Disqualification (Removal) Act of 1919 and the destruction of the government's marriage bar in 1946 showed.[88] In each case, equal pay and equal opportunity were subverted by the institutionalization of women's economic dependence.

Behind these statements of economic inability loomed a cohesive set of traditions and practices in both government and industry of assigning labor value on the basis of the needs of a self-sufficient heteronormative family unit, nominally controlled by a male breadwinner. The prioritizing of the vast array of social services proposed by the Beveridge Report meshed well with established notions of social needs and justice, whereas the concession of equal pay introduced a diametrically opposed system of economic reward relatively unmoored from social responsibility as previously understood.

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[87] Ibid.

[88] The Sex Disqualification (Removal) Act of 1919, was intended to remove the bar against women from holding certain government jobs, but was rendered toothless through narrow interpretation. Federation of Women Civil Servants, "Statement of Case presented to the Royal Commission on the Civil Service," June 1930, 6/JCS/C4 Joint Committee on Women in the Civil Service, 1919-54, WL.

Yet equal pay also promised serious repercussions for the massive bureaucracies of the state, through its effects on the growing feminized labor forces that ran them. As a result, the economic argument against equal pay continued to be put forward in the House of Commons as late as 1954. Even after the passage of the Equal Pay Act, it remained as a rationale for the phased process of pay equalization that occurred over the course of several years rather than immediately.

3.6.2 Maintaining Inequality to Preserve Social Justice

The Equal Pay Commission, composed of four women and five men, and chaired by Sir Cyril Asquith, devoted an entire section of their 1946 report to the idea that equal pay might "create a sense of injustice in the men" by setting up a dichotomy between "representative" working men and "representative" working women.[89] In their view, the typical male worker was generally a married man with the financial responsibility, or the potential financial responsibility, of parenthood "upon his shoulders," while the typical working woman was a "spinster."[90]

Equal pay was therefore out of step with social justice in a broader sense. Equalizing women's pay would put "a married man with a family in a relatively worse economic position than any other section of the community, and there would undoubtedly be claims, which might soon be of universal application, for a system of occupational family allowances."[91] In other words, equal pay might result in a double outlay for the government. At the same time, however, the report recognized that "such a view has less

[89] Royal Commission on Equal Pay, *1944-46 Report*, 122, 125.
[90] Ibid.
[91] United Kingdom, *Parliamentary Debates*, Commons, 5th ser., vol. 438 (1947), col. 1070.

and less justification as the State takes on an increasing share of the financial responsibilities of the family by the provision of social services."[92]

Yet a belief persisted that women needed less than men, and that single women, due to their lesser needs, would still be in a more favorable position than both single and married men in the event of equal pay. Treasury officials contended their research showed single women already had a relatively higher standard of living on their lower government paycheck than single men had on their wage: "You would find that with a woman civil servant and a man civil servant on the same level, the woman can afford to take more expensive holidays than the man. She can go abroad. The man has to go and dig in his garden or perhaps snatch a week at Southend."[93] So persistent, and relatively unsupported, were these assertions that the Communist Party released an equal pay pamphlet, illustrated with cartoons of a large, imposing woman and a small, bookish man, that pointed out women consumed goods in similar proportion to men and paid all the same prices for consumer goods and services, all on lower wages.[94]

The perceived wealth on the part of lower-paid female employees made equal pay claims seem especially onerous to the government, particularly when paired with the idea that women workers were inherently less productive. Statistics on employee absence rates collected by the Equal Pay Commission confirmed that women were, on average, absent from work up to twice as much as men in similar positions. For every sick day taken by a man, a woman would take 1.1 to 2 days.

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[92] Royal Commission on Equal Pay, *1944-46 Report*, 132.
[93] Treasury, "Minutes of Evidence, 20th April 1945", reprinted in pamphlet "Equal Pay" by Elaine Burton, 10, 6/EPC Box 261 Evidence Given Before the Royal Commission on Equal Pay by the NAWCS, WL.
[94] Communist Party of Great Britain, "Equal Pay for Equal Work: The Price of This Pamphlet is the Same for Men or Women!" l944, 6/EPC Boxes 262 Equal Pay Campaign and Evidence to the Equal Pay Commission WL.

These statistics, however, left out war-disabled men, who had a higher sick rate than the non-disabled men's average. In the case of married women, absence for childbirth was excused, although the Industrial Health Research Board noted that absence rates broken down in this fashion were inherently inaccurate "to an unknown but not negligible extent" since women who would lose their jobs if married were known to sometimes "conceal their marriages from their employers while others remained single in a legal sense only."[95] Certain departments, including the War Office, noted that auxiliary servicewomen were actually encouraged, by medical authorities as well as their commanders, to report sick "more easily" than men, perhaps reflecting the assumption that women's real calling was elsewhere.[96]

Interestingly, the statistics gathered also showed that in primarily women's professions, such as teaching, single women had an absence rate almost equal to men, and in the civil service the higher the ranking and salary of a job, the lower women's average rate of absence due to sickness.[97] The insalubrious nature of the jobs in the all-female machine grades, which the report on the marriage bar had pointed out, may indeed have contributed to higher rates of illness or at least a higher willingness to miss work when possible.[98]

The focus on productivity also worked against equal pay in the sense that the higher wages women sought were being asked for "without any assurance of a compensating increase in production." In addition to making equal pay financially unsound from an employer viewpoint, the government argued that equal pay without

[95] Royal Commission on Equal Pay, *1944-46 Report*, 216.
[96] Ibid., 209.
[97] Ibid., Appendix IV, 209, 208, 210, 207-220.
[98] Whitley Council Committee, *The Marriage Bar*, 14-15.

corresponding productivity gains would be "wholly inflationary in its consequences, and thus tend to cancel, through higher prices, the gains … conferred."[99]

But these economic concerns were repeatedly conflated with ideas about the overall justice of the claim for equal pay. The government feared the effects of a widespread rise in women's wages, noting that "the effect of the government decision would be to improve the position of women in relation to men throughout employment generally," a situation that was not perceived as fundamentally just. "The standard of living of a married man with a wife and children to support would compare unfavorably with that of an unmarried woman with no dependants," was a repeated example used to try to divide the men and women within clerical unions.[100]

The Equal Pay Report did not strongly recommend equal pay, but rather qualified its findings with an appeal to a broader sense of equity. Noting that because the majority of women were not employed, and that only a minority of those who were held the same jobs as men, equalizing pay was not a matter of strict equality but only equality for some. The idea of women's domestic work loomed as large in the report's findings as did women's work in the public sector, the ostensible topic of their inquiry. As such, they wrote, equal pay "involves not merely equitable considerations, but a clash of equities."[101]

More critically, the report highlighted the fact that depending on how the concept of equal pay was interpreted, it could be applied to government workers in very different ways. Potentially, only women who held jobs in civil service grades where there were

[99] United Kingdom, *Parliamentary Debates*, Commons, 5th ser., vol. 438 (1947), col. 1072.
[100] Ibid., vol. 489 (1951), cols. 527-528.
[101] Royal Commission on Equal Pay, *1944-46 Report*, 133.

similar proportions of men and women, or a majority of men, would have their pay raised.

Nevertheless, the government re-affirmed their commitment to equality of pay in theory, even while declining to enact the principle, from the end of World War II right up to their final decision to grant it in 1954. "As a broad affirmation of a general principle, the government accept, as regards their own employees, the justice of the claim that there should be no difference in payment for the same work in respect of sex," stated the Chancellor of the Exchequer in 1947, adding that nonetheless, "the government are definitely of the opinion that is principle cannot be applied at present time."[102] Both Labour and Conservative governments maintained this view of financial impossibility despite adding more than the amount needed for equal pay to the wages of the civil service as a whole, and presiding over an economic recovery from 1952 onwards. [103] Once again refusing to implement equal pay in early 1954, despite the country's economic recovery, the Chancellor of the Exchequer quipped, "Like a good many things to do with women, this is entirely illogical."[104]

If equal pay continued to not make financial sense to the government and other employers in the 1950s, it had begun to make more sense to trade unions. Despite early clashes over the necessity of equal pay that alienated some women unionists from the larger mixed-sex unions and perpetuated all-women's auxiliary unions, unions foregrounded the need for equal pay in the mid 1950s. Women's growing numbers in the civil service, added to the large influx of women workers during World War II, had shifted the labor dynamics of the public sector and impressed upon union leaders the

[102] United Kingdom, *Parliamentary Debates*, Commons, 5th ser., vol. 438 (1947), cols. 1069-1070.
[103] Ibid., vol. 489 (1951), cols. 527-528.
[104] Ibid., vol. 524 (1954), col. 1913.

necessity of gaining equal pay so that men's salaries would not be undercut by the continued expansion of the female labor force. If pay scales were not equalized before women workers gained a majority, the unions realized they would face an uphill battle in all future wage claims.

Once unions had made equal pay a priority in their wage claims, the campaigns orchestrated by national and local women's associations achieved a critical mass.[105] The petitions presented to the House of Commons in 1954, with over 1.3 million signatures, reflected the changing tide. After again refusing to grant equal pay in the House of Commons in early 1954 on the basis of economy, the government quickly entered into talks with the unions through the National Whitley Council, hammering out a plan for equal pay before the year's end. Equal pay still had far to go after its concession in 1954, given the gradual plan for its implementation over the course of more than six years. By 1956, for instance, some women had only gained as little as £5 towards their new pay rate, a tiny fraction of the total difference in pay.[106]

Yet, critically, equal pay left out most women working in the public sector. The government had assented to the principle of the "rate for the job," but not the principle of equal pay for work of equal value. The former term referred to the practice of disregarding gendered job classifications already in place that kept certain areas of work feminized, and therefore depressed their wages in comparison to similar work done by men. The latter term referred to the granting of equal pay only in those jobs where men and women were employed in exactly the same job categories. The financial difference between the two interpretations was considerable: the Equal Pay Report estimated that

[105] Ibid., cols. 1903-1904.
[106] NAWCS, *Annual Report*, 1956, 1, 6/NCS Boxes 279-282, WL.

only 46 percent of the women in the civil service fell into categories that would gain equal pay via the application of the "rate for the job" ideal. On the other hand, 54 percent of the women in the civil service would be left unhelped by equal pay, as they were employed in "grades confined to women." [107]

3.6.3 The "Excluded Grades" and the Institution of the Machine Underclass

With the majority of women employed by the government gaining no pay increase from the Equal Pay Act of 1954, the wages in expanding, automation-adjacent job classes remained depressed. The government argued that "in a situation where over 98 percent of our typists and virtually 100 percent of typists outside are female, the assessing of pay by reference to a male rate is highly artificial, and indeed, runs counter to the principle of fair comparisons [with industry]."[108] This situation both reflected the rationale for government automation and encouraged its extension.

Some members of the machine classes, recently transferred from desk work to punching, verifying, and tabulating work, expressed anger that they would not receive equal pay in their new positions: "There was also a good deal of discontent among the machine operators on Scale A, a number of whom have been specially selected for the work, having previously been on desk work, and had they remained on that work they would have automatically qualified for equal pay," wrote one supervisor, bringing a complaint against the new wages. [109]

With the former women's grades, now the so-called "excluded grades," being nominally gender-neutral, unions recognized that future gender integration of these

[107] Royal Commission on Equal Pay, *1944-46 Report*, 9.
[108] Handwritten Letter from J. J. S. Shaw to G. F. Green, 17 November 1958, T 215/1595 CSA: Typists and Machine Operators' Survey 1956-1958, TNA.
[109] British Transport Commission, Memorandum of Meetings of Railways Staff Conference, 5 December 1957 and 14 February 1958, 4, RAIL 1172/2467 Rates of Pay – Machine Operators, TNA.

grades could result in depressed wages for men. These grades excluded from the Equal Pay Act on the basis of being wholly feminized still maintained complementary men's pay scales for many years afterward.[110] Throughout the 1960s, unions attempted to bring wage claims, using the men's scales in the machine grades—artifacts of pay negotiations that were rarely, if ever, used— as the true standard, arguing that pay equalization in these grades was only fair, as long as there were any men doing, or potentially able to do, the same work on higher wages.

The government quickly rejected these pay claims, reiterating that "one of the arguments for paying lower scales of pay for the 'Excluded Grades' was that they were confined to women and that the work they performed was 'women's work,'" and noted that in future, rare cases when a man might work in these grades it was "important that there should be an understanding that any man selected for an 'Excluded Grade' post should be paid not more than the 'Woman's' rate, and that because both men and women do the jobs this will not be used in the future as ground for raising the scales of pay for 'Excluded Grades' up to those for 'equal pay' grades."[111] Nevertheless, clerical unions persisted in shoe-horning a few male workers into these grades as test cases, each time re-arguing the principle of equal pay.

Wage claims for machine work intensified in the wake of the equal pay decision, with union representatives arguing that this work, would "with the extension of mechanized accountancy and the development of electronics… occupy an increasingly vital position in the general scheme of things." Dealing unfairly with machine workers

[110] This file shows women's machine operator pay scales as roughly 10% lower than men's machine operator pay scales in 1957. Twentieth Supplement to Establishments Circular No 27/56, 13 May 1957, CAOG 16/213 Pay, Machine Operator Grades, TNA.
[111] Treasury, Memorandum "Equal Pay: Excluded Grade Posts," 17 August 1960, AN 171/398, TNA.

threatened to become the next major point of contention within the civil service, with managers increasingly realizing that "any difficulty which might arise in recruiting or retaining such staff could have serious repercussions on the whole scheme of mechanized accountancy." [112]

Yet, work that was associated with white-collar women workers, of which automation was a key ingredient, was very difficult to equalize in pay, because the value of the work had long been established as low. It was just barely white collar, viewed as rote and requiring little skill and ability. The respectability of these office jobs was in constant tension with their devaluation. Although performed in an office setting, the jobs were seen as subclerical work, more aligned with a factory's assembly line than the knowledge-based environment of an office.

Even as equalizing and reskilling measures were introduced into wage negotiations by unions, the feminization of these jobs combined with social expectations to continue to enforce certain career outcomes. Noted one department, considering the problems to making a long-term career in computing, "A high proportion of the [Scientific] Assistants are girls; this appears to be because they like the routine work. The resignation of a large proportion on marriage certainly eases the problem of careers in computing." The department's young men were in turn put on other work, due to "the absence of any recognized career in computing and of any suitable specialist courses or qualifications." The fact that machine-aided calculation work had no career trajectory determined that it would be feminized, whereas the presence of a career trajectory would undo this feminization: "Boys generally prefer laboratory work to computing… this might be due in part to the absence of any recognized career in computing and of any

[112] British Transport Commission, Memorandum, RAIL 1172/2467, TNA.

suitable specialist courses or qualifications; if this be true it may be possible to make computing into an attractive career for some boys if current plans come to fruition."[113] Manual and electromechanical computing within the civil service would not, in fact, provide an attractive career for some boys, as this author envisioned, but electronic computing methods would soon open up a whole new range of career options and management directives.

3.7 Conclusion

The same year that limited equal pay was granted in the public sector, Lyons Tea Shop and Bakery incorporated the division of their business that had produced the first dedicated electronic business computer in 1951 for inventory, costing, and payroll. LEO computers, short for Lyons Electronic Office, quickly became an early leader in the British business computing industry, and the study of workflow and management techniques. The advent of dedicated electronic computers for business and administration began to increasingly transform the national discourse on work productivity from the late 1950s onward.[114]

The insertion of this new technology into a deskilled clerical context had the effect of reskilling, and beginning to de-feminize the work. The administrative computers brought into government offices in the late 1950s through the 1960s succeeded in raising the status of machine operator jobs where previous efforts focusing on equal pay and better skills training had failed. As discussed in chapters five and six, this process also eventually masculinized the jobs.

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[113] Aeronautical Research Council, *Training and Careers For Computers*, 1955, 2, DSIR 23/23112 Aeronautical Research Council, Training and Careers for Computers, TNA.
[114] See David T. Caminer, "...And How to Avoid Them," *The Computer Journal*, 1, no. 1 (1958), and J.R.M. Simmons, *LEO and the Managers: A Theory of Management Organization,* (London: MacDonald, 1962).

Far from running parallel or being ancillary to questions of productivity and national progress in postwar Britain, equality of pay and opportunity for women were constituent issues in Britain's attempts to enhance its national productivity. The public dispute over both issues also highlighted the postwar reconfiguration of the state's responsibilities to its citizens, as the ideal models of those citizens underwent gradual, but significant economic and social change.

In order to increase the state's efficiency, the government struggled to use automated tools in a way that could side-step problems that might reduce their productivity without being called to account for the justice of their employment practices. Since normative concepts of national morality had to be reconfigured to align with new requirements for industrial achievement, the state consciously institutionalized an underclass of feminized machine jobs. In many ways, the unequal Equal Pay Act of 1954, and the organizational changes in the civil service that preceded it were a rehearsal for the government's actions in trying to balance workers' rights with the ever-intensifying drive to maximize productivity through the computerization of white-collar professions.

In this sense, the campaign for equal pay in the civil service was both a precursor of, and theoretical proving ground for, the government's later automation projects. The organization of their clerical workforce into highly disparate groups of high-level managers and low-level functionaries, and the increasing centralization that maintaining a huge, deskilled mass of workers required, began with the creation of the machine grades and the efforts to ensure that these job classes remained feminized following equal pay. As the bottom of the civil service pyramid expanded, the government became more

invested in automation, and increasingly constructed the lower rungs of the workforce to accommodate that goal.

The institutionalization of a feminized underclass of machine workers was recognized as a harbinger of larger labor organization trends already long in process, as well as those yet to come. As pointed out by the head of the National Trades Union Congress for Women Workers in 1955, the effects of such reorganization promised to intensify, rather than dissipate, with the introduction of more powerful and complex machinery:

> "We are living in a period of great changes, technological and scientific. New methods, new processes, new machines—these face us with the prospect of changes in our working lives that may as be far-reaching as the introduction of the early machine processes. Just consider for a moment that great area of women's work—office employment. It is generally thought that women replaced men in offices. They did not. They entered offices at a time when clerical employment was expanding through the speeding up of industrial processes and they took over the new machines, the typewriter and the telephone—and have developed their spheres of employment as machine operations in offices have expanded. Now a new development—the automatic electronic calculating machine—is emerging and threatens to open up a whole range of problems affecting not only the future employment of women in offices but men also."[115]

The predominance of women in the field of automated office work, and the lack of career options for workers in these jobs helped perpetuate each other, with this state of affairs paving the way for further automation as a method of increasing productivity, lowering costs, and centralizing state control. By 1960, there were only a dozen computers installed in the civil service, with just over half used for clerical and administrative work.[116] The devaluation, and sometimes taylorization of machine-aided office work appeared to make it a perfect candidate for further automation since it had

[115] Anne B. Godwin, "Chairman's Address," 1955, 21-22, GB0152 MSS.292/4/12/1-17, MRC.
[116] Central Computing Agency, "Schedule 1A," HN 1/67, TNA.

already been broken down into simple steps to mitigate the need for training. Yet although these jobs seemed to be a logical inroad for the progress of the "industrial revolution in the office," the widespread use of electronic office computers in the 1960s brought new complexities into machine-aided office work. Their hiring standards and general image of computing jobs were soon overhauled to better serve the image of the new technology meant to lead Britain's "white hot technological revolution."

4. The Neuter Computer and the Gendered Worker: Uneven Progress through the "White Heat" of Britain's Technological Revolution, 1958-1965

> "In the spring, young men (grown vague and lazy)
> And girls (grown starry-eyed and hazy)
> Being human
> Lack acumen
> How undistracted, single-minded,
> Never mooning, never blinded,
> The computer,
> Being neuter."
> -*Office Magazine*, 1960[1]

> "The use of computers and other electronic devices has increased in large engineering companies and nationalized industries since 1958…. Experience has shown that most work fed into these machines is prepared by female labor. This may be due to their manipulative skills but it is suspected that it is because it is a cheaper form of labor as 'equal pay *for work of equal value*' has not yet been established." (italics mine.)
> -Trades Union Congress Memo, 1962[2]

4.1 Introduction

Far from being the clockwork hope of a nation, business computing was largely untested and systems were prone to failure throughout the 1950s and 1960s. This chapter explores the importance of low-level day-to-day human control over early computing systems, to differentiate and humanize the workforce that has too often been discussed as an undifferentiated mass. Operators, labor unions, and to a lesser extent, computing company engineers and designers struggled to establish a clearly-defined role for low-level technologists at the genesis of the computing age, exemplifying a larger struggle within the country to redefine and modernize its social and economic institutions. Against this backdrop, management, computing manufacturers, and news sources provided their own gloss on the role of the computer operator.

[1] "The Neuter Computer," *Office Magazine*, January 1960, 47.
[2] TUC, "Confidential Memo: Technological Developments Including Automation," 19 July 1962, GB0152 MSS.292B/571.82/1 Automation: Trade Unions' Attitudes 1961-1970, MRC.

In 1963, at the annual Labour Party conference, Harold Wilson reinvigorated the party with his vision of a new socialist mandate compatible with a technologically-advanced Britain. In Wilson's view, technology would not be the stumbling block of socialist egalitarianism, but instead would be a catalyst for it. "Since technological progress left to the mechanism of private industry and private purpose can only mean high profits for a few, a high rate of employment for a few, and mass redundancy for many, if there had never been a case for socialism before, automation would have created it," Wilson argued. Wilson's rhetoric was later supplemented by his Ministry of Technology. Headed by the youthful Tony Benn, the ministry was charged with enacting Labour's vision of national technological salvation.

Not only was this technological leap critical for British workers and British industry at home, but it was also the last great hope of a renewed British empire. Wilson, christening a new computer center in his constituency at the English Electric Factory noted that the computer would be as essential to the current industrial revolution as the steam engine had been to the first. In order for the nation to maintain its role as a world power, "Britain cannot opt out of the automative revolution. If we do we shall be left behind and this country will become a center of industrial stagnation. We have to get in the race, get ahead, and stay ahead," he proclaimed.[3]

The technological revolution proclaimed as part of Labour's effort to win power in 1964 after thirteen years of Conservative rule, demanded that modern Britain dispense with the cronyism, favoritism, and aristocratic mores that had long influenced who attained positions of power, prestige, or benefit within industry and society. In addition to being unfair, the current state of affairs actually hurt industry's and the nation's ability to

[3] *Times* (London), "Britain Must Lead the Computer Race: Mr. Wilson's Warning," 17 July 1965.

excel, Wilson argued. “In science and industry we are content to remain a nation of Gentlemen in a world of Players,” Wilson scoffed.[4] Amateurish men, catapulted to the positions of highest power in the absence of any sort of meritocratic vetting, were crippling the nation’s ability to effectively modernize and compete in the global marketplace. “The Britain which is going to be forged in the white heat of the revolution will be no place for restrictive practices or for outdated methods on either side of industry,” he warned. All these illogical and anti-meritocratic practices would burn up in the irresistible white heat of the coming revolution. In this way, technology was made out to be the hope of the modern proletariat, while simultaneously tasked with being the savior of a contracting economic empire as well.[5]

Labour’s rhetoric, at once socialist and vaguely neo-imperialist, failed Britain, on the whole. Despite a thriving computer industry, the country remained firmly mired in the past as it attempted to revolutionize industry. Indeed, by the time Wilson’s government took power in 1964, much of the most innovative work in British computing was being rendered irrelevant by the superior organization and manufacturing capabilities of American rivals, in particular IBM. Simultaneously, the government was beginning to lay the groundwork for a consolidation of all the major British computing companies. Although the government could not nationalize the industry outright due to the enormous cost, it used the funding power it had to eventually coerce the nimble and varied field of competitors into one hulking company, to whom the home market was left to lose. It was within this mixture of technological promise and incipient stagnation, budding meritocracy and persistent, class- and culture-bound traditions, that computer workers,

[4] Philip Ziegler, *Wilson: The Authorized Life of Lord Wilson of Rievaulx* (London: Weidenfeld and Nicolson, 1993), 143.
[5] Tudor Jones, *Remaking the Labour Party: From Gaitskell to Blair* (New York: Routledge, 1996), 77-80.

computing companies, and computer purchasers struggled to understand the nature and implications of the technology that had been promised to them as the hope of the future Britain.

This chapter juxtaposes the personal accounts of several operators who worked in early computing installations with popular conceptions of operators, as represented in advertising and computing company magazines. In the next chapter, these personal anecdotes and media creations will be contrasted with labor unions' attempts to bring more self-determination to the nascent electronic computing workforce. Media representations played an important part in developing an image of the technological workforce in the minds of business consumers and workers alike. As actual workers came up against the plentiful technological imaginary of computing as a self-determining force, ideally meant to work without the constant and careful human intervention required by older systems, the white-hot technological revolution revealed an iciness before it ever had the chance to warm up.

4.2 The Electronic Clerk and Its Shortcomings

From the mid 1950s on, British institutions increasingly purchased and installed computers for a variety of business uses, rather than the mathematical and scientific uses to which similar machines had earlier been dedicated. Large consumer-goods retailers like the grocery chain Sainsburys, and the pharmacy Boots, along with large banks, and many small insurance companies joined nationalized industries like British Rail, the dockyards, and numerous national and local government agencies in installing computers

ranging from £50,000 to £350,000 between 1955 and 1960.[6] The central government purchased their first dedicated administrative computer, an ICT 1201 for the post office, in 1957 and installed it in the fall of 1958.[7] At that point, computer installation began a period of rapid growth in government. (See Table 3.)

The teashop and bakery Lyons was itself a computing pioneer, creating an in-house computing division first to solve their own inventory problems, and later marketing their machines and expertise throughout Britain and its former dominions.[8] Ironically, Lyons had to look to America after World War II for ideas on electronic computing. A fact-finding mission to the USA by several Lyons managers in 1947, several years after the secret destruction of the Colossus machines, began the project that would become LEO. Later, the EDSAC project at Cambridge University provided home-grown expertise which Lyons eagerly bought and adapted.[9]

While smaller computers like the English Electric Deuce sold for around £50,000, mid-range computer systems installed by the government and banking institutions began

[6] *Times* (London), "Electronic Computer Demonstrated Drum Capable Of Storing 250,000 Digits," 18 February 1955; *Times* (London), "Computer Process For Insurance Work (Business and Finance)," 2 March 1959; *Times* (London), "EMIDEC Computer For Sainsburys," 12 May 1959; *Times* (London), "190,000 Computer For Air Ministry Pay," 6 August 1959; *Times* (London), 'It's Quicker By Computer: 'Leo' Works Out Rail Distances," 24 June 1957; *Times* (London), "Assurance Companies Share Computer," 18 April 1960; *Times* (London), "'Eric' Joins L.C.C. Computer Will Cost £30,000 To Install," 13 April 1960 (they rented the computer for £60,000 per year, but claimed it only cost £30,000 per year because of the money it would save); *Times* (London), "Computer Production And Installation In U.K.," 4 October 1960.

[7] CCA, "Schedule 1A: Computers for Administrative Purposes Installed in Departments up to 30 December 1968," 22 October 1968, HN 1/67, TNA.

[8] For a full-length study of the Lyons' computing project that became LEO Computers, see Georgina Ferry, *A Computer Called LEO. Lyons Teashop and the World's First Office Computer* (London: Fourth Estate, 2003).

[9] Lyons made a handshake agreement with the Cambridge team under Maurice Wilkes, himself an intellectual successor of the ENIAC and EDVAC projects, to which he had been exposed through brief study in the United States. In exchange for a payment of a mere £3,000 to the Cambridge team, the agreement would allow Lyons to build their own copy of the EDSAC if it worked. The EDSAC ran its first successful program in 1949 and Lyons began re-envisioning the machine and adapting it to business use soon after.

pricing at treble that amount.[10] The Air Ministry for instance, installed a £190,000 computer from EMI Electronics for its 80,000 employee payroll in 1959, while Lloyds Bank installed three IBM 350s in 1960 for around £350,000 to take care of the hundreds of thousands of customer account entries required each week.[11]

Many more businesses and government agencies took advantage of "computer centre" or "computer bureau" services, like the ones run by Hollerith and LEO in London, rather than buying machines. Such centers processed data-sets, or sold time on computers operated and maintained by the computing manufacturer within its own offices.[12] In 1966, the national government followed suit, setting up a central computer bureau in Bunhill Row in London to take over from their earlier "Combined Tabulating Installation" running electromechanical machines. The goal of consolidating government computing in one location, thereby lessening the need to rely on outside agencies or individual departmental computers, never achieved success however.[13]

Larger companies bought their own computers rather than resorting to time-sharing. A brief survey by the *Times* of computers installed in the United Kingdom between 1953 and 1960 turned up over £16.3 million worth of computer purchases, not including peripherals.[14] At an average cost of just over one hundred thousand pounds per computer, this put the new computer installation rate for these years at more than one hundred units, or greater than ten new computing installations on average per year before the 1960s. By 1965, 600 computers had been installed through the country, with 400

[10] *Times* (London), "Electronic Computer Demonstrated Drum Capable Of Storing 250,000 Digits," 18 February 1955.
[11] *Times* (London), "£190,000 Computer For Air Ministry Pay," 6 August 1959; *Times* (London), "£350,000 Computer System For Lloyds Bank," 27 July 1960.
[12] *Times* (London), "Hollerith Computer Centre," 1 October 1958.
[13] Treasury, "Provision of computer facilities for Treasury, 1965-1968," T 199/1090 Provision of Computer Facilities for Treasury 1965-1968, TNA.
[14] *Times* (London), "Computer Production And Installation In U.K.," 4 October 1960.

more on order from computer manufacturers. The national government led the way in computer purchasing, spending £14.1 million on computing hardware alone for sixty-two installations from 1958 through early 1965, and more than half a million additional pounds were spent buying time on other computing installations each year. Government studies projected that the need for over 300,000 office jobs, or roughly 9 percent of the clerical workforce, would be obviated by computer installations before 1975.[15] Meanwhile, western Europe as a whole spent an estimated £250 million on computers in 1965.[16]

Prime among the uses for this new breed of data processing machine were the very old tasks of payroll and inventory. Lyons Teashops, pioneering the application of computing for business endeavors, was the first and arguably the most successful company to use the new technology before 1960. Initially applied to the problem of a large, complex, daily inventory, in 1954 Lyons transferred 7,000 of their employee payroll accounts onto their new computer, eliminating twenty-three clerical and accounting staff members previously required to do the payroll with conventional accounting machines. In the following months, thousands more Lyons employees would have their pay transferred to the computerized system as it proved reliable.[17] Yet, even the apparently seamless working of the original LEO machines, engineered specifically for Lyons inventory and payroll, belied an enormous amount of behind-the-scenes troubleshooting and maintenance. One Lyons computer operator, Colin Hobson, noted that in addition to the standard problems caused by programming or punching errors, "the

[15] *Times* (London), "Computors May Fill 9 percent Of All Office Posts By 1975," 16 December 1965.
[16] *Times* (London), "Computer Growth in Western Europe," 2 June 1965.
[17] LEO Computers, "The Scope for Electronic Computers in the Office: Reprint of a Paper Submitted to the Office Management Association," May 1955, 3, NAHC/LEO/D1-7 LEO Press Clippings, NAHCM.

earliest machines were very temperamental… Some of the early applications needed a lot of nursing."[18]

In 1959, well into the era of computerized payroll, thousands of men went unpaid one Saturday at the Rosyth dockyards owing to a computer failure when not one, but two payroll computers "broke down" simultaneously.[19] The men returned home by drawing IOUs for train tickets and some received meal vouchers. Others received an advance on their next day's pay in a haphazard fashion; some being overpaid by as much as £10 as the payroll office struggled to apportion money to tide workers over for the weekend.[20] The workings of business computers stood in contrast to the public relations machine of the British computing industry: at the same time that dockyard workers were returning home without pay owing to a nearly cataclysmic computer failure, a widely-run advertisement for the "Electronic Computer Exhibition and Business Computer Symposium" at the end of 1958 proclaimed "Management will be able to see the advanced stage reached in the application of electronic computers as a means of achieving greater productivity in office and factory."[21] Through the late 1950s, the publicity and the reality of British business computing sometimes sharply diverged.

The national government also often found their systems did not live up to the promises of the manufacturers well into the 1960s. An internal government memo from the treasury to the Central Computing Bureau, the successor to the Combined Tabulating Installation, noted that "more than a year ago we replaced our troublesome ICT 1201

[18] Colin Hobson (Employee of LEO Computers), E-mail Interview by the Author, 18 December 2005, London.
[19] *Times* (London), "The Computer That Failed: Workers Go Home Without Wages," April 11, 1959.
[20] When the normal yearly salary was between £500 and £1000, being overpaid by £10 for one day's work represented an enormous error.
[21] *Times* (London), "Electronic Computer Exhibition," October 14, 1958.

computer by a well-recommended second-hand 1202 machine but, regrettably, this has also turned out to give us an unacceptable performance. The suppliers, ICT, threw in clearly uneconomic maintenance resources to keep us going," but nevertheless, "they cannot guarantee the level of performance we would normally expect." The solution, the treasury felt, was to purchase yet another ICT machine, at a discount, to take up the slack, despite ICT's "unsolicited admission of inability to satisfy."[22] Indeed, the government continually increased spending on computing, and particularly favored ICT, even when the machines failed to work as expected.

Computer hardware itself, however, was not solely to blame for all computing failures. Poor systems analysis and implementation slowed the effective use of many systems. In 1960, the large chain of pharmacies, Boots, installed an Emidec 1100 computer at its headquarters in Nottigham to handle inventory for over 60,000 different products stocked by the company. In order to arrive at the "the transfer of orders from the shops to computor [sic]" by means of mark-sense lead technology, the company undertook a pilot study lasting more than two years' time. In part, this was because input needed to go through several steps in order to become part of the database. Instead of simply inputting the data directly, items had to be transferred by hand onto a special card using mark-sense lead in a piecemeal fashion by non-dedicated staff. Next, "the card is then converted to a punch card by a mark-sensing punch and is passed to the card reader."[23] The enormous advance offered by the machine was hobbled by the uneconomic and poorly-thought-out implementation of the system into the existing

[22] Treasury, Memorandum from Lees to Donaldson, 26 October 1965, STAT 14/3093 Treasury Investigations: Combined Tabulating Installation; Automatic Data Processing (ADP) Bureau Service 1964-1967, TNA.
[23] *Times* (London), "Boots New Computor At Nottingham," October 7, 1960.

business model and structure of work. The system was only utilized for the more common products stocked by the pharmacy, and it is unlikely that the outlay for the computerized system and start-up costs were recouped by gains in efficiency.

The physical infrastructure of office environments added to the creakiness of the endeavor to modernize. Rife with old buildings lacking air conditioning and even sufficient power, British industry was almost inimical to computerization on a physical level. As a result, even mark-sensing, a "foolproof" advancement over punched entry, could be far from foolproof in the early years of computerized input. Vacuum tubes often broke in machine room environments that usually lacked temperature control. Punched card entry could fail due to moisture-warped cards or sometimes more unusual reasons. Recalling what was perhaps an overly-spectacular failure at LEO during this same period, Hobson related that "one very hot summer we were working, stripped to the waist, with all the windows open when a plague of newly hatched black flies came in from the playing field opposite. They got everywhere and caused data failures when the card readers tried to read them."[24]

The infrastructure available to house and power the machines was often insufficient. Air conditioning was a rarity, and properly-installed electrical wiring could not be taken for granted, even at the pioneer of business computing, Lyons: "Our chief operator was paralyzed from the waist down and roared around in his wheelchair," recalled Hobson. "He used to help himself along by grabbing the card punches on one side of the aisle and the card sorters on the other. One day he stood up, for the first time in years. It turned out that the punches and sorters were on different power supplies and

[24] Hobson, Interview by the Author.

the earth [ground] on one was faulty, catapulting Martin into the air."[25] The government's recognition of these problems took the form of a government inquiry in 1946-1949 on the need to extend the health and safety benefits of the Factory Acts to those in white collar employment, and to concomitantly modernize British office infrastructure.[26] The "Gowers Report" resulted in the passage of several bills throughout the 1950s to create higher standards of health and safety for office workplaces and mandate the creation a more modern industrial setting.[27] These advances, however, were slow in coming; throughout the 1960s, the majority of both employees and employers had to contend with far less than ideal physical plants.

4.3 Dupes of White Heat: Computers, Staff, and Government Bureaucracy

As the largest early adopter of computing technology in Britain, the government and nationalized industries played a major part in shaping the role of the computer operator. The provisions put in place by the Beveridge Report for the expansion of government health and welfare services, in addition to the continually-increasing national bureaucracy, created ever more daunting data processing tasks and a need for large numbers of electronic computers. The government employed a variety of electromechanical tabulating, sorting, and printing machines before the advent of electronic computers, but the speeds attainable by these older systems were expected to be inadequate to the needs of the growing bureaucracy employed to keep track of the many different accounts and systems of payment required by the pay-as-you-earn

[25] Hobson, Interview by the Author.
[26] *Report by a Committee of Enquiry on Health, Welfare, and Safety in Non-Industrial Employment and Hours of Employment for Juveniles (Health, Welfare and Safety),* Cmd. 7664 (1948-1949).
[27] For example: Bill to make further and better provisions for health, welfare and safety in offices and for purposes connected therewith, 1959-60 (80) iii.35; and, Bill to provide for securing the safety, health and welfare of persons employed in offices and for purposes connected therewith (Offices Regulation), 1957-58 (29) iii.83.

(PAYE) system of employee taxation and government pension contribution instituted in 1948, and the other government-run systems of benefit payments such as war and disability pensions. The adoption of electronic computing as the gold standard for government data processing at a fairly early juncture both determined the future shape of computer engineering and sales in Britain (which will be discussed in Chapter 5) as well as largely constructed expectations for the field of computer operator work in Britain. As a result of the vast number of data processing jobs required by the national government, and the on-the-job training given by government departments, these posts heavily influenced the shape of the larger labor force that performed the work. The clerical workforce of the civil service, and indeed all occupations, remained heavily feminized by the 1960s—of the nearly 7.8 million working women in Britain in 1961, close to 2.7 million were clerical workers, and this did not even include office machine operators who were often counted under a separate census designation.[28]

The massive record-keeping required by the Ministry of Pensions, the largest computing installation in the country, handled millions of entries for the recently-instituted PAYE contribution system, in addition to old age, welfare, disability, and war injury benefits. The Ministry utilized a LEO II system for its own administration, but deferred to a more specialized Emidec 2400 for the data processing required for the pension payments. The Emidec was capable of reading more than 20,000 characters a second from magnetic tape and it was able to print out some 20 million annual

[28] Office of Population Censuses and Surveys, *Census 1961, Great Britain, Summary Tables* (London: HMSO, 1966), 64, 67. The exact figures are 7,781,850 for total female workforce and 2,694,800 for women whose primary census designation was clerical work. The latter figure does not include all office machine operators or clerks, whose numbers were partially recorded within different census job groups. Only those not subsumed in other census categories have been included. This leaves out up to 750,000 female clerical workers.

statements, working at the rate of 900 statements per minute.[29] An estimated 1,200 miles of magnetic tape, recording 200 characters per inch, was required for the first year of operation alone.[30] Emphasis on these figures and statistics, however, obscures the fact that for every few hundred recorded characters, or every few feet of tape, a chain of workers including programmers, operators, data input workers, and systems analysts, was required. Added to that were the computer manufacturers and their staff who provided the machines and trained government employees on the use of the new systems. Of these groups, operators and data input staff formed the largest number of workers. (See Table 5.) Indeed, their numbers represented an overall increase of staff in certain cases, rather than a reduction, when compared with the workers they replaced. The amount of work had increased, however; meaning that much more work was being done by fewer workers.

The 1960 yearly report from the Ministry of Pensions and National Insurance laid out the staff training underway to bring the Emidec 2400 system online. Executive and clerical staff spent more than 8,500 additional man-days on training (or more than twenty man-years of training) over the previous year's nearly 43,000 man-days of training (over one hundred man-years) to become technically proficient with the new system. This 16 percent increase in staff training for the year represented a significant outlay, in addition to the cost of the machine. Close to a thousand new clerical staff were recruited to keep pace with the needs of the system, with 700 of these being in the central office handling the start-up work and data input required to prepare the new system, bringing the total number of workers in the ministry to just over 37,000 people. Data input staff had the

[29] *Report of the Ministry of Pensions and National Insurance for the Year 1960*, Cmnd. 1458 (1960-61), 75.
[30] *Report of the Ministry of Pensions and National Insurance for the Year 1960*, Cmnd. 1458 (1960-61), 118; *Times* (London), "Largest Computer For Pensions," 18 August 1961.

daunting inaugural task of preparing a master punched card for each and every one of the millions of employees, pensioners, or welfare benefit recipients. Within the first year of the undertaking, only 5.5 million such cards had been completed.[31]

The earlier, original electronic computing system, a LEO II employed to do the 25,000 member payroll for the Ministry's own workers, had resulted in a net decrease in staff. The LEO replaced a "largely manual system" of computing the variations in data that required about one hundred workers, before being fed through "conventional punched card machinery" by machine operating staff. As a result, it replaced the hundred workers who computed variable factors like overtime and other changes, and eliminated the need for as many operators because the need to pass punched data cards through several machines, several times during each run, in order to arrive at the desired output was eliminated.[32] The larger Emidec system, on the other hand, created an increase in staff, because rather than automating an older system already in place, it was brought in for the express purpose of creating a new system of payments and records. The Emidec computer, by virtue of its speed and versatility, helped to co-create and enable a new set of tasks within the Ministry of Pensions. Rather than streamlining a system already in place, it was purchased with the express intention of creating a new system for completing work that had not previously existed. In so doing, it impelled a new class of workers into the Ministry of Pensions. A similar process took place in all other government ministries that turned to computing to redefine, rather than just speed up, their daily and long-term operations.

[31] *Report of the Ministry of Pensions and National Insurance for the Year 1960*, Cmnd. 1458 (1960-61), 75.
[32] Ibid., 118.

4.4 Biographical Sketches From The Machine Workforce: The Trainer and Company Man, Colin Hobson

In September 1961, four days before his nineteenth birthday, Colin Hobson started work as an operator at the LEO computer company. Still based out of the J. Lyons' bakery and teashops headquarters in Cadby Hall, and then later in Queensway, London, LEO had graduated from handling only the inventory of the Lyons Tea Shops to handling payroll and inventory for a variety of other businesses, either though providing custom-built computers for installation at other companies, or through selling time on their own computers. Hobson worked as a computer bureau operator within LEO. This meant he operated computers both for Lyon's own use, and on which time was bought by other companies to run their own programs. In either case, the LEO bureau staff operated the machines and were responsible for delivering the output. Later, he worked as a trainer, going to customer sites to train the staff who would operate the newly-installed computers purchased by their businesses and government agencies.

Working on the LEO I, II and III models between the years of 1961 and 1967, breakdowns were frequent, particularly on the valve (vacuum tube) machines, LEO I and II.[33] Upon starting at LEO, he was given hands-on training and sent on several two-week programming courses to learn relatively high-level languages like Intercode.[34] Since it was important for the operators to know enough code to be able to debug the programs during runs, most bureau operators at LEO could write simple computer programs. As the systems were upgraded, operators were sent on training courses to learn the new

[33] LEO III was transistor-based.
[34] As opposed to low-level programming languages: see footnote 41. Intercode was a subset of Autocode, a language designed to program the Ferranti-Manchester Mark I.

functions and procedures, but the most useful training, Hobson stressed, was the hands-on work.

Computing power was still in short enough supply during the early 1960s that the LEO bureau staff would often "beg, borrow, or steal" whatever time they could on the LEO machines installed in other companies and in government offices to be able to run all of their bureau programs, often on the overnight shift. Of doing so on the large government post office machine, Hobson noted "we had very little contact with the staff on these machines because they would hand over and go home. The post office machine was particularly impressive because they had a habit of loading it up with four massive programs and then their entire shift (of what seemed like twelve people) would go, leaving one or two LEO operators to finish off the post office work and run the bureau work."[35] LEO bureau operators expressed exasperation with the government workers at times. Government installations, like the one at the post office, were both overstaffed and under-motivated from the perspective of the LEO bureau operators, who considered themselves, working so closely alongside LEO's engineers and designers on cutting-edge computing applications, to be a cut above other operators in government and industry.

From the perspective of some of those other workers, however, the LEO bureau seemed less than paragon. Recalled one post office operator, Ann Sayce, whose tenure at the post office overlapped with Hobson's time spent as a LEO bureau operator: "The worst places [to apply for a job] were the computer firms. They didn't want women because they thought they couldn't work at night."[36] Indeed, Hobson recalled the stigma against women operators working at night at LEO, remembering his impression that extra

[35] Hobson, Interview by the Author.
[36] Ann Sayce (Government Computer Operator), Interview by the Author, 5 January 2006, London.

female supervision, in the form of a women's officer, would be needed if even one woman were employed, and so none were. Another LEO employee recollected as an aside that, "incidentally, the operators were always male, and one of the rumored reasons for this was that the spools on the tape decks were so high that if a female operator tried to load tape, her bra straps were likely to snap!"[37] Though this reasoning was clearly stated in jest, the iteration of such myths at the time, as well their reiteration decades later, gives a glimpse into the computing company's machine room culture.

Nevertheless, Hobson noted that while female operators were not welcome, "the odd thing is that some of these [programmers] were female, but there seemed to be no problems about them hanging around at night in a partially deserted building with a bunch of young men!"[38] Although female programmers could escape the some of the strictures placed on women operators, owing to their elevated professional identity, even women programmers were not treated on par with men in all respects. Mary Lee Berners-Lee who worked at Ferranti, (and is also mother of Tim Berners-Lee, inventor of the World Wide Web), recalled that women programmers doing the same work as men were paid less owing to the fact that "Ferranti was a paternal firm," and as such believed that "men would have to support a wife and children so they needed more money," an idea that "went nowhere with the professional women."[39] The relations of the idealized nuclear family influenced not only what work women were likely to do, and the conditions under which they worked, but also what they would be paid for it and how their work was valued.

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[37] David Forward, "My Recollections of LEO at Shell-Mex and BP," collected by Peter Bird. NAHC/LEO III/6, NAHCM.
[38] Hobson, Interview by the Author.
[39] Mary Lee Berners-Lee, "Anecdotes: How did you first get into computing?" ed. Anne Fitzpatrick, *IEEE Annals of the History of Computing* 25 no. 4 (2003): 78-79.

Gendered proscriptions intersected with class-specific social mores in a variety of ways, and female workers sometimes inhabited confusing social identities at the crossroads. Even workers doing the same job in the same installation could see their social roles quite differently. Cathy Gillespie, who worked in the post office computing installation beginning in 1965 recalled that women who worked with men at night were sometimes looked upon in a suspicious light: "'What sort of a women would want to do that?' was the idea," she recalled, adding, "there was also this idea that you didn't indulge in sexual things before marriage." Her former coworker Anne disagreed, however, asking incredulously: "What sixties were *you* in?" Cathy, coming from a more middle-class background, perceived the taint of sexual promiscuity very differently than Anne, whose working-class background seemed to allow her to focus less on sexual mores and more on competing with her fellow co-workers on the basis of more tangible skills and expertise. She proudly recalled that she had once held a speed record for processing data on an early IBM. Nonetheless, both recalled a similar general picture of their first computing shifts within the civil service with fondness. The atmosphere in the computing installations, quite different from the run-of-the-mill civil service office spaces, was marked by a youthful and gregarious atmosphere. Said Gillespie, "It was like going to a party every day as we were all about the same age."[40]

Youth also prevailed within computing companies, although there young men tended to be heavily favored over female operators. This came in contrast to prevailing norms in the public sector, where office computer operation was assumed to be largely an offshoot of earlier kinds of feminized clerical machine labor, rather than an endeavor

[40] Cathy Gillespie and Ann Sayce (Government Computer Operators), Interview by the Author, 5 January 2006, London.

adjacent to engineering and systems analysis. Gillespie and Sayce worked in an environment where women operators made up half or more of the operating shifts, at the post office, and later at the Central Electricity Board. By the late 1960s, however, a shift in the gender of this labor force was underway. In later years, as women left those jobs to have children or to move to other jobs, the gender balance of the quickly-professionalizing field shifted, with young men filling both new posts and the posts that women had left.

Through the mid 1960s, however, these professional distinctions had yet to take firm hold. Gillespie and Sayce both received on-the-job training, in addition to having to learn the machine code in the thick LEO operator's manual. Their first job with the post office dedicated two weeks to paid training before they began work. They also learned how to program in binary and to read certain machine encodings, including hexadecimal, parity, nonparity, and mBIC. LEO bureau operators like Hobson, often regarded as elite amongst operators, were given formal training in programming in addition to operator training. The innate skill of bureau operators before such training, however, was no different from any other group of operators. Hobson recalled that in the close-knit all-male operator environment of the bureau:

> "It was like a big adventure in which we were all, down to the guys that made the tea, involved. Indeed, a man who was employed to do fetching and carrying (there was a lot of paper to move!) started to show interest in what we were doing so the operators trained him up, pushed him into the next selection test and he ended up working on my shift."[41]

But Hobson also recalled one female punch operator with a similar promotion story. She was able to make the leap from punching to becoming a data assembly clerk, which entailed controlling work going to the operators, scheduling work with commercial

[41] Hobson, Interview by the Author.

customers and Lyons' own departments, and ensuring that the correct new data was associated with the data that had been carried forward. She was also responsible for scheduling non-regular work.[42] The relatively important and responsible position that this punch operator was able to attain showed that gendered promotion structures at LEO were more fluid than the makeup of their operator workforce might lead one to assume.

Hobson also trained female workers from other companies, even though his regular shift was all men. Trainees came in to help run jobs on computers that their employers had ordered from LEO but which had not yet been installed because they were still undergoing testing. He recalled the women trainees were no different from the men trainees in terms of skill and aptitude, remarking that their relative scarcity at some companies probably had to do with the politics of office supervision or shift scheduling, rather than an expectation that women would not perform the work as well as men.[43]

4.5 Within the Government Machine: Civil Service Operators with Divergent Careers, Cathy Gillespie and Anne Sayce

One aspect that all three operators agreed upon was that their line of work, and the meticulous low-level program reading, writing and debugging skills it required, was a young person's field.[44] It was recruited for accordingly. Operator jobs were suitable for applicants with a solid, though not necessarily stellar, secondary school record, and they were not jobs for college graduates. School grades and experience counted only slightly in determining an applicant's suitability to the work. A keen ability to learn and a hard-

[42] Ibid.
[43] Ibid.
[44] Low-level programming refers to programs written directly in the machine code of the system they are intended to run on, or in an assembler language that did not obscure the machine details. As such, low-level programs are close in symbolic representation to the structure of the machine. Additionally, operators sometimes had to correct programs by directly editing their binary representation on punch cards. High-level programming languages abstract away many of the hardware details of the machine allowing for more general and reusable programs to be written.

to-quantify spark or interest in the work, so often deemed necessary in ill-defined or young fields of endeavor, were the key to getting hired. The individual preconceptions of hiring managers regarding the field in general, and their work in particular, played an equally large role. On-the-job training had little direct relationship to subjects of study in secondary school, and was held in higher regard than academic training. Although he studied for A-Levels (advanced subjects) at school, Hobson received only several O-levels instead (ordinary level subjects). This in no way hurt his career at LEO.[45]

Cathy Gillespie had also received O-levels, having not had the money for A-Level study. Indeed, she was surprised to have been among the forty people hired from a large field of several thousand applicants to work on the post office's LEO III/26 installation, because she lacked O-levels in math and science. Ann Sayce came from a different background, however, being several years older than Hobson and Gillespie. Having attended a more academically-oriented grammar school, rather than a more general, trade-oriented comprehensive secondary school, Sayce had considered the idea of training to become a systems analyst after leaving school. Discouraged by the lack of opportunities to get this training (to her knowledge, there were only two universities at the time with such curricula), Sayce took articles to qualify to work as an accountant. After finding accountancy work too dull, she applied along with thousands of others to the same post office computer operation job as Gillespie.

Computers, both women recalled, seemed like a fascinating new field; just like the advertisement said. A cut above the other jobs available, located neither in the dull world of the office, nor in the realm of the service industry or factory labor, computing

[45] Under the General Certificate of Education rubric—the main method of grading secondary level student educational achievement in the United Kingdom at this time— students who did not achieve A-levels could be awarded the lower O-level qualification instead.

operation work seemed to represent the remarkable new social and economic future that Labour, and the nation, had begun aligning itself with by the mid 1960s. Nor did the reality of the job disappoint. Recalled Sayce, "operating a computer at that time was quite interesting and exciting," a sentiment echoed by Gillespie: "The atmosphere was fantastic and the best bit was that no one knew what I did as it was so new."[46] In addition to having interesting and relatively well-paid work, there was a particular caché and a level of prestige associated with working with cutting edge technology.

Hobson became interested in computing for much the same reason, citing the allure of the unknown for his earliest interactions with computers. His curiosity was piqued when a computer company representative came to his school to speak to the students "about these wondrous science fiction things called computers. At the time everybody else called them electronic brains!" Conceptions of the "futuristic" nature of computers also figured heavily into Hobson's decision of where to go to work. He nixed going to work for ICT, because he recalled, "I was not impressed by the ICT idea of a computer, which seemed to need a lot of bicycle chains, but saw an advert from LEO in the press and went to them."[47] Knowing little about computing, other than the fact that he wanted to know more, Hobson epitomized the early wave of computer operators who found work in computing installations before the existence of such jobs was even widely known, and before related experience in the field was expected or required.

The job advertisement Gillespie and Sayce answered made no secret of the fact that experience in related fields was of no import: "Know Nothing About Computers? Then We'll Teach You (and pay you while doing so)" read the advertisement, promising

[46] Gillespie and Sayce, Interview by the Author.
[47] Hobson, Interview by the Author.

that “Here at the GPO London Computer Center … You can take your first steps into the fascinating world of computers-- into a fascinating future as well!” [48] Unusual for its time in presenting a long-term career opportunity in the civil service as something for which the employer would be willing to train entry-level employees of either gender, the advertisement immediately appealed to Gillespie, who was working in a shoe shop when she applied for the job, having quit secretarial college due to lack of interest in that type of work. Sayce, coming to the position from within the civil service, where she was already employed, still had to compete along with the other applicants for the job, and barely squeaked in, being just one year under the age limit.

The post office advertisement asked specifically for applicants under twenty-five, which, along with the promise of training and the job’s location in the permanent civil service, meant it was a high-status career opportunity, rather than just a job. Starting at £9 an hour, and rising as high as £15 by age twenty-one, the already above-average wages were enhanced by a pension plan that did not require employee contribution, while salaries of £1000 and above were promised as attainable with time. This sort of salary, in the £1000 to £2000 range was “what all the guys wanted” at the time, noted Sayce.[49] Further education opportunities were also expressly mentioned in the ad, along with three weeks’ paid vacation. Decorated with numbers evocative of computerized output, and designed with a clean, modern look, everything about the large, quarter-page advertisement attempted to sell promising young applicants on the wondrous new world of computers. The job posting ran in newspapers several times over the course of the summer of 1965.

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[48] *Evening Standard*, “Know Nothing about Computers?” Staff Wanted Ad, 21 and 23 July 1965.
[49] Gillespie and Sayce, Interview by the Author.

Asking explicitly for both male and female applicants was a rarity at that time for jobs of this nature. Often jobs that were presented as career opportunities confined their applications to men, while the routine office jobs, with potentially high starting pay but little upward mobility, often sought only women applicants. Many advertisements that pitched a job to one gender or the other did so explicitly, simply asking for men or for women. Even greater numbers of advertisements, however, employed subtler language or fine print. Some limited applications by asking applicants to direct inquiries to the company's "Women's Officer." Others warned that night work would be required, intimating that men were preferred. A variety of code words, having to do with career opportunity, pension plans, and the possibility for advancement to salaries over £1500, were also used to convey that young men, rather than young women, were the target demographic for a staff wanted advertisement.[50] Women, on the other hand were targeted with promises of part-time work, flexible hours, marriage bonuses, sociable outlets at the workplace, and workplaces in districts of London described as exciting, fun, and fashionable, like Kensington (a shopping area) and the West End (the theatre district). The post office computer operator advertisement uniquely combined elements that were meant to appeal to both young men and young women, promising not just careers and good pay, but also marriage bonuses, a fashionable location, and flexible hours.

In the fall of 1965, Gillespie and Sayce started work at the post office's LEO III/26 installation, ages eighteen and twenty-four respectively, joining roughly sixty other operators spread across three shifts. The operators, of whom roughly half were female,

[50] Pension plans, when mentioned in an advertisement seeking young employees, were almost exclusively targeted towards young men. Young women generally still lost pension rights upon marriage, and therefore, if they opted or were allowed to contribute to a pension plan at all, they would take a lump-sum payout of their contributions in the form of a "marriage bonus" upon finding a husband to help them set up a married household.

were overseen only by male supervisors. Initially both worked on feeding cards into the reader, and loading the appropriate tapes and paper. Gillespie did some last-minute punching when needed and later specialized in organizing the batches of cards that would be run on the machine. She also processed the printed paper output, right down to physically chopping it up and bringing it to the relevant departmental destinations.

There was no overnight shift, although programs would run into the night. The programs ranged from telephone billing (the post office was in charge of telephone service at this time), to payroll, to civil engineering programs that coordinated road work or maintenance on underground utility lines. As previously mentioned, Hobson and the rest of the LEO bureau operators often utilized any remaining time, bringing bureau work to run on the post office machines at night. When not in use, nighttime downtime allowed engineers to make repairs or perform essential maintenance.

Gillespie worked the "early shift" from seven-thirty in the morning to roughly two-thirty in the afternoon. She recalled the young, largely female environment of the job fondly, noting that "At the post office it was fun to work there and the atmosphere was great. The majority of us were about the same age so it felt like going to a party every day, not work. It was a great first job, you were not trapped in an office, you were working fantastic hours, which gave you a lot of freedom, and no one had any idea what you did."[51] Some enterprising person, she recalled, had somehow programmed the noisy machine to play an approximation of Bob Dylan's "Rainy Day Women" at the start of the day, by orchestrating the machine's various whirrs and clatters.

Sayce, who supplemented her hours as an operator with a part-time job doing accounting, and another job dealing antiques in her spare time, recalled the benefits and

[51] Gillespie, Interview by the Author.

complexities of having such seemingly limitless economic potential. Since she had a lot of money saved, she attempted to get a mortgage to buy a home, but was turned away despite meeting the financial qualifications because she did not have a male relative to co-sign. “Men earning eight to twelve pounds a week could get a 90 percent mortgage at the time,” Sayce recalled bitterly, but when she requested a modest loan from the bank, “a spotty eighteen year old laughed in my face.” Her money was good many other places though: one lunch hour she ran out to buy a car, remembering “I told the salesman that I wanted a car with a radio, and he sold me the longest car that they had at the time!”[52]

Less tangible factors also contributed to Gillespie and Sayce’s perceptions of themselves and their jobs. Both recalled the married engineers who were on site to fix the computers thought female operators were “a bit dodgy” and shied away from them, viewing them as “man eaters.”[53] A similar view was held of the women in the all-female punching pool, who were seen as loud and aggressive. Trousers were not allowed attire for machine operators despite the physicality of the job, even though protective attire, like a long “overall” coat, was sometimes supplied. Yet, at the same time, hemlines were rising, and women were wearing more and more revealing fashions to work.

The effect of such nebulous cultural factors on the shape of their early careers cannot be concretely discerned. It is worth noting, however, that even though Hobson had left school at the earliest allowed age, while Gillespie or Sayce had stayed in school past the required age of sixteen, he had been hired into one of the more elite positions open to computer operators at the time, that of a LEO bureau operator. Gillespie and Sayce were

[52] Sayce, Interview by the Author.
[53] The trope of a predatory, single, working woman reached an extreme in the engineers’ and operators’ impressions of the all-female punching and verifying pool, who they described as “a sexual wolf pack” known to stake claims to male co-workers they fancied and to sexually harass them.

very fortunate to have been selected from a much larger field for a government computing job, during a period of economic crisis and computer labor shortage in the civil service that worked to the advantage of women operators.

As female coworkers left to have children, however, the gender balance of operators shifted, and new female hires did not replace the old. Both Gillespie and Sayce saw married colleagues come back to work, after having had children, in different, less desirable jobs, and at lower pay. From her own experience, Sayce recalled that some workers were more equal than others. In addition to passing the required math and writing tests for the post office job, she had to convince the hiring officers that she would not have children in the near future: "You would never get the job until you swore up and down that you wouldn't have children."[54]

In addition, even though she was divorced, Sayce was disqualified from getting a civil service pension, because she had been married at one time. Marriage, even the remnants thereof, or the future inclination towards, could spell trouble for women seeking a career rather than a job. Popular opinion regarded it more suitable for white-collar women to only seriously pursue either career or marriage during the 1960s and beyond. Echoing this state of affairs as late as 1975, survey of school-age girls' academic and work aspirations noted that "the simple and obvious escape route to marriage and motherhood was not merely socially acceptable for girls, but almost obligatory."[55] Sayce, in fact, did leave to have children shortly after taking another computing job a few years later, and never returned to computing work.

[54] Sayce, Interview by the Author.
[55] Irene Rauta and Audrey Hunt, *Fifth Form Girls: Their Hopes for the Future*, ed. Social Survey Division of the Office of Population Censuses and Surveys on behalf of the Department of Education and Science (London: HMSO 1975), 9.

In 1967, only two years after arriving at the post office, both Gillespie and Sayce left the security of their current positions for the large, new IBM installation at the Central Electricity Generating Board (CEGB). In addition to leaving a guaranteed job for life behind in the civil service, Gillespie and Sayce also relinquished their excellent working hours. Their new jobs required work on both day and overnight shifts. Yet, in order to have the opportunity to advance to higher computer operation jobs, leaving the civil service was a necessity. Due to its organization and promotion structure, there was no guarantee one could continue to work with computers upon promotion. Civil servants could be required to work in a totally different office doing completely different work after each promotion to a higher job grade. The limited number of vacancies in the Senior Machine Operator (SMO) grade in the post office meant that, if they wished to continue working with computers, they might wait many years until even one SMO post was vacated. Leaving the post office installation had downsides as well. In contrast to the relaxed atmosphere there, "at the CEGB things were slightly more serious," Gillespie recalled, nonetheless adding that it was still "great to be young in a new industry, earning good money and being on a par with the men regarding wages and opportunities."[56]

The CEGB ran IBM 360s rather than LEO machines, representing the early curve of a shift already underway in favor of IBM at the expense of British computers. Indeed, Gillespie's rationale for applying for the job was due as much to her desire to become an SMO as her recognition that she would need experience on IBMs in order to advance further, as more and more British firms began to turn to IBM. An IBM 360/30, 360/50 and 360/75 occupied two different London offices of the CEGB, the first used mainly for administration tasks, with the latter two forming part of a new system called ASP

[56] Gillespie, Interview by the Author.

(Attached Support Processor). While the 360/50 did input and output, the 360/75 ran the programs. In order to wring maximum efficiency from the machines, they were used in tandem, automated to perform different tasks in the processing chain, for the purpose of speeding up the programming runs beyond what a human controlling the input, processing, and output functions non-programmatically could achieve.[57] The computer operation staff at CEGB consisted of only about twenty-four operators for three machines, in contrast to the more than sixty at the post office's installation.

In the machine room at the CEGB, Gillespie would again receive input to organize, this time from a remote location where the cards had been copied to magnetic tape. They were sent to her with a job sheet indicating the tape contents, along with any paper tapes needed to input the program. In addition to feeding in these programs, scheduling the work, and processing and debugging the jobs, she performed initial program loads (IPL) to bring the system up after crashes, and logged hardware faults and other problems to pass along to the engineers who performed overnight maintenance. Engineers were on staff during the day as well, to correct insurmountable operating problems and machinery breakdowns. Even into the early 1970s, Gillespie recalled, these tended to occur regularly two or three times each day.

In addition to machine faults, operator faults could wreak havoc with the installation. Opening a door to one of the magnetic tape reels too early, before it had stopped spinning, earned Gillespie a broken foot when the reel shot out of the case. The scratch tapes, forming the short-term writes that would not comprise the final output could occasionally get confused with an output tape. "Imagine how popular you were if

[57] Ann Sayce recalled that by tweaking the scheduling of jobs, she was able to hold the speed record for processing jobs using ASP.

you picked the wrong one," Gillespie said with chagrin. In fact, management consistently feared that the ease with which scratch tapes could be switched with other tapes could be used by disgruntled workers, in the context of a labor dispute, to wreak havoc on the workings of the government.[58]

Figure 3: Cathy Gillespie performs the Initial Program Load on the CEGB's new IBM 360

In the photo above, taken as publicity for the CEGB's new IBM 360/85 installed the fall of 1970, Gillespie sits at the console, typing and answering commands.[59] Acting in place of the modern equivalent of a screen, the paper from the console comprised a hard copy of the daily log which could be referred back to in the event of an error. In the photograph, the dials are set to the initial program load, from the card reader on address 00C, which read the initiation deck containing the information needed to "boot up" the

[58] HN 1/38 Industrial Relations In The Civil Service: Government Computing 1973-1979, TNA.
[59] Cathy Gillespie, personal collection, 1970.

machine, or bring it to the point where it would be ready to run a program loaded via the read-only input tapes on the units in the background. The glass cases behind the console contained system tapes, used both to bring the machine up at the beginning of the day and after crashes. The scratch tapes, stored on the rack in front of the tape unit, were used to record incremental output throughout the day. Dedicated magnetic tapes collected the final output, but output could also be put on paper tapes or cards if required.

Perched at the console in this image, Gillespie both represents and obfuscates the actions described above. Instead of focusing first and foremost on representing the work Gillespie did as an operator, the publicity photo casts her as a young, pretty girl sitting near the machine in order to draw interest to the picture as a whole. Indeed, the posed photograph puts her in a passive position similar to that of a secretary at a keyboard, one that she would not have occupied for all of her workday, subtly packaging the role she performed as an operator for viewers who were familiar only with more common types of women's office work. Other photographs, often containing male operators, presented operators in more active roles, to give the illusion that the photographs accurately presented a fly-on-the-wall image of an exciting, serious, and somewhat opaque work process. Instead of representing a worker first and foremost, the cameraman's posing of Gillespie in this photograph puts her at risk of becoming window dressing, like many of the female models used in later computer advertisements. Without the background story, it might be difficult to say with certainty whether the young woman in this photograph was a worker or a model brought in for the photograph.

4.6 Changing Representations of Computer Operators from the Fifties through the Swinging Sixties

Dressed in the latest fashions, Gillespie's photograph mirrored an increasingly common trope of representing computing labor in both the popular press and in advertisements in the later 1960s and into the 1970s. In the imaginary void surrounding computing at this time, published images possessed the ability to become powerful ambassadors for the current state of affairs in computing. Repeated images within similar tropes, in addition to reflecting a version of reality, actually helped cement in the public's mind, even if only subconsciously, both how things were in computing, and how they should be.

While some publicity photography used models, Gillespie's publicity photograph utilized her both as a stand-in for herself as a worker, and as a broader appeal to a generalized, heteronormative male gaze. The image's sleek veneer is only eroded upon close inspection. The contrast between her Mod attire and the disoriented, clenched look on her face slightly disrupts the imaginary constructed in the photo. A tooth extraction the previous day had left her face swollen and completely numb, and undermined the polished, professional image that later photographs using models achieved. Gillespie's very embodiment as a laborer, reporting for work despite a physical setback, undermined the publicity photo's project of presenting a stylized, hyperreal image.

From representing quantifiable enhancements in efficiency, the computer soon became a symbol of industrial and social modernity in a more abstract way, a status symbol that was a shorthand description of the bright future in store for Britain. The psychologically compelling images of pretty young women, or more rarely, dapper and serious young men, that accompanied the machines lent immense support to this project.

In order for the technological future to materialize, the public would first need to be able to envision it, in order to recognize it as it happened.

As computers became more common within industry and familiar to the public, publicists also gained more freedom in how to represent the machines themselves, dispensing with more realistic and rigidly professional images to emphasize a sleeker, sexier view. Didactic photos of the worker-computer system as the focus of the advertisement, as those shown in the Powers-Samas and ICT advertisements below, began to give way to an idealized tableau in which the computer sometimes took center stage. Industrially-designed to be aesthetically pleasing and arrayed in neat, linear formations, the computer would be placed in the sort of immaculate modern offices that were still very much in the minority.

Legislation brought in after the Gowers Report had not yet begun to scratch the surface of London's office problem, and workplaces in the capital, where most computers were installed, remained less than ideal. In many cases, the health of office workers was not even as robust as their industrial counterparts; tuberculosis rates, in particular, were much higher among office workers.[60] Images and stories from internal company magazines sometimes showed the spectacular lengths to which the company had gone to shoehorn a new computing system into an old and unsuitable building using cranes, added floor reinforcement, and other tactics. [61] Nevertheless, these more common, older, office settings were never implied in advertising images, for obvious reasons.

From the 1950s through the mid 1960s, photographs used to sell and showcase computers pictured a relatively plain female workforce as they stood working at the

[60] *Office Magazine*, February 1960, 161.
[61] "Installation Problem," *Tabacus: The Magazine of the British Tabulating Company*, March 1957, 5.

machines. Powers-Samas machines, which combined with British Tabulating Machines in 1959 to create ICT, consolidated this trope early on with the creation of the "Powers Girl" who demonstrated their machines in advertisements. Dressed in ladies' business attire, the Powers Girls showed how the company's calculating devices might be used, humanizing an otherwise opaque, intimidating, and potentially confusing series of machines. They also served another didactic function, by representing the appropriate kind of worker who would operate Powers machines after a company purchased and installed them. Below, a Powers Girl poses operating one of the earliest Powers electronic computer peripherals, nicknamed the "Emp" (Electronic Multiplying Punch).[62]

Figure 4: Advertisement for Powers Samas Computer Peripherals, 1955

The Powers Girl was a visual extension of well-worn hiring preferences that continued in various jobs and industries as late as the 1980s. "The conventional method is to hire women trained to operate any of the many machines available on the market,"

[62] *Powers Magazine*, January 1955, 4.

wrote one author when discussing the economics of purchasing a new electronic Powers calculating machine.[63] Even when men were hired for computer operation, there was often reference to the need to hire a "girl assistant" to do data punching work and other miscellaneous operation.[64]

Throughout the 1960s, most British computing companies' advertisements were dominated by figures similar to the Powers Girls. The one exception was Ferranti Computers, which showed men operators in their advertising as often as women. Ferranti aimed at a slightly different market; the scientific and engineering niche market, rather than the broader business computing market. In their ads, computing companies featured workers, or worker stand-ins, who resembled those that the target business audience would feel most comfortable hiring. For more general calculation and data processing applications like payroll and billing, these were women. For more specialized, scientific or engineering computing, they were often men.

The woman on the cover of the 1963 LEO-English Electric advertising brochure below could easily be mistaken for a Powers Girl. One important difference sets her apart. Unlike the Powers Girls, she was faced away from the camera, and did not engage with the viewer. The images from a 1963 ICT magazine and 1962 advertising brochure illustrate a corollary of this advertising technique, with more anonymous, more numerous, and less visually interesting or engaging female workers.[65] The advertising brochure, in particular, displays page after page of photographs taken at companies who have already signed on to "progress" and installed ICT computers. Despite the ordered

[63] "Practical Economics of the EMP," *Powers Magazine*, May 1955, 7.
[64] "LEO Computers, An Overview," NAHC/LEO/D2 LEO Press Clippings, NAHCM.
[65] "EE-LEO brochure for LECTOR System," NAHC/LEO/D2, NAHCM; *ICT Data Processing Journal*, February 1963, 15.

nature of the machine and punch rooms shown, the effect of viewing all of the photographs one after another is discomfiting: the silent, oblivious, female workforces do not seem to be alleviating the drudgery of calculation work, as promised, but rather only speeding up its performance.[66]

Figure 5: English Electric-LEO Advertising Brochure, 1963

Figure 6: ICT Magazine Photograph, 1963

[66] ICT, "Progress in the North," Advertising brochure, 1962, NAHC/ICT/C96 ICL Advertisements, NAHCM.

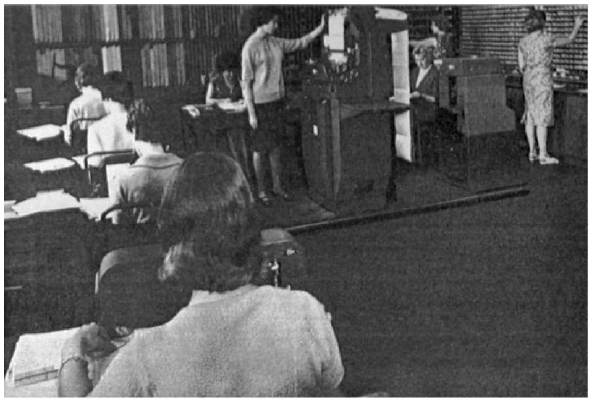

Figure 7: ICT Advertising Brochure Photo, 1962

British companies exported these cultural and economic roles along with their machines. Overseas markets for British computers were also targeted with information on who should fill such jobs. By 1955, Powers Samas had opened a "Service Bureau" in Delhi stocked with their machines and staff to train local workers, as part of a plan coordinated with the government and the Indian Statistical Institute for economic uplift and industrialization.[67] The article pictured street scenes showing the "clean symmetry of Western-influenced architecture" replacing older buildings. A company canteen was shown filled with young Indian women in training to become machine operators and punch operators. They were described as efficient, well-trained, and "proud to be associated with a great venture." Furthermore, "no effort has been spared in the planning of this service bureau to conform to modern trends and to show it off as a model," from ice-water in the canteen refrigerator to special cooling and lighting in the rest of the building. "The noise of steel against steel in battles fought over this ancient city, gives way to the busy chatter of Power-Samas machines engaged in a combat of a different

[67] "Powers-Samas Service Bureau in Delhi," *Powers Magazine*, July 1955, 4.

kind," fighting instead "the battle against hunger, poverty, and underproduction," or perhaps, less altruistically, battling for a share of a potentially lucrative new market.[68]

ICT continued this mission into the 1960s, wooing the Indian market despite the seeming irrationality of selling expensive labor-saving devices to a relatively poor country with a large labor force. Prime Minister Nehru viewed ICT equipment at the Indian Industries Fair in 1962, while President Khan of Pakistan inspected the new equipment at the State Bank of Pakistan in 1961, below.[69] Both photographs show the Indian and Pakistani businesses following the labor model set out by the British, and in each case, British computing was presented as a modernizing force set to bring former colonial holdings into a clean, orderly, and productive future. British ingenuity was marketed as the saving grace of non-industrialized nations, rather than presented as a holdover of colonial economic influence.

Figure 8: Prime Minister Nehru views ICT equipment at the Indian Industries Fair, 1962

[68] Ibid., 6. For more on the export of British social mores into high-technology sectors in underdeveloped nations, see Carla Freeman, *High Tech and High Heels in the Global Economy: Women, Work and Pink-Collar Identities in the Caribbean* (Durham, NC: Duke University Press: 1999).
[69] *ICT Data Processing Journal* 1962, no. 12, 21, and 1961, no. 11, 23.

Figure 9: President Khan of Pakistan inspects the new equipment at the State Bank of Pakistan, 1961

Nationalist pride in British computing was prominent at home as well. Pictures of the Royal Family inspecting or inaugurating computer installations were a perennial favorite of the industry and popular press. From the Queen Mother, to the Queen, to the Duke of Edinburgh, members of the Royal Family could be found sitting at an operator's console or inspecting a new machine whenever a major computing installation was inaugurated, or a new manufacturing plant was built by one of the British computer manufacturers.

Comparing didactic photographs showing women using machines, from the Powers Girls to overseas installations, with Gillespie's photo above, shows the beginning of a shift in the essential characteristics of computer advertisement underway by the late 1960s. Instead of focusing on a relatively plain-looking feminized workforce, whose presence is simultaneously meant to stand-in for low-cost labor and recede into the background as the viewer considers the computing system, women themselves started to become a subject of the advertising photography and were increasingly represented as a point of interest irrespective of their interaction with the product on display.

In many later images, women simply stood by the machines, and later still, the machines disappeared, while only the image of a woman remained. Immaculately dressed, young, and fashionable, female operators became important as sex objects in computer publicity, but all the while retained their importance as a shorthand representation of a particular kind of laborer; a worker who would present most of the benefits and few of the downsides of modern office labor in a time when trade unions still held a large degree of power, requisite pension plans for men cost a great deal to fund and administer, and men still received higher pay for similar work. Computer advertisements graduated from using gender, to using both sex and gender to pitch their products, as the 1967 and 1970 ads below show.[70]

Figure 10: Advertisement in Office Methods and Machines Magazine, 1967

[70] *Office Methods and Machines Magazine*, September 1967, 33; *ICL Computers International*, September 1970, 3.

Figure 11: Advertisement for ICL Baric Remote Computing Service in ICL News, 1970

In addition to trading on the pleasing image of each young woman, the advertisements above portray the women as nearly superhuman when combined with their trusty computers (or, in the BARIC ad, the computer bureau service). With the help of computing, the "girl operator" could fulfill functions that previously would have required many more staff. Better yet, the operator did not require special training or expertise: the "Susie" computer 'is operated by a typist—not highly paid programmers and controllers," and the BARIC "girl operator" was shepherded by the expertise of the computer bureau services at the other end of her terminal link. These subtler messages appealed to particular business users, while the sexy image at the center of the advertisement functioned to draw the reader in to consider these finer points. All the

while, these ads reminded the viewer of normative feminine work roles, to help convey the myriad benefits of the product being marketed.

Using sex to sell computers also extended beyond printed advertisements. By the 1960s, some companies, including International Computers and Tabulators (ICT, later International Computers Limited, or ICL) employed all-female computer demonstration teams, who went to trade shows and worked on site at ICL operating the demonstration machines for potential customers. Happy-go-lucky images of the all-female ICT demonstration teams from the mid 1960s gave way to more carefully uniformed and coiffed teams in the 1970s.

The photograph below shows the ICT demonstration team of 1964, playing with output paper from the console of their demonstration machine at a trade show exhibit.[71] The four-person team appeared to be having a good time in front of the camera. The individual names of all the "girls" were also recorded in the caption, a relatively rare sign of respect for computer operators, who were often seen as interchangeable or ancillary to the machine in publicity photos. Though they were attired in matching outfits that seemed to echo those of contemporaneous stewardesses, the uniforms were modest and professional. Consisting of a dark suit with a knee-length skirt and an ICT pin on the lapel, the uniform did not aim to draw an undue amount of attention to the fact that the demonstration team was made up exclusively of young women, in a setting where the gender and age ratio of the audience was weighted heavily in favor of older men.

[71] *ICT House Magazine*, September 1964, 8.

Figure 12: ICT Demonstration Team photo from ICT Magazine, 1964

By contrast, the picture of the 1970 ICL demonstration team, below, aimed to capitalize on the youth and sex appeal of the female operators.[72] Though only a minority of the team were attired in ICL mini-dress uniforms, those young women were deliberately placed in the photo's foreground. The larger number of team members who opted for the pantsuit uniform were placed at the back of the line. Rather than taking the photograph with the line of operators parallel to the camera's lens, the publicity image was orchestrated to highlight certain members of the team while others gracefully receded into the background. While the effect is obvious, the originating intention is harder to pin down. The all-male ICL upper management was not solely responsible for injecting sex-appeal into the mission of the demonstration team; the older woman on the right, the head of the demonstration room, was credited with choosing the white linen outfits and contrasting bright orange ICL scarves. Unlike the earlier photograph, the women in the 1970 team photo were not referred to by name, only as a group.

[72] *ICL News*, November 1970, front page.

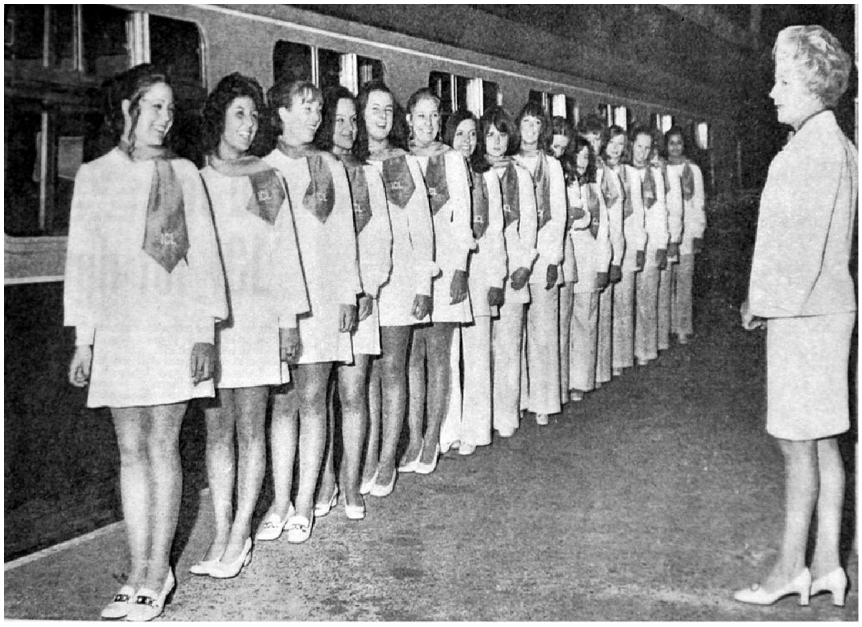

Figure 13: ICL Demonstration Team pictured in ICL News, 1970

Behind the polished images presented to the press and the public were those intended to be consumed only by computer company employees themselves, in slightly more informal, employee-produced magazines circulated within each company. Although these magazines did serve to keep employees up to date on product lines and the latest company endeavors, content within their covers was mostly freed from the constraints of presenting a controlled public image. In-house company magazines often gave expression to slightly bawdier or less flattering elements attached to computers and computer professionals, occasionally even mocking their own products, though more often mocking their competitors' lines.

These magazines were not immune to larger trends influencing the popular press, such as the desire to "sex up" imagery whenever possible. If anything, their limited readership allowed them greater freedom. A risqué 1964 cover of the ICT in-house magazine showed a woman wearing only the bottom half of a bikini while holding a

strategically-placed copy of the company magazine.[73] A fascination with women considered "exotic" by British standards meant that images of foreign machine installations performed a dual function within company magazines, colonizing hearts and minds at home as they showed British ingenuity structuring economies and bureaucracies abroad. An Ashanti operator in a tight, shiny dress, pictured working on a British computer in Ghana, was one of many images and stories in these computing magazines that represented the allure of the exotic, both economically and otherwise. The photograph was tangentially linked to the column describing British success selling computers overseas, particularly in former colonial and dominion countries.[74] Another cover in that magazine's run featured a glamorous close-up of a young Indian woman, who had recently joined the company as a programmer.[75]

Figure 14: ICT House Magazine Cover, July 1964

[73] *ICT House Magazine*, July 1964.
[74] "HOT Stuff in GOSO," *ICL Marketing*, 6 February 1970, front page.
[75] *ICT House Magazine*, February 1967.

Yet, the company magazines also gave voice to certain elements that were not present elsewhere. Images of soon-to-be-married punch girls decked out in punched tape for their "retirement parties" regularly adorned the marriage announcements page, providing a rare glimpse into the lives of young machine workers just as they decided to leave the workforce, either temporarily or permanently.[76] Few marriage announcements related that the new bride would remain at work in the company, and the announcements that did almost always applied to the few female programmers on staff, rather than the operating or clerical staff. Retirement and obituary columns showed that most women who remained in the lower-level, relatively dead-end jobs were not married, providing thumbnail sketches of the economic division present between married and unmarried women. Because pensions were based on the amount earned, lower pay for women also meant smaller pensions in their retirement, unless they inherited a husbands' pension.

Figure 15: Punched-Tape Dress at "Retirement Party," ICL News 1970

[76] *ICL News*, August 1970, 2.

The photographic representations of women in computing magazines in the 1960s and early 1970s were the successor to a variety of more informal representations of women in computing from the late 1950s and early 1960s. Many of these earlier examples showed cartoon representations of women. One interesting facet of these earlier cartoons was the way that they explicitly editorialized on the gendering of jobs, in a way that later photographic representations could not.

The cartoons were one of the few places, aside from trade union proceedings, where feminist sentiment about automation bubbled to the surface, commenting on women's place in the new, modernizing workforce. Sometimes the effect was subtle and could be read as largely comedic, as in the cartoon below, which pokes fun at stereotypical work roles. Not content to wait for the engineer, two female operators dive in to fix their machine. Upon arrival, the male technician is shocked and flummoxed by the topsy-turvy scene of operators taking more "technical" matters into their own hands.[77]

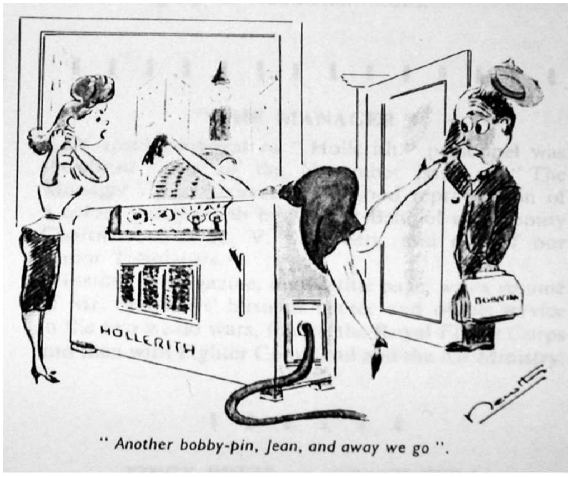

Figure 16: "Another Bobby Pin" Cartoon from the Magazine of the British Tabulating Machine Company, 1957

[77] *Tabacus: The Company Magazine of the British Tabulating Company*, January 1957, 13.

The cartoon seemed to presage the concerns presented by women trade unionists at their 1960 congress: "More trained technicians and technologists are required in this country and many girls are capable of qualifying for work of a technical character if given suitable opportunity," the women's congress of the TUC declared. Female high school graduates were not needed as untrained, "cheap labor but as qualified technicians."[78]

Another cartoon takes a more serious turn, wistfully criticizing the lack of job opportunity for women in fields where advancing professionalization had changed what was once the province of women workers.[79] Once computing started to become a more desirable field for young, career-minded men, the cartoonist implied, women would be left out, regardless of what they might be capable of, or what they might prefer. Indeed, as the computer industry, and the media used to represent it, graduated from line-drawings to slick photography in the 1960s, such uncomfortable ideas about the gendering of jobs largely disappeared.

[78] Women's Trade Union Congress, *Women Workers, Proceedings of 1960 meeting at Hastings,* 21-22, GB0152 MSS.292/4/12/pieces 1-17 Women Workers (Report of the Annual Conference of Representatives of Trade Unions Catering for Women Workers), 1953-1970, MRC.
[79] *Tabacus: The Company Magazine of the British Tabulating Company*, May 1957, 4.

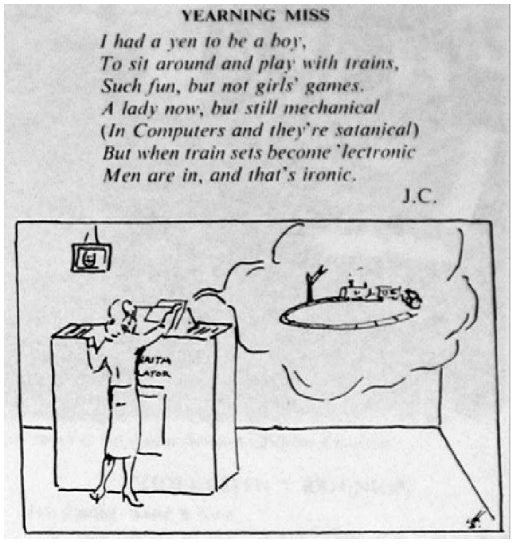

Figure 17: "Yearning Miss" Cartoon from the Magazine of the British Tabulating Machine Company, 1957

The 1962 Trades Union Congress meeting adopted a resolution on office automation "calling for a study of the problems connected with the widespread use of electronic machinery in offices during recent years," and arguing that there was a need for more training facilities for women to "fit them for higher-skilled work" in this area. Women trade unionists noted with alarm that young women were taking more vocational courses in school at the expense of math and science curricula, all but ensuring their fitness for only low-level office work. In 1964, the congress published a pamphlet called "In The Automated Office" to publicize and follow up on these recommendations, again stressing that the issue "is of particular interest to women trade unionists whose employment prospects will probably be more affected by mechanization than those of men."[80]

Yet, the resolutions passed by the close to 1.5 million members of the women's arm of the Trades Union Congress had little effect on the broader cultural discourses on

[80] Women's Trade Union Congress, *Women Workers, Proceedings of 1964 meeting at Folkstone*, 17-21, GB0152 MSS.292/4/12/pieces 1-17, MRC.

automation and gender.[81] A later article on computer training from another computing company magazine provided an uncanny coda to the cartoon above. Years later, the same gendered stereotypes and ideals touched upon in the cartoon and verse continued to resonate. An article entitled, "Terminals Beat All the Toy Trains," claimed that boys' natural interest in computing had to be carefully encouraged through education. Students at Eton College, an elite all-boys boarding school, had been given the opportunity to play games on a local university's ICL computer to get comfortable with the machine, and the photograph pictured three smiling boys around the age of twelve, standing near a paper-printout terminal, like the one pictured on Cathy Gillespie's IBM 360, reading the text output and typing responses.[82] As predicted, the computer had become the electronic train set for a new generation of young men.

4.7 Conclusion

As much as British industry and government sought a new style of meritocracy to define the modernized, increasingly industrially competitive nation that Britain sought to become, accidents of birth, in the form of age, class, race, and gender, heavily weighed upon who would become part of the technological elite and who would become drones in the different kind of workforce that Wilson's technological vision prefigured. The educational and employment practices that made it difficult for men of lower classes and income levels to become highly-paid, highly-skilled technologists like programmers and systems analysts, acted doubly on women of the same class and generation. Without even discussing these higher-level jobs, however, it is possible to draw distinctions between the fortunes of lower-level technologists. Male and female computer operators, for

[81] Ibid., 1.
[82] *ICL News*, November 1970, 8.

instance, though able to escape the class-based training requirements for certain other posts by leveraging an interest in a new technology, were nevertheless still subject to gendered assumptions that in many cases defined their career options.

The high number of women operators in the early decades of computing, far from contradicting stereotypes about women's work roles, actually grew from them. The feminization of prior white collar and mechanized office work led to hiring managers' early affinity for women operators alongside the new injections of bright young men. As operator jobs diverged into lower-level input jobs, with the advent of the inexpensive and widely-available visual display unit, and higher-level system administration jobs, computer operation similarly diverged into gendered subspecialties. Only the few women who had gotten into the field at a specific point in time and remained in it without interruption, like Cathy Gillespie, had a leg up in this process.

The particular cultural expectations of British computer manufacturers, advertisers, and publicists manifested in advertisements that initially took a feminized workforce for granted, and then gradually began to draw more and more attention to this feminized workforce in the service of specific advertising goals. So symbolically and economically potent was the young, female operator, that she was re-imagined for and within postcolonial and former dominion export markets, even though the jobs available in those countries often were seen locally as much more suitable for men than women, and were often given to men.

On the ground, the white heat of the technological revolution left untouched many discrepancies and inequalities of birth. Indeed, the equalizing effects of technological progress were largely lost on the echelons of workers that should have been helped by

them: the drudges; the workers doing messy jobs; or, those engaged in grindingly boring and repetitive work. One need only look at the quickly rising numbers of punch operators impelled into government and industry by new computing systems to see that society did not re-emerge from White Heat well on the path to a technological future where drudgery was reduced. The rapidly modernizing society that the Labour Party envisioned would reform all work along egalitarian lines never materialized.

The gains made by female operators from the 1950s began to disappear in the late 1960s and onward, as employers and policymakers began to place more and more hope in young men who would learn to advance the application of the new technology, and reconfigure the British economy with home-grown technological expertise. Beginning in the mid 1960s, computer operator labor became increasingly restive. An agglomeration of computer operator strikes, union renegotiations, and labor association meetings tasked specifically with solving the problem of growing inequality in the technology workforce muddied the image of a technological revolution in which egalitarian ideals were meant to have superseded older methods of determining workers' worth.

5. Automation in Action: Following the Computer Workforce through Economic Crisis and the Centralization of Government Computing, 1965-1970

> "I could not believe my luck as now I had a job in the government, the civil service, with brilliant prospects and it was a job for life. When I joined, we were taken to Kensington in groups of twenty and then had two weeks training."
>
> -Cathy Gillespie, hired as a computer operator in 1965[1]

> "The pay scale of the Senior Machine Operator is increasingly causing us unease…. Politically, we are sitting on a powder keg and something must be done as a matter of urgency…. It is out of proportion that these girls, academically unqualified compared with clerical staff, should so quickly be able to reach salary levels above those of Clerical Officers and even Executive Officers."
>
> -Executive Officer at government's Central Computer Bureau, 1969[2]

5.1 Introduction

In the late 1960s and into the early 1970s, the fruits of the "White Heat" of Labour's Technological Revolution remained economically uncertain and difficult to quantify. Vastly increased efficiency, for instance, was not uniformly indicated by the government's manpower studies on their own computing systems, but vast outlays on computing hardware and software continued apace.[3] (See Tables 3 and 4.) At the same time, the British computing industry required ever-increasing injections of government funding to stay competitive, in the form of grants, loans, and preferential government purchasing policy for civil service offices and the nationalized industries. In addition,

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[1] Cathy Gillespie and Ann Sayce (Government Computer Operators), Interview by the Author, 5 January 2006, London.

[2] C. W. Blundell, Letter to F.G. Burrett, Civil Service Department (CSD), 25 February 1969, STAT 14/2765 Review of Machine Operator Grades 1961-1970, TNA.

[3] Before a department could purchase a computer, the government required studies to establish the need for the computing system. Ideally, such studies would show a cost benefit, although the projected savings often fell short of the actual. Additionally, cost savings were not explicitly necessary: "Cost is not the only criterion on which ADP projects are judged and projects which do not show a positive present value… may be given Treasury approval if it can be shown that additional indirect savings will accrue, or that some operating advantage will be given…." Treasury, "ADP Projects: Notes for Guidance of Departments", June 1966 and November 1967, HN 1/60 Civil Service Dept., Policy and Planning, Ministry of Technology, Use of Data Processing in Government, TNA.

growing labor problems plagued the government. Their installations required an ever-increasing number of skilled computer workers (see Table 5), but in a field with hazy qualifications and no set career path, hiring and retention on the scale needed became increasingly difficult.

This trifecta of technological problems played out against the backdrop of a protracted economic crisis during the mid-to-late 1960s. From the 1950s on, Britain's gross national product had increased only slowly, far outpaced by the growth of the economies of its continental rivals. British military action in the Middle East, which took a stronger, past incarnation of the empire for granted, had badly hurt British commerce on the Suez Canal, compounding the problem. Meanwhile, former colonies and commonwealth trading partners increasingly turned to the United States for consumer goods. Attempts to reverse the poor trading situation, through technological modernization geared to increase production for both domestic and export markets, could not produce a quick or dramatic enough change in Britain's economic outlook.

By the summer of 1965, an economic crisis had sharpened enough to necessitate a government pay freeze, and an expenditure reduction policy that necessitated, among other measures, deferring computer purchases, unless they effected major reductions in civil service labor costs.[4] In November 1967 the pound had to be devalued against the dollar for the second time in under two decades, a move that failed to quell inflation or give British exports the necessary boost. [5]

An increasingly dissatisfied British labor force, stung by the economic situation, and unconvinced by Wilson's reassurances that "the pound in their pockets" remained

[4] T 224/900 Economic Situation 1965: Deferment of Expenditure On Capital Projects, Application To Computers, TNA.
[5] Dockyard strikes in 1966 and again in 1970 frustrated Britain's already-flagging export position.

sound, took both official and unofficial measures to try to secure the ever-improving standards of living promised by Labour. Computer workers, despite being the vanguard of Britain's new high-technology economy, were no exception. As early as 1965, computer industry workers struck fear into government ministers by taking strike action. International Computers and Tabulators Limited (ICT), the firm heavily favored for government data processing installations, saw its maintenance engineers go on strike for higher pay in 1965, a move that left ICT users in government and industry throughout the entire country scrambling to cope.[6]

Rather than giving the maintenance engineers what they wanted, ICT used professional workers from their management and supervisory staffs to take the place of the striking workers. ICT's action reflected a shift already underway towards making computer workers an integral, and ideally interchangeable, subsection of middle management. Later that same year, the Civil Service Clerical Association (CSCA) considered taking strike action to protest the use of such non-unionized ICT workers who were being brought in to run certain administrative computing installations in the central government.[7] Clerical unions, however, would see their power winnowed over the course of the computing revolution.

Within government, high-level ministers made plans to orchestrate broad changes in the public sector's workforce. Officials endeavored to migrate computing posts from being liminally white-collar, subclerical jobs at the bottom of the civil service professional framework the to the top. The rationale for these changes turned on not only the perception of computing as an increasingly important and complex field, but on an

[6] *Times* (London), "Computer Strikes to be Escalated," 18 June 1965.
[7] STAT 14/3239 Strikes, Effects on HMSO and Emergency Arrangements to Alleviate Disruption, Computer Maintenance ICL/Asset Dispute, TNA.

understanding of computer systems as management tools. Such tools required a "high caliber of systems man" who would combine his technical knowledge with a concern for the broader management picture, and operate in a different milieu than current computer workers. Yet such professionals would be hard to find and keep in the civil service, as a result of the dead-ended nature of computing work there. Despite the job security offered by government posts, "those who have a real flair for it could well see their opportunity outside rather than inside the civil service," warned one minister.[8]

During much of the 1960s, the career ladder and composition of the government's data processing workforce remained relatively constant. The introduction of large numbers of electronic computing installations in place of older electromechanical tabulating and calculating machines, a dramatic technological systems change, did little to alter the workforce currently in place, or the hiring patterns that sustained it. Against the wishes of some government ministers, young, female, and often part-time machine operation staff, who also did programming, continued to be employed. In part this was because of financial concerns and a history of feminization in office machine work, but change in the government's labor force was also delayed because the computing jobs available at this point lacked any outlet into a career structure within the civil service, making it difficult to recruit higher level workers.

Only with strong intervention throughout the 1960s from the highest levels of the civil service did the computing workforce begin to transform by the decade's end. Even so, these changes primarily affected high level workers, who were not drawn up from lower computing positions but moved into the new field from executive positions. Rather

[8] C. R. Currie, Ministry of Agriculture, Letter to W. R. Atkinson, Management Services Computers Division, CSD, 9 July 1970, HN 1/22 Report on Development of Computers in Government: Forecast for next ten years 1969-1971, TNA.

than promoting from within the ranks of workers already performing operating and programming work, non-technical management workers were brought in and trained to be practitioners and supervisors in the field. The government's rationale for remodeling this workforce illumines a situation fraught with growing rifts between workers of different classes and genders, despite the government's public campaigns that suggested the state aimed at eliminating these divisions. These labor changes also highlight a transition away from understanding administrative computing in a primarily technical sense, and towards viewing computers as tools that could fundamentally change the government's ability to manage, organize, and even conceive of new tasks.

5.2 The Growing Pains of a Technological System and its Reluctantly Professionalizing Workforce

In 1965, the government undertook a survey of all computer installations in the various departments of the central government. These numbers did not include computers in the sprawling National Health Service, local government, the nationalized industries, or the university system. The survey found that the central government's forty-five administrative (as opposed to scientific) computers had an estimated capital cost, including equipment rentals, of £8.5 million, with an additional seventeen computers on order for installation within the next two years, at a cost of £5.66 million (£4.5 million of which was to be spent on British products). An additional sixty computers were to be installed within the next five to seven years.[9]

By 1968, however, there were roughly a hundred administrative computers in government, with nearly that number again for scientific computing, and dozens more on

[9] Her Majesty's Stationery Office (HMSO), "List of Government ADP Projects," 1 January 1965, STAT 14/3093 ADP installations in Government in 1965 and Staffing, TNA.

order.[10] Contrary to forecasts made just three years earlier, more than a hundred computers over the number originally estimated necessary were ordered by 1970, making the hardware of government systems valued at more than £41 million by the decade's end.[11] Indeed, the central government was one of the largest computer users in the country; by 1970, they used 5 percent of all of the nation's computers.[12]

Although the British government had initially sought administrative computing systems that would either reduce the number of staff needed, or effect a long-term cost savings, many departments quickly found themselves in a position where computing installations were necessary not simply to do work more efficiently, but to be able to do the kind and volume of work required at all: "The number of cases in which expenditure on a computer can be regarded as an alternative to expenditure on staff does not now seem to be great," wrote one minister in response to a request for a study on computers' staff cost savings.[13]

5.2.1 Changing Labor Patterns and the Rise of the 'Computer Men'

In 1958, when the first administrative electronic computers were installed in government for "processing large blocks of what had been clerical work," the staff representatives were chagrined by the government's estimate that between 5,000 and 10,000 staff redundancies would result in the next five to ten years. In their own words, they observed growing computerization of work processes "with not a small amount of

[10] "ADP Staffing and Projects", HN 1/67 Consultation with Civil Service Staff Association about Automated Data Processing (ADP) 1968-1971, TNA.
[11] United Kingdom, *Parliamentary Debates* Commons, 5th ser., vol. 787 (1969), col. 361w.
[12] "Down Among the Datacrats," *Civil Service Opinion* 48, no. 557, February 1970, 54, HN 1/67, TNA.
[13] W. S. Ryrie, "Computers", 9 May 1974, T 316/308 Investment Appraisal for Government Computer Projects 1971-1974, TNA.

trepidation."[14] Job loss was not their only concern. The prospect that better jobs might be outsourced to computing companies prompted civil servants to push for better training and demand that government employees be given all responsibility for the new machines, from operating and programming to maintenance and repair.

This problem was ameliorated, and clerical union backlash avoided, by focusing the redundancies in the feminized machine grades of the Machine Operator Class.[15] Redundancies became largely invisible as a result of high turnover. Yet some officials complicated the picture by asserting that the composition of the machine grades should change in concert with the changing technology. One government official wrote of his department in 1959:

> "Our accounting installations are operated by female staff, and with the continued development of ADP [Automatic Data Processing] we are not at all happy about future staffing prospects. We are finding that, with the acquisition of more complex equipment, it is becoming increasingly difficult to maintain a satisfactory standard of operator and we have therefore under consideration the introduction of male operators into our accounting installations with a view to building up a more reliable core of expertise."[16]

As early as the late 1950s, government documents began to sketch out desired changes in the civil service computing labor force, discussing in detail how to re-professionalize certain computing jobs and in the process elevate "computer men" into the executive structure.[17] The first step in this process was to reshape the current clerical

[14] "Notes of a Meeting between the Official and Staff Sides," 21 December 1959, HN 1/16 ADP Staffing Problems Other than Shift Working 1956-67, TNA.
[15] "Introduction of Computers as a Cause For Redundancy," 1961-62, T 216/710 Redundancy Owing to the Introduction of Computers, TNA.
[16] A. J. Long, HMSO, Letter to N. E. A. Moore, Treasury, 11 December 1959, T 222/1323 Demonstration of Electronic Computers to and Consultation with Civil Service National Whitley Council and Staff Associations about Introduction in Government Offices 1959-60, TNA.
[17] *Times* (London), "The World of Management, Computers: For the Want Of A Man…", 29 January 1968, clipping, STAT 14/3484 Central Computer Bureau Organization and Staffing; J. D. W. Janes (Organization

structure, through installing new data processing systems and trimming redundant staff from the new system. Unexpectedly, the new systems instead resulted in a strong, steady rise in the data processing labor force by the mid 1960s.[18] Forecasting of labor requirements through the early 1970s indicated that the labor pool required for government computing would continue to steadily rise as "projects not yet approved and not yet identified" continued to be developed in conjunction with "technical developments which will widen the range of applications" for computers in government.[19] (See Table 5.)

By 1961, specially-designed ADP aptitude tests were used for machine operator hiring, with an eye to finding not just good operators but potentially good programmers as well. A 1962 overview of government computing policy reported that the government aimed to recruit most programmers from the ranks of the 70,000 workers within the Executive Class, the middle-management class of workers with A-level secondary school training, but not the university training of the higher Administrative Class nor any particular skill set commonly associated with early programming expertise.[20] The Executive Class ideally dealt with long-term departmental goals and the development of processes for greater efficiency. "It was early decided that for most programming of clerical operations one did not need graduates in mathematics or other knowledge of

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and Methods Division, HM Treasury), *Observer Weekend Review*, "The Computer As Bureaucrat," 18 February 1962, clipping, T 216/710 Redundancy Owing to Introduction of Computers 1961-1962.

[18] Treasury, "Government Statistical Services Advisory Committee on Computers," 31 August 1967, Appendix E, HN 1/16, TNA.

[19] Ibid., 5.

[20] Executive Class workers were a step above the 200,000 Clerical Class members, and in the opinion of this report's author, two steps above the 25,000 or so workers in the Machine Operator Class—an interesting assessment, given that machine operators often took umbrage at the notion that they were on a par with lowly clericals, who had no particular technical expertise nor the salary allotments that rewarded special skills. The author, however, rightly associates Machine Operators with feminized labor, and therefore understands their position as an "ancillary technical class," likening them to the Typing Grades, the lowest class of clerical workers.

professional standard, but a reasonable level of intelligence and certain aptitudes," explained the author, an organization specialist in the treasury.[21] Management potential, and a broad understanding of the workings of government agencies, were the key qualities.

Meanwhile, initial feelings that "the operation of computers was expected to be similar to that of punched card equipment and thus proper to SMOs [Senior Machine Operators]," gave way to the idea that computing jobs were too complex and required too much training to warrant continuing to train and use the feminized labor of the Senior Machine Operator grade.[22] "Although a number of staff currently graded in the MO (Machine Operator) class are demonstrably suited to be computer operators, it must not be assumed that all machine operators capable of traditional responsibilities for that class have in fact 'operating' ability," hedged one 1966 report, supporting the idea that Machine Operator recruitment tactics should change, without specifically saying why, or how much.[23]

5.2.2 From Tabulating to Computing: Elevating the Programmer

The need to get and train more computer operators, system analysts and programmers encouraged a reappraisal of the machine grades. Particularly, the labor market shortages that made programming work more highly paid than the usual machine operator posts played a role in changing management expectations of what types of staff should be programmers. By 1959, the CTI re-evaluated its staffing methods in conjunction with the installation of a new electronic computer. Although Senior Machine

[21] J. D. W. Janes, Treasury Organization and Methods Department, "Electronic Computers 'Oil' the Wheels of Government," June 1962, 11, T 216/710, TNA.
[22] Treasury, "Advisory Committee on Computers," 1-3, HN 1/16, TNA.
[23] UK Atomic Energy Authority (AEA), "Computer Operations Staffing: Note by the London Office" 28 September 1966, AB 46/16 Authority-wide Computer Operations Staffing, 1965-1969, TNA.

Operators had previously done all programming work, more expensive and complex machinery had engendered an expectation of higher wages and more responsibility. As the machine took over progressively more and more complex work, the directors in charge of the CTI decided to bring in Executive Officers for programming work, instead of continuing to operate with Senior Machine Operators doing programming.

The problem, however, was that no Executive Officers in the civil service, at least among those available to transfer to CTI, had any of the necessary programming experience. The Executive Officer put in charge of the new operating section for the electronic computer at CTI, was "new and inexperienced. For the next six months we must regard him as under training," stated one supervisor in the CTI minutes log. The second Executive Officer they planned to add to supervise this section was no better: "He too will require a long period of training and 'running in'." While these new Executive Officers were under training in the posts, the programming work would continue to be done by a Senior Machine Operator already in the job, described as having "a good brain and a special flair for this type of work."[24] The new Executive Officer would "need assistance from the SMO on programming and she will be responsible for setting up and testing programs on the electronic calculators." Rather than "upgrading her post" to Executive Officer level, she was temporarily given a bonus plus "the normal allowance for more difficult SMO work." Eventually, after a period of doing all the programming and helping to train her replacement, the Senior Machine Operator would be demoted to an assistantship position under her former trainee: "We can leave the SMO on programming until the supervisory EO [Executive Officer] recommended for

[24] Minutes, 20 April 1959, STAT 14/2320 Accounts Division: Combined Tabulating Installation Staff Inspection Report 1958-1959, TNA.

[programming] in our report is fully trained, say nine months, and then replace her with an EO… The SMO will eventually become an assistant to the EO on programming work."[25]

In contrast to the candid and specific minutes in these records, the formal report on the new training and staffing practices stated that none of the current Machine Operators and Senior Machine Operators in the CTI were of a high enough "caliber" to be used for programming. The idea of trying to recruit women who might be more suitable, such as the "intelligent grammar school girl" was nixed on the grounds that these applicants would not be happy with the dullness of lower-level machine work, like punching, that the jobs would require of new women recruits, but not of men.[26]

The decision taken in the late 1950s and early 1960s to ideally recruit and train programmers only from the higher-powered and more prestigious Executive Officer grades quickly ran into difficulties however. As intimated in the exchanges in the minutes of the CTI, implementing this policy was easier said than done. On the ground, Senior Machine Operators and Machine Operators had the operating and programming experience for these posts, not Executive Officers. The management abilities that Executive Officers were to bring to these computing posts could only go so far in preparing them for the technical aspects of the work, which required a different set of skills and training. These deficiencies became a major problem as the amount of time that it took to find and train suitable Executive Officers for these technical posts became an increasingly precious commodity. The treasury's Technical Support Unit, eventually handed over to the Ministry of Technology, provided high-level support for the

[25] Minutes, 20 April 1959 and 20 May 1959, STAT 14/2320, TNA.
[26] Combined tabulating installation (CTI), "Report: Staff Inspection," STAT 14/2320, TNA.

government's computing centers. Even this unit, however, only consisted of thirty professional engineers in 1965, many of whom came from the post office and had no prior experience in computing or in programming. "On the face of it this looks like a staggering underestimate of the importance of the highly specialized and complex software side of things," quipped the *Times* of London, though "it may, however, simply reflect the difficulty of finding experts in this field," conceded the author.[27]

In the face of these difficulties, the CTI and other government computing installations attempted other recruiting and training tactics. The pay scales offered, hindered by the government's pay freeze, were not competitive with industry. Under these circumstances, moving to a new office location to undertake training for a strange, new field was an unattractive option for many workers. In 1964 and 1965 the programmer shortage became so acute that the government began to make more concessions, while still confining calls for programming trainees to the higher grades of the service. After their first call for applications met with little success, they reissued it, adding assurances that applicants who "did not make the grade as programmers" would be allowed to return to their previous posts: a procedural nightmare, and a plan that would potentially waste thousands of pounds on training unsuitable candidates, but an apparent necessity in coaxing people to apply. They also decided to add a paragraph describing what a programmer actually did.[28] Lastly, they lowered the minimum age for promotion to the Executive Class from twenty-eight to twenty-five.[29]

[27] *Times* (London), "Ministry of Technology in Computer Business," 20 October 1965.
[28] Memorandum from Drake to Shipton, 20 May 1965, LAB 12/1471 Policy Considerations on Recruitment of Programmers and Computer Operators, TNA.
[29] T. H. Caulcott, Treasury Circular, 12 March 1965, LAB 12/1471, TNA.

Recruitment literature and job postings also began explicitly saying that these positions were "suitable for women" as well as for men.[30] Unfortunately, the lack of a programmer career ladder in the civil service tended to scare women away from the jobs just as effectively as it had men. In addition, women made up only 8 percent of the Executive Class.[31] As such, their inclusion in these job postings did little to enhance the pool of potential recruits. In an ironic twist, the government even considered "a proposal to widen the eligibility of Senior Machine Operators for promotion to the Executive Class, and hence for ADP [programming and systems analyst] work," instead of simply recruiting and training members of the machine class for programming in their current positions.[32]

One civil service executive in charge of finding programmers pointed out that suitable programmers were not likely to be forthcoming because of apprehension, particularly among higher grades in the service, that volunteering for such work would stall their careers: "There is a fear among staff… of getting in a 'backwater'" he pointed out, adding that assurances should be offered to potential applicants: "could we say that once on programming an officer is not likely to remain in this work for the rest of his career?"[33] Another report noted that the requirement of shift work scared away the workers the government wished to hire, since "shift work may also be seen by the machine operators as being associated with the 'working class' employee."[34] The gender and class intimations of machine work, along with a fear of the unknown, combined with

[30] J. Bruce, Note, 25 May 1965, LAB 12/1471, TNA.
[31] "Career Prospects for Women Civil Servants," *Civil Service Opinion* 48, no. 557, February 1970, 52, HN 1/67, TNA.
[32] Caulcott, Treasury Circular, LAB 12/1471,TNA.
[33] Minutes, 30 June 1965, LAB 12/1471, TNA.
[34] P.R. Bixby, Chief Scientist of the Royal Air Force, "Recruitment and Retention of Machine Operators," November 1967, 5, AIR 77/384 Recruitment and Retention of Machine Operators, TNA.

the uncertain career prospects of the jobs to frighten higher-level workers away throughout the first half of the decade.[35]

One impractical idea floated to reverse the situation required all clerical workers to do a "tour of duty" of two years at a government computing installation in order to "create an ADP career grade within the civil service." From there, more "individuals could be recruited initially as machine operators, and be provided with a full career within this field," courtesy of the career outlets in the new ADP grade. As "probably the largest single user of computing resources in the country," some within government thought this course of action might effectively end their computer labor problems.[36] The unwieldiness and difficulty of implementing such a plan, however, kept it on the drawing board.

An easier solution was to revise downwards their expectations for computer staff in this time of near-critical labor shortage.[37] Having A-level qualification in mathematics was no longer a requirement.[38] The ADP aptitude tests that the service had implemented a few years earlier, in order to separate out executive and clerical officers with computing potential, were deemed too difficult, and as a result, imprecise. Worried that they were "wasting talent" by turning away those unable to pass the tests, the Civil Service Department, which was in charge of staff oversight at the broadest level, suggested ignoring their results.[39] Increasingly, departments adopted a "train-and-see" attitude for officers they wished to make into computing professionals. These measures eventually

[35] In this round of calls for programmers, recruits were accepted from Clerical Grades 3, 4, and 5. By decade's end, only pensioned recruits from Grade 6 were accepted. LAB 12/1553 Shift Working Of Computer Operators: Applications For Vacancies And Other Papers 1966-1969, TNA.
[36] Bixby, "Recruitment and Retention," 49, AIR 77/384, TNA.
[37] *Times* (London), "Urgent Need for Computer Training: Burden Must be Taken from Manufacturers," June 30, 1965.
[38] Shipton, Minutes, 8 June 1966, LAB 12/1471, TNA.
[39] HN 1/62 Central Computing Agency, Papers of Origin, TNA.

helped get more Executive Officers into operating positions: by 1968, roughly a third of all operators came from the Executive and Clerical Classes, instead of the machine grades.[40]

During the mid 1960s, however, the intense labor shortages and economic turmoil in the country at large sometimes pushed broader concerns about shaping a reliable, professional, career computing class in the civil service to the back burner. As the government struggled to computerize as quickly as possible, the theory of an all-executive programmer class did not always translate into reality. Indeed, as late as 1967, the CCB noted that they were "pleased to see that the quality" of their "girl trainees" was "still very high," and they began to send larger and larger complements of operators from the machine grades for programming training in NICOL (Nineteen Hundred Commercial Language) a language developed by the British computing company, ICT, for programming their 1900 series of large mainframe computers. NICOL was a subset of PL/1, an imperative computer programming language designed for business, scientific, and engineering applications. At the same time, the CCB sent several Executive Officers for COBOL training.[41] CCB management could only hope that both groups of trainees would stay long enough to give a return on their investment.

Into the mid 1960s, many departments regarded programming as appropriate work for higher machine operator posts, a logical progression from lower level machine operator work.[42] 70 percent of the workers in the machine grades worked in computing

[40] July 1968, HN 1/67, TNA.
[41] Central Computing Bureau (CCB), "Steering Committee Meeting Report," 8 June 1967 and 5 June 1968, STAT 14/3303 Shift Working Of Computer Operators: Applications For Vacancies And Other Papers 1966-1969, TNA.
[42] Treasury, "Machine Grades: Notes of an Interdepartmental Meeting," 8 May 1964, STAT 14/2765, TNA.

installations.[43] Aptitude testing for programming posts proved an unreliable measure of recruits' future success, whereas familiarity with the departmental installations tended to produce programming trainees more easily.[44]

5.2.3 The Trouble with Turnover

The government's labor problems did not end with getting high-level recruits into computing jobs. The government lost ADP staff in 1968 to 1969 at a rate of 9 percent (not including resignations for marriage), while the staff loss rate of men in the executive ranks of the civil service was only around 1 percent.[45] By 1970-1971, computer operator losses in the government's Central Computing Agency (CCA), the successor to the Central Computing Bureau, were an astounding 17 percent. Yet only 20 percent of these losses were due to marriage. Most left either to take another ADP position or to transfer to clerical work, which had a clear-cut career structure and promotion ladders with higher end points.

High turnover, long associated with feminized grades staffed by young women, became even more of a problem in the competitive, and by the 1970s, mostly male classes of systems analysts and programmers. Among programmers, a mere 5 percent of the total resignations that year, and roughly 10 percent of the total resignations for the next two years, were for marriage.[46] Meanwhile, Executive Officer programmer trainees often looked for better jobs in industry after as little three to six months after being hired by the government. While senior programmers did not have a high turnover rate, junior programmers and systems analysts, who were mostly men, resigned at a rate of close to

[43] D. W. G. Wass, Treasury, Confidential letter to P. W. Buckerfield, HMSO, 14 June 1963, STAT 14/2765, TNA.
[44] "ADP Staffing and Projects," July 1968, HN 1/67, TNA.
[45] "Losses of ADP Staff," 1971, HN 1/62, TNA.
[46] Ibid.

40 percent in 1970, often finding better-paid jobs in industry after taking advantage of civil service training programs. One department was said to have had all of its Executive Officer trainees resign immediately after completing superficial training in a high level programming language.[47]

In 1967, an Air Force report on computing noted that their mostly-female workforce had served them well during periods where careers for computer operators and programmers were not easily found in the civil service. At this point in time, however, they felt a change was necessary to bring them into line with new ideas about computing within the civil service: "The majority of other organizations considered during this investigation recruit young men as machine operators," and in order to groom computing professionals, "they offer a complete career to such people." The report notes this trend is due to a widespread presumption that bright young men are needed in the field, "because it is felt that the computer field generally is a young man's domain…. The young man seems to represent the "best bet" if career opportunities and financial rewards are satisfactory." The report goes on to point out that "if, on the other hand… machine operators are required who have no career ambitions and simply want to earn a bit of money, then the best bet is the middle-aged married woman."[48]

Though women had attained equal pay in the clerical grades of the civil service by the late 1950s, the persistent division of "machine" and "clerical" work perpetuated the legacy of the feminized grades excluded from the Equal Pay Act for civil servants. Even within clerical work, different promotion tracks operated.[49] In industry, untouched by any

[47] "Down Among the Datacrats," *Civil Service Opinion* 48, no. 557, February 1970, 42, HN 1/67, TNA.
[48] Bixby, "Recruitment and Retention," 48-49, AIR 77/384, TNA.
[49] Several women civil servants complained that workers were not allowed to accrue seniority in the same fashion when they were in the excluded grades, as there were two different seniority scales kept for the

equal pay legislation until 1975, the discussion of women workers' wages and roles was often more candid throughout the 1960s. In 1965, the chief accountant of Bibby and Baron Ltd , the largest paper bag manufacturer in England, wrote a series of articles on how office managers could wring the greatest efficiency from their workers at the lowest cost. In it, he explicitly pointed out that women were lower cost workers who often performed equally well as men, and as such were bargains for the efficiency-minded employer:

> "Equal pay for male and female workers is unlikely to be accepted by industrial concerns until the claims of female workers are combined in a union movement or the supply and demand warrants it. Meanwhile, because female clerks can be obtained at a cheaper price than males, and may be just as good if given the same opportunities and training, it should be your policy to employ them wherever possible."[50]

Likewise, he suggested that married women, long seen as less reliable labor, were becoming a better economic investment than single girls, who were often on the lookout for better job prospects and were generally more mobile, willing to move and switch jobs for higher pay or greater benefits.

Up until a hiring sea-change in the late 1960s, the civil service's computing needs were still met by workers who, in the main, did not travel up a full career ladder. The Air Force report rightly notes that the situation must change: "It has become quite clear during the course of this investigation that unless some considerable improvements are made to both career prospects and salary levels of the machine operator… then the

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excluded grades and the clerical grades, and most of the promotional outlets were available in the latter category. They wished to integrate the two job categories, have a common seniority list, and, critically, allow men to take up excluded grade posts and promotions as well as women. Letters from Transport Salaried Staffs Association to the Secretary of the British Transport Commission, 18 July 1961 and 15 July 1963, AN 171/398 Equal Pay, Equal Work: Shorthand Typists and Machine Operators, TNA.

[50] J. B. Archer, "The Office Manager's Guide to Greater Efficincy at Lower Cost, Part 6: Staff Problems, Interviews, Wages," *Office Magazine*, December 1965, 1020.

recruiting and retention situations which exist at the centre at the present time is unlikely to improve."[51]

Government research carried out in punching rooms in 1969 approached one subset of the computing turnover problem from a different perspective. The lack of career avenues available to punchers, whose "work has clerical content but is also mechanical, repetitive and soon becomes boring," is noted, but better career prospects are not put forward as a solution to high turnover in this case. Since punching was not a field into which management felt a better standard of worker could be enticed, nor one whose applicants were seen as capable of greater contributions, the report focuses on the role of physical plant problems in these high turnover jobs.

The authors conclude that the primary problem is the habit of treating punching locations as factories rather than office environments. The noise level in the punch rooms they investigated was eighty-four decibels, high enough to cause hearing loss.[52] Normal levels of office noise were independently estimated to be between forty-five and fifty decibels.[53] Meanwhile, the post office considered seventy-seven decibels to be an acceptable standard.[54] The size and layout of punch rooms, often containing several hundred workers and doubling as a pathway to the machine room, negatively affected the "high degree of concentration [that] is necessary to work with speed and accuracy" and

[51] Bixby, "Recruitment and Retention," 48-49, AIR 77/384, TNA.
[52] Prolonged exposure to noise at or above 85 decibels is currently understood to cause gradual hearing loss, according to the US National Institute on Deafness and Other Communication Disorders.
[53] D. O. Hagger, "Management of Data Preparation Staff," 20 December 1971, para. 8, HN 1/25 Management Issues Arising from Introduction of Data Preparation Work 1970-1979, TNA.
[54] Charlotte Robinson and Colin Cave, Offices Group, Directorate of Building Development, Dept. of the Environment, "Report on Noise and Some Other Environmental Aspects in Data Preparation Rooms for the Inland Revenue," April 1970, 5, HN 1/25, TNA.

the "rigid layout, high noise levels, and lack of amenities gave the impression of a factory rather than an office environment."[55]

Lowering the noise levels in punching rooms and adding simple amenities like carpet not only to produced more accurate work but also lowered the illness rate by 37.5 percent and the turnover rate by as much as 47 percent according to one study.[56] Making nurseries and childcare available further reduced turnover. Attempts to enhance efficiency without regard for worker comfort, such as moving punching staff around to different computing installations depending on fluctuating workload, tended not only to fail from an efficiency standpoint, but to increase turnover. "If all punch operators in the UK went on strike for better working conditions and more pay, the data processing business would be in a sorry state" the report warned, attempting to elevate the importance of the lowest staff in the data input chain.[57]

5.3 Labor and Computing at the Central Computing Bureau: Integrating Computer Workers

The government's Combined Tabulating Installation (CTI), a centralized data processing bureau for payroll and other clerical and administrative tasks, changed over gradually to electronic computers in the late 1950s and early 1960s. In 1965, the CTI changed its name to the Central Computing Bureau (CCB) to reflect its changing methods, and in 1968 the new CCB re-located to a larger location outside of central London. Nearly one hundred of the female staffers in the CTI, who comprised the bulk of the workforce in machine operation, carried over with ease into the new, improved

[55] Ibid., 5-11.
[56] Hagger, "Management of Data Preparation Staff," para. 24, 42-44, HN 1/25, TNA.
[57] HN 1/25, TNA.

CCB.[58] Barely a year later their number had almost doubled.[59] Nonetheless, a desperate search was concurrently being conducted for six Executive Officer programmers, three Executive Officer operators, and seven Executive Officers for systems analysis and training.[60]

The CCB handled payroll for all of the central government, as well as other accountancy functions. Between 1966 and 1968, the computing staff at the CCB increased more than fourfold, and still more operators, programmers, and data input staff were needed.[61] The Bureau's primary machines were an ICT 1904 computer and a Univac (Sperry-Rand) 1004 Data Processor. The ICT 1904 used 24-bit words made up of 6-bit bytes that could be represented in octal notation as opposed to the IBM System/360 which used 8-bit bytes represented in hexadecimal, which was quickly becoming the standard. It usually came installed with 16 kilobytes of memory, with four to eight megabytes of removable disk memory. Input and output were done on 80-column cards, paper tape, and line printers.

By 1972, when the CCB again changed its name, to the CCA, the staff had doubled again from their 1968 position, now 800 strong, and the total budget for the agency's two computing bureaus was £42.5 million. Less than a quarter of this outlay was spent on staff, whereas in the civil service as a whole, staff costs formed the

[58] Sixteen Senior Machine Operators (SMOs), thirty-seven Machine Operators (MOs), and forty-five Machine Assistants (MAs) carried over from the CTI to the CCB. The CCB continued to advertise for "women punchers" throughout the sixties, self-consciously reproducing the feminization of data input. Minutes, 19 April 1966; Rex Affolter, "Authorized Complement of Central Computing Bureau," 14 April 1966; and, Establishments and Organization Division, "Development of Central Computing Bureau, Complement of Machine Grades," October 1966, STAT 14/2727 Progress Reports on CCB, 1961-1969, TNA.
[59] 31 SMOs, 48 MOs, and 103 MAs worked at the CCB by October of 1966. Establishments and Organization Division, "Development of Central Computer Bureau," October 1966, STAT 14/2727, TNA.
[60] Minutes, 19 April 1966, STAT 14/2727, 1961-1969, TNA.
[61] STAT 24/2727, TNA; STAT 14/3093, TNA.

government's largest expenditure.[62] From 1965, when the CTI reorganized as the CCB, through the early 1970s, the civil service hired computer workers at a faster pace than any other category of staff. Dozens of "girls" were hired each month at the CCB for both punching and computer operation, to make up the necessary staff complement and replace loss from turnover.[63] In isolation, the example of the CCB seems minute; but this agency functioned as a microcosm of the changes underway throughout the civil service, changes that affected thousands of workers directly, and close to a million civil servants through indirect means.

The pressing need to quickly hire and train large numbers of computing workers and the concomitant shortage in the nascent field created a temporarily beneficial situation for the feminized machine grades. The staff in Machine Operator posts had begun to fall out of favor in the early 1960s, as departments grew to view certain computing jobs, especially programming, as needing a different, and better, class of workers than those civil servants who had traditionally held them. Yet, in 1962, when these ideas about Executive Officer responsibility for computing were still only a few years old, a related movement was afoot in the opposite direction. The Civil Service Alliance lobbied the ministers in the treasury and other departments to formalize a promotion structure that allowed workers from the machine grades to compete for posts in the Clerical Class and Executive Class. Although this was technically possible, it was almost unheard of for supervisors in the machine grades to be chosen for promotion to non-machine grade positions.

[62] HMSO, "Estimates 1972/1973 Computers" and "ADP Common Services, Organization and Articulation," 11 February 1972, 1, HN 1/15 Setting up of the Central Computer Agency, TNA.
[63] STAT 14/3604 Central Computer Bureau 1968-1972, TNA; STAT 14/3303, TNA.

The plan was proffered in response to worker wage dissatisfaction and the inability of women to rise into higher posts after a relatively quick period of meeting the requirements for the two available Machine Operator promotion grades in the few years after they were hired. The ensuing argument between Her Majesty's Stationery Office (HMSO) and the treasury, among other departments, revisited contentious issues dating back to the granting of "equal pay" in the civil service, primarily the idea that the nature of the work done by the machine grades was materially different, in a negative way, from clerical work.

The Machine Operator Class was limited to three grades: Machine Assistant, Machine Operator, and Senior Machine Operator. In theory, a Senior Machine Operator could be promoted into the Clerical Class or the Executive Class, becoming a Higher Clerical Officer, or an Executive Officer, but in practice, such promotions were "virtually theoretical."[64] In part, this was due to the fact that the numbers of Clerical Officers in line for promotion were far greater than the posts available, and Clerical Officers were favored over members of the machine grades, owing to a pervasive belief that "in practice the Senior Machine Operators are rarely found to be suitable for this kind of promotion."[65] Posts with greater responsibilities and management duties that would require supervision over men as well as women workers remained unlikely outlets for promotion from feminized grades.

The clerical workers' alliance attempted to rebut these contentions by arguing that "the SMOs' duties have become of higher quality generally" with the introduction of more complex equipment. Pointing out that the Senior Machine Operator grade was more

[64] Treasury, "Notes of Confidential Interdepartmental Meeting," 28 May 1962, T 216/710, TNA.
[65] D. W. G. Wass, Treasury, Letter to W. Donaldson, HMSO, 25 April 1962, STAT 14/2765, Review of Machine Operator Grades 1961-1970, TNA.

broadly used now than originally envisioned at its creation in 1948, the Civil Service Alliance noted that many Senior Machine Operators had supervisory responsibilities and did work similar to Clerical Officers. Civil service clerical unions with increasingly larger proportions of women members, an artifact of labor shifts in the civil service as a whole during the 1950s and 1960s, resented that Machine Operators were still consigned to a lower pay scale than Clerical Officers as a result of the non-equal civil service equal pay act of 1954.

While the government admitted that "no one would deny that machines have developed and become susceptible of being used in increasingly complex processes," they maintained that "it is questionable whether these changes themselves necessarily enhance the quality of the Senior Machine Operator job," even as they agreed to proficiency allowances for increased output and bonuses for Senior Machine Operators who were in charge of supervising other staff, and bemoaned the fact that losing Senior Machine Operators to the Clerical Class through "promotion out of the machine grades would represent a loss of a particular talent" that they desperately needed in their computing installations.[66]

While the Treasury Operations and Management division, supported by several other departments, "thought that machine grades on ADP work should have better career prospects than the present structure afforded," almost none of the department heads believed that career prospects should take workers out of the machine grades by elevating them to the Clerical or Executive Class.[67] A compromise was suggested of adding a higher, Chief Machine Operator grade. In practice, several departments already had Chief

[66] Wass, Letter to Donaldson, 25 April 1962; Treasury, "Notes of Confidential Interdepartmental Meeting," 28 May 1962, T 216/710, TNA.
[67] Treasury, "Notes," 28 May 1962, T 216/710, TNA.

Machine Operators, but these promotions were few and ad hoc; it was not an official civil service-wide grade. Where employed, Chief Machine Operators earned the same as Higher Clerical Officers, a supervisory grade that required management and organization skills. The suggestion of making the Chief Machine Operator grade official, and more widespread, meant that machine grade workers would do more supervisory work, while still being contained within the technical, rather than more prestigious executive or clerical branches of the service.

The Chief Machine Operator grade could have elevated Machine Operators significantly, as these posts were currently on par with Executive Class posts in terms of pay and responsibility. Yet, the new Chief Machine Operator grade under discussion would not be paid as much as the old, ad-hoc Chief Machine Operator positions. The treasury's rationale that "it might be appropriate to fix the [potential new] Chief Machine Operator scale a level rather lower than the present one," nominally turned on the idea that the quality of entrants into the new grade would be a cut below the few ad-hoc Chief Machine Operators currently employed, but it was also another way of making sure that machine grade workers would still not be able to easily transition out of their class and into the Executive Class.[68] After all, the main point of adding a standardized, service-wide Chief Machine Operator grade was to keep valuable machine staff from leaving machine work.

Employing ever more aptitude tests for machine grade entrants, departments tried to figure out who would make good programmers and computer operators, and who would be "likely to be more suitable to punch operating." Many punchers seemed suitable at first but did not last: "Besides manual dexterity there was a necessary aptitude

[68] Ibid.

required to be content to sit at a desk and do a boring job," wrote one head of the computing division of HMSO.[69] Indeed, women who would tolerate low-level punching work were often at such a premium that some departments refused to allow their best punchers to leave the department through promotion to better jobs elsewhere.

As a result, the government devised an offer to the unions that aimed to enhance divisions between the Machine Operator Class and other classes, rather than lessen them. They rejected the idea that there should be an educational standard for recruitment to the machine grades, effectively short-circuiting attempts to re-skill the class. Additionally, they stipulated that if the Chief Machine Operator grade were created, those workers would not be allowed to be promoted to Clerical Officer positions without a long trial period on clerical work, effectively destroying their chances to compete for non-machine grade promotions. Several departments noted that this would cause difficulty for them, because their Senior Machine Operators and departmental Chief Machine Operators were already doing some clerical work and being paid and promoted accordingly. Under the new requirements, they would have to be temporarily demoted.

Similarly, there would be Machine Operators who would be taken back down to the Machine Assistant grade under the new proposed government package to the CSCA that "calls for the making of two 'streams of staff'…one in the punch rooms and the other in the machine rooms, with one stream not *necessarily* inferior to the other"[70] (italics mine). The unions had asked for more interchangeability between the technical and clerical grades, but the plan proposed by the government offered only further deskilling and a redux of the job segregation caused by the original creation of the Machine

[69] Treasury, "Machine Grades" Notes of an Interdepartmental Meeting, 8 May 1964, STAT 14/2765, TNA.
[70] Ibid.

Operator Class in 1948. The CSCA rejected the package out of hand, and aired their displeasure in the press.[71]

Union anger at the treatment of the machine grades echoed broader dissatisfaction with the civil service's fictive meritocracy. This situation was perceived as just another example of the classism and educational divisions that organized the service. "By all means encourage young people to start with the best possible education," said the president of the CSCA, "but do not let these qualifications be used to create watertight divisions and class barriers throughout the organization… The time has come to abolish the antiquated caste system of the British civil service where talent is trumped by age and protocol, and people are promoted or not due to their age and qualifications and in what division they entered the service." [72] Increasingly, the service was becoming a microcosm for the larger class antagonisms within British society that were being laid bare in the social flux of the 1960s.

By the end of the decade, the Chief Machine Operator grade had still not been created, but continued to be discussed, brought up at interval as a potential salve, though an inadequate one, for the simmering resentment of career Machine Operators, who quickly reached their maximum pay scale after being in their jobs for only a few years. Computer-using departments believed the pay and promotion structure was not "so markedly out of line with work requirements" and that because "the final promotion of most in the class occurred around the age of thirty," it was "adequate to the interests of the workers."[73]

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[71] *Times* (London), "Civil Service Rebuff Treasury on Pay Offer," 5 May 1964.
[72] Ibid.
[73] F. G. Burrett, CSD, Letter to C. W. Blundell, HMSO Norwich Computing Installation, 21 March 1969, STAT 14/2765, TNA.

On the one hand, reaching maximum pay at thirty was unheard of for most civil service jobs. On the other hand, the impression that these workers should either leave the workforce around that age, or have a supplementary income from a spouse, tended to justify the claim that the situation was "adequate to the interests of the workers." While admitting that the wages and prospects of workers might be unduly poor in certain geographic areas, the civil service's oversight department asserted that overall, the situation was not egregious enough to warrant a change.

In 1969, when the government was no longer as constrained by the lean computing labor market of the middle part of the decade, pay issues bubbled to the surface once again. This time, however, the acrimony originated from within the ranks of management, and not the rank-and-file. Despite poor career prospects, the pay for computer operators, especially at the Senior Machine Operator level, was quite high in relation to other women's jobs and even many men's jobs at similar ages. Extra allowances for speed, particular skills, shift work, and overtime, which were common for most computing jobs, further enhanced salaries. Some Senior Machine Operators could make as much or more than workers on the Clerical and Executive Officer scales who did not do computing work.

The operators at the CCB from 1966 to 1970 made around £800 per year, at a time when £1000 per year was a good salary even for young men. Nonetheless, the government pay scales attached to these jobs were admittedly at or below fair market rate when compared with the private sector, and at times too low to even effectively compete with industry in retaining these suddenly very desirable and relatively scarce workers.

Workers on the Clerical Officer and Executive Officer scales who happened to do computing work got much more than workers on the Machine Operator scale.

Many departments, however, felt that these "girls" were getting too much money for their jobs, and wanted to stem, rather than encourage, the flow of Machine Operators into higher positions. In the process of building up the CCB, the government moved the former CTI outside central London to Norwich, increasing the number of new hires required, since many CTI workers found other jobs in central London rather than move or commute to Norwich. In rapidly hiring many operators local to the CCB's new location, managers found that "the best of the recruits coming forward in Norwich have tended to be very young," and as a result, were promoted at younger ages than usual. By 1969, there were seventeen full-time, established (pensioned) Senior Machine Operators at Norwich below the age of twenty-five, with more on the horizon. One member of the CCB management stated that although he was:

> "…quite satisfied that the MOs being promoted are fully capable of doing SMO work, we are not happy with the size of the group we are building up receiving pay on a scale starting at £814 per annum. It is out of proportion that these girls, academically unqualified compared with clerical staff, should so quickly be able to reach salary levels above those of clerical officers and even EOs."[74]

Having no further promotion outlets in the Machine Operator grade, these young women might theoretically take examinations to move into the Clerical or Executive Classes and from there attain the higher top salaries available on those scales. In practice, such promotions rarely, if ever, occurred. But the suggestion that Machine Operators might be promoted into these jobs, and progress to higher management and supervision duties, still rubbed many the wrong way. The CCB's hiring manager suggested that "a

[74] C. W. Blundell, HMSO Norwich Computing Installation, Letter to F. G. Burrett, CSD, 25 February 1969, STAT 14/2765, TNA.

fundamental and searching examination of the grading and pay of the machine class is badly needed," if such young recruits were rising so quickly through the ranks and earning so much.[75]

The dangerously expensive precedent these workers set threatened to throw into question the "internal relativities" of civil service pay. That the highest paid Machine Operators earned slightly more than the lowest paid Clerical Officers was, to some, an indictment of the civil service's meritocracy. These workers were not only young, but as machine workers, they were still slightly stained by the perception that their field was subclerical, and more manual than intellectual. The fact they were mostly single women exacerbated the situation further. At a time when male Clerical Officers wrote angry letters to civil service union newsletters complaining their salaries meant they could not "afford to keep a wife" or support a family, many civil service officers believed that market forces had taken things in an unsavory direction.[76]

In response to these fewer than 200 Senior Machine Operators in the entire civil service, who at twenty-five were deemed too young for their posts, treasury officials actually suggested that all new hires, irrespective of merit, should be subject to new decremented pay scales with a slower promotion track and lower top-level earnings. This unprecedented action went against decades of government agreements with civil service clerical unions that posts could not be downgraded once a pay scale had been agreed upon. Although this idea ultimately fizzled, many promotions were intentionally deferred as a result of informal attempts to throttle back the flow of young women into high

[75] Ibid.
[76] Roger Mortensen, "Economic Nightmare," Letter to ed., *Civil Service Opinion* 48, no. 557, February 1970, 54, HN 1/67, TNA.

computing operation positions at the CCB: "where it is not absolutely essential that we fill posts now, we will defer appointments," wrote the CCB manager.[77]

Less than a year later, in 1970, the government did finally set up a new ADP grade in the service, to cater to the pay and career needs of programmers and systems analysts. The decision to exclude the Machine Operator grade from the list of grades whose work would be reviewed and upgraded as part of the process, and also to exclude the Machine Operator Class from putting forward recruits for this new grade drew objection from the Clerical and Professional Civil Servants Association, but the plans moved ahead unchanged.[78]

5.4 Parallel Developments at the Atomic Energy Authority: Divisions Between Scientific and Administrative Computing Workers

Other heavy users of computers within government were similarly fraught as they slowly revamped hiring patterns and struggled with retention in the mid to late 1960s. Labor shortages combined with economic crises resulted in a fall-back to traditionally feminized machine workforces in certain situations, but not in others.[79] The Atomic Energy Authority (AEA), the largest scientific computing user within the government, largely paralleled the CCB's staffing trends in this period, although the AEA also diverged in important ways that helped show the influence of career-track availability on the shape of government computing staff.

The AEA, much like other government departments with a high proportion of computing work, considered setting up a specialized class for computing workers in 1965, in order to hold onto good staff by offering promotion prospects and clear cut

[77] Blundell, Letter to Burrett, 25 February 1969, STAT 14/2765, TNA.
[78] "Computers In Government Ten Years Ahead: Notes of an Informal Meeting with the National Staff Side," 21 September 1970, HN 1/22, TNA
[79] T 224/900, TNA.

career ladders within computing.[80] The idea came in part as a response to pressure from the staff's unions. Interestingly, all the letters of complaint on the topic of poor computing promotion outlets were lodged by women workers, undercutting the view held by many managers that career advancement was not a pressing concern for women. As a result, the AEA argued for the abolition of the Machine Operator Class, and its replacement with a new Data Processing Class which would "include all people whose livelihood depends on the handling of punched cards" and give "the good computer operators" a "career avenue to the top of the class."[81]

The situation in the AEA's many computing installations did not, however, mean uniformly poor promotion prospects for all operators. The KDF 9 computers used in most of the AEA's installations, and the work done on each, were not widely disparate, although the nature of the work did vary enough for certain patterns to develop. Operators were paid relatively well: the 1966 pay scales ranged from £292 at the lowest end of the Machine Assistant scale, which was primarily a trainee grade, to £1040 at the highest Senior Machine Operator post. Executive Officers with operating and programming experience earned as much as £1569.[82]

In computing installations concerned with scientific operations, a larger percentage of workers tended to be male, as opposed to computing installations designated for commercial and administrative work, where larger proportions of workers tended to be female.[83] In the scientific computing installations in the reactor subsection,

[80] AEA, AB 46/16 Authority-Wide Computer Operations Staffing 1965-1969, TNA.
[81] V. Griffin, "Computer Operations Staffing"; A. H. Armstrong, Memorandum to S. J. Sharman, 16 November 1966; R. N. Simeone, Memorandum to A. L. Scott, 9 January 1967, AB 46/16, TNA.
[82] P. Dawson, and W. L. M. French, "AEA Computer Operations Staffing Covering Developments to Mid 1966," October 1966, AB 46/16, TNA.
[83] Ibid.

for instance, 62.5 percent of the operators at Risley, the site of a prototype gas-cooled fast reactor that came online in 1959, were men. At Winfrith, a prototype gas-cooled reactor in operation from 1962, 100 percent were men.

The commercial operations groups at Risley and Winfrith, however, were each 100 percent women. Commercial operations at Donbury were likewise 100 percent female. This distinction between scientific and commercial computer operations was not hard and fast; both the scientific and commercial operators in the weapons subsection were mostly women, and the scientific operators at Culham Research Station and Capenhurst's scientific production section were 75 percent and 100 percent female respectively. (Culham's commercial operators were also 100 percent female.) Likewise the scientific group at Windscale, the site of Britain's first major nuclear reactor for military purposes, and the subject of a devastating meltdown nearly a decade earlier in 1957, were also all women.[84]

The higher percentages of men in many scientific operations in the AEA, compared with the near-domination of commercial and administrative operations by women, implies that different career tracks operated within the AEA according to the type of work being done, even though some scientific operations were also largely or exclusively staffed by women. The inclusion of Windscale hints at one potential reason for the differing percentages of men and women amongst scientific installations. The scientific operations with the highest percentages of men were both prototype reactors that were still online when these labor statistics were collected. The reactor with the scientific group that was all female had been taken offline years earlier, and was likely involved in monitoring and stabilization rather than new, cutting-edge research.

[84] Ibid.

The AEA's computing labor mirrored the CCB's in several ways. First, all administrative and commercial operations were staffed either completely or by a majority of women. Second, detailed turnover statistics showed that in several installations men were hired to replace operator losses in the late 1960s, rather than continuing the pattern of hiring young women. Lastly, although no new class was created for computing workers at the AEA in the 1960s to upgrade the old structure of the machine grades, as was briefly discussed, more computer operation was done by workers from the Executive Class as the decade came to a close. By the 1970s, moreover, computer work done by those at and above the Executive Officer level was designated a "functional specialization," and departments were "exhorted to make specially adapted career development and staff management plans for computer staff," in order to make an elite core of professionals who would be given pay and promotion benefits for going into, and staying in, computing work.[85]

5.5 The Missing Masses in the Government Machine: Upgrading the Hardware Side of the System

The labor changes underway in the 1960s reflected the fact that government departments, beginning with those in charge of purchasing and organizing computing hardware—the Civil Service Department, HMSO, the treasury, and the Ministry of Technology—had gradually come to perceive computing hardware as quite different from previous forms of data processing machinery. No longer were electronic computers simply an upgrade from earlier data processing installations. Rather, they were a wholly new kind of system for information collection and processing. More than that, proponents of greater centralization within government saw computing as a management tool that

[85] CSD, Memorandum, 26 April 1977, AB 46/16, TNA.

could not only speed work, eliminate certain staff, and enhance output, but which could change the very nature of the work that might be accomplished.

Through allowing enhanced record-keeping and complicated data manipulation, computing technology encouraged the government to embark on previously unimaginable projects. By the late 1960s, computers became an integral part of policy in a way heretofore unanticipated by all but its most avid proponents. Computers allowed government ministries to collect, categorize and wield information in a variety of complex ways, from the PAYE system to the files maintained by the NHS. The Ministry of Pensions and National Insurance database alone held over 35 million people's records.[86] Computing began to reshape the state itself, as advancing techniques made possible ever more ambitious projects.

The outlook was not unreservedly optimistic, however, and even proponents of increased computerization warned that the systems might produce the opposite of their desired effects if improperly engineered or organized: "We must face the fact that we are in the process of developing a monumental machine for handling the detailed affairs of government, and that the design of this machine is one of the most crucial matters of policy in hand. It could either benefit, or cripple, the government for years to come," remarked Stanley Gill, a professor of computer science credited with the invention of the subroutine who consulted with the civil service planning department.[87]

The re-imagining of computing's scope and importance for the functioning of central government in triggered a decades-long struggle to produce and hold onto good computing staff. Efforts to make more attractive career ladders for programmers by

[86] Janes, "Electronic Computers 'Oil' the Wheels of Government," T 216/710, TNA.
[87] Stanley Gill, Memorandum to ADP Planning Committee, 30 January 1968, HN 1/60, TNA.

offering them promotion prospects in the Executive Class, rather than sealing them into limited promotion structure of the Machine Operator Class, came as a direct result of not just a technological change, but a change in how a technology was understood by the highest levels of government.[88] Training efforts for all computing staff, from punchers upward, increased as the number of ADP workers in the central government grew to over 12,000 by 1972, with a full half of these jobs concentrated in data preparation and input.[89]

The Ministry of Technology, founded under Wilson's government in 1964, aimed to fulfill Labour's campaign promises to reshape Britain's future through the use and production of high technology. The second Minister of Technology, Anthony Benn, took on the role in 1966, determined to translate Labour's starry-eyed technological ambitions into reality.[90]

The young and energetic former postmaster general quickly became the iconic minister of technology. A true believer in Labour's socio-technological project, Benn stepped into the role with a ready understanding of the issues at hand, coming as he did from an agency that required systematic thinking, the management of a massive technological bureaucracy, and astute attention to machinery's interaction with labor processes.[91] Tasked with improving technological use and acceptance in British industry, Benn's mission was to modernize, if not revolutionize, all aspects of industrial production in Britain to bring the nation up to par with other industrial democracies. Both Benn's

[88] J. A. Annand, "Computers In Government Ten Years Ahead," 7 November 1969, HN 1/22, TNA.
[89] HN 1/72 Interdepartmental Working Party on Computer Personnel: Implementation Of Recommendations 1972-73, TNA.
[90] After a false start under the first Minister of Technology, Frank Cousins—a traditionalist whose goals for Britain's technological revival were neither sufficiently ambitious nor detailed enough to satisfy Wilson—Benn stepped in to head the Ministry from 1966 until its dissolution under the next Conservative government in 1970.
[91] Martin J. Daunton, *Royal Mail: The Post Office since 1840* (London: Athlone Press, 1985). Daunton discusses the increasingly crucial interplay between new technological processes and older labor patterns in the Post Office in the 20th century.

ideology, and his experience in dealing with the large and unwieldy technological systems within the post office, made him an ideal choice for the post. The minister of technology was intended to be the pre-eminent systems analyst for the entire nation's industrial and administrative technology.

As part of this project, Benn was tasked with bolstering high technology production at home, a concern that manifested in his vocal support for, and involvement with, the British computing industry. Benn's mission also resulted in the government-brokered merger of all of the most promising British computing companies into one major corporation.

Despite this, Benn's ministry was at a loss when it came to applying the government's own advice on industrial modernity and technological rationalization to its own workings. In the end, Benn and his ministry were often no more than masterful public-relations workers, interpreting and packaging cutting edge technological advance for tradition-bound industrialists and ministers alike, while soothing and cajoling workers who were perceived as reluctant or unable to give up older methods. "Suspicion of computers is mainly due to ignorance," Benn opined. "People are worried about things they don't understand and one of the characteristics of modern society is that it is surrounded more and more by the incomprehensible... the advent of computers has created a very real need for education, re-education, and industrial training."[92]

The National Computing Center (NCC) set up under his ministry's tutelage in 1966 aimed to proselytize the benefits of computing to public and private organizations who could become members of the organization, primarily through disseminating

[92] *Civil Service Opinion* 48, no. 557, February 1970, 33, HN 1/67, TNA.

information on data processing techniques and standards.[93] The NCC owned two computers on which member organizations could share time, devised educational courses for systems analysts, programmers, and executives, and offered an advisory service for companies considering computer purchases. The effects of these outreach measures, though powerful, often yielded different results from what was intended. The NCC's abortive attempt to create a software library, stocked by their members, epitomized the NCC's ambitious but ultimately minor role in jump-starting the country's technological future. Nevertheless, the education and publicity provided by Benn's ministry had an enormous effect on elevating expectations for high technology workers.[94] Most importantly, the computer merger that Benn strongly supported would redefine the British computing landscape both at the level of research and design and at the level of user implementation in the case of the government.

5.5.1 Government Purchasing and Organization

Despite the fast pace at which the government was purchasing new systems, the process by which these systems were bought was incredibly inefficient, unwieldy, and confusing—even to the agencies and ministers directly involved. Determining which departments needed and were entitled to computers, how much should be spent on each, what sort of system should be purchased, and how it should be organized and staffed had become a labyrinthine process by the mid-1960s. Born out of the processes established over a decade earlier when government mechanization was vastly different, and machines had more similarity to each other and much longer life spans, these methods had all but

[93] "The National Computer Center: What it Is, What it Does" June 1966, HN 1/60, TNA.
[94] The ministry's training and outreach programs aimed to create a positive public perception of computing professions, casting the ideal computer professional not as a narrow specialist but as a skilled generalist aligned with management's interests.

lost any coherent rationale. Enormous manpower and management resources were sucked into not only the decision-making process, but also attempts to overhaul and fix it.

This proved a decade-long project, because in addition to the great expense of computing installations, computing purchasing decisions were increasingly understood as policy decisions, freighted with the responsibility of determining, perhaps irrevocably, the shape of future government organization and production. The decision-making chain encompassed multiple departments and anywhere from three to six years would elapse between a department's signaling intent to buy a computer and the machine's eventual purchase and installation. Added to this were several more months for staff training and bringing the system fully online. The treasury, HMSO, the Civil Service Department, and later, the Ministry of Technology were all involved in this process. These four departments, in addition to the department in which the computer would be installed, often found themselves at cross-purposes, fighting for hegemony to determine the shape of the civil service as expressed through its bedrock; its data processing structure.

As purchasing processes became increasingly cumbersome, with just the contract bidding stage taking a year or more, multiple departments would regularly go over the same ground and recommend different outcomes. Many within the government recognized the problem, and were chagrined with the inexpediency of so many departments and sub-departmental units "plowing the same furrow." [95] Yet, often this recognition resulted only in further internal squabbles and unhelpful attempts to arbitrarily seize control over the process. Hundreds of people spread over several departments were now involved in the research, procurement, and testing process. In addition, policy debates over whether or not to centralize government computing, in part

[95] J. T. Whittaker, CSD, Memorandum, 30 April 1969, HN 1/60, TNA.

to tame this procedural leviathan, and if so, how and according to what method, created further delays.

Until the creation of the Ministry of Technology, the Treasury Operations and Management Division was tasked with the procurement and approval of new computer installations in all governmental departments, as well as advising local government branches, the NHS, and the nationalized industries. The treasury's sub-departmental Technical Staff Unit advised other departments on which computers would be suitable to their needs, whether or not that department wanted such advice. Initially, their guidance dealt with administrative and business computing applications—scientific computing installations within government got their advice elsewhere, or devised their own plans. In 1964, however, both administrative and scientific users were told to consult with the treasury for all purchases, as well as with HMSO.

Soon, HMSO began making all scientific computer purchases on behalf of departments, even agencies that could easily have made their own computing decisions, like the Computer Board of the Department of Education and Science for the Universities. When the Ministry of Technology set up its Computer Division Advisory Service in 1965, they took over the responsibilities of the treasury's advisory Technical Staff Unit, giving both general systems advice and engineering advice to supplement that given by computer manufacturers, who usually maintained a relationship with the machines they installed through service plans.

The small size of the Ministry of Technology's Computer Advisory Board, however, in addition to its novelty, hindered their ability to wrest the role away from the treasury. Older procedures continued to be followed, with the treasury taking the lead in

giving advice on what machines to buy for quite some time. By 1966, another department, the Civil Service Department (CSD), was also brought into the role of advising on computing purchases, and more importantly, on the standardization of data processing systems procedures throughout the civil service. Once again, the Ministry of Technology had to take a back seat, with the CSD telling them that "as a department using computers," the Ministry of Technology "ranks in exactly the same way as other departments, and the CSD looks to them to organize [themselves] along the same line as others."[96] In other words, the Ministry of Technology was given no special status or leeway regarding computing decisions within their own department, despite the fact that one of their mandates was to establish best practices for the implementation of computerized systems.

Not surprisingly, the Ministry of Technology chafed at being regarded "as merely another central government department to which normal procedures apply" in this regard.[97] Given that the ministry's mission was to advise on technological purchases and practices, the fact that they had to take computing advice from another department predictably aroused ire and encouraged dissent. The CSD's attitude towards the Ministry of Technology expressed a thinly-veiled hostility towards a newcomer department often perceived as staffed by technocratic idealists: "We… deal with a project as a whole and not just from the hardware and software angle," intoned a CSD official. "Whilst I do not deny that they have considerable knowledge of ADP from which we should benefit, they

[96] Ibid.
[97] Minister of Technology, "Comments on a Brief Memorandum on Data Processing in Government," April 1969, HN 1/60, TNA.

are completely lacking in the other aspects of advice which we give in respect of say, staffing, recruitment, grading of posts, and many other matters."[98]

Trying to keep abreast of the changing situation, the Ministry of Technology devoted a large share of resources to establishing policy on computer planning, but with little power and a primarily advisory role, their suggestions were not met with enthusiasm. "This is a major machinery of government problem and not a computer problem" warned a critic of the Ministry of Technology's attempt to create a new policy, before categorically rebuffing all of their suggestions.[99] The Ministry of Technology's cogent efforts to effect computer savings by bulk-purchasing schemes, to cleave some of the time out of tendering processes going on in parallel or one after another in multiple departments for similar machines, and to create a central government software resource, were met mainly with disapproval. The organization of computerized systems, the departments at the apex of the civil service command chain believed, was too important to leave to technicians: it was a matter that, improperly handled, could destroy the state's ability to govern.

By 1969, when the responsibilities for computer advising and installation had reached a state of permanent flux, and yet another agency, the National Computing Center had been created to advise on computing, many ministers had simply accepted the increasing unwieldiness of the process. "It is freely acknowledged that the procedures are more cumbersome than they would have to be if fewer departments were involved," wrote one minister, "Nevertheless, business-type computer schemes are complex and government ones more so than most; cutting down the interplay between departments

[98] Whittaker, Memorandum, 30 April 1969, HN 1/60, TNA.
[99] P. T. F. Kelly, Letter in Response to Memorandum on Data Processing in Government by the Minister of Technology, 20 March 1969, HN 1/60, TNA.

would help, but it would be absurd to suppose that extremely radical changes are possible in a government environment." [100] Indeed, the impossibility of effecting change, radical or otherwise, once institutional momentum took over in computer selection policies would prove to be a major hindrance to the government's modernization plans.

Denigration of the Ministry of Technology's role in computer procurement continued, with other departments feeling threatened by the Ministry of Technology's positions on larger issues and their ambitions for future central government computing projects, such as a national computing information bank. "In practice, the contribution [of the Ministry of Technology] has not gone beyond pointing to 'blue sky' computer possibilities of the future," complained one minister, adding that their high-level interventions to try to improve computing processes in government over the last several years had "merely turned out to be irritants rather than valuable contributions."[101]

The Ministry of Technology, for its part, believed that the problems facing government computing, especially in terms of compatibility and future flexibility, "stem[med] from a too-complete separation of policy making from the implementation of ADP systems," and that in order to rectify this, in the future they must include "ADP planning in policy making at a high level." Citing short-sighted decisions "confined to immediate objectives only, leaving the system designers to decide where to leave room for future changes," the Ministry of Technology painted a grim portrait of systems analysts sabotaging the very systems they intended to build. "This they do to the best of their ability, in ignorance of policy motives. In doing it they unwittingly lay traps and obstacles in the way of the administrators, who then find themselves in a straitjacket

[100] Minister of Technology, "Data Processing in Government."
[101] Ibid.

which they took no part in designing. This danger has been aggravated by the policy of rigid economy in ADP application planning, which has made a virtue of planning for strictly limited objectives."[102] Planning for strictly limited objectives, however, was a failing that the Ministry of Technology was itself guilty of when it came to the British computing industry.

Part and parcel of the attempts to rationalize and centralize government computing were the late-1960s backroom dealings with the anointed few British computing companies that the government deemed viable. In large part, the government's approval turned on which companies made machines that were most useful to the civil service. Top ministers made decisions for the computer industry based on the particular image of government computerization they had become convinced was the most ideal.

ICT was the most successful British company in the international market as well as at home, with their large, flexible, mainframe systems being the closest thing to a British version of IBM. Constructed through a 1959 government-backed merger of British Tabulating Machines and the wholly-British-owned subsidiary of Powers-Samas, ICT had also later absorbed, with government encouragement, EMI, GEC, and Ferranti's data processing divisions in the early 1960s. The only other principal player in British computing by 1967 was English Electric, itself a merged company comprised of the former LEO Computer Company and the original English Electric, with Marconi and Elliott Automation's data processing interests absorbed along the way in the 1960s.

In 1968, the government, through the Ministry of Technology, brokered a merger between ICT and English Electric in order to consolidate British computing expertise into a single company called ICL (International Computers Limited). Nominally, the intent

[102] Ministry of Technology, "ADP Planning Procedures," 30 January 1968, HN 1/60, TNA.

was to create a large British company with the resources to compete with IBM at home and abroad. While Benn and his ministers accepted this logic at face value, in reality, other desires also played a role.

Creating a single British computing company decreased the government's incredibly unwieldy process of buying machines through a multiple tender process designed to encourage all British computing companies equally. ICL would now be the de facto supplier. In addition, in exchange for agreeing to the government-backed merger, ICT and English Electric were favored with all available government loans and grants for private sector computing research, in addition to their non-competitive government computing contracts. Secret documents outlined that the government was to buy the products of the new, merged company whenever an administrative computer was required, and even scientific government computing installations could not buy from companies other than ICL unless they could show that ICL's machines could not perform "similarly" to a foreign machine for a price equal to the cost of the foreign competitor's machine plus 25 percent.

In exchange for this preferential treatment, the government demanded a level of general control over, and debriefing on, ICL's future projects, primarily to ensure that ICL would produce machines well-suited to the government's applications: "The government will place its expertise at the disposal of ICL and will expect its views to be given due weight in the framing of the research and development program."[103] Costs and to some extent technological ignorance compelled particular decisions in the earlier stages of government systems design, ultimately resulting in hardware playing an unduly

[103] The merger that created ICL was under discussion from 1964 until 1968 when it was completed. The government supported ICL with grants and preferential purchasing into the 1970s. Annex C/6, T325/161 MinTech: History of the Computer Merger 1964-1968, TNA.

important role in deciding how the government itself would run, and what tasks could be effectively accomplished, rather than the other way around.

Determined to prevent this from happening in the future, the government took an extraordinarily hands-on role in shaping their main supplier. The mainframe successor to the ICL 1900 computer, the 2900, came as a direct result of this government intervention. ICL was to be a strong British computing company that could compete in both industrialized and emerging markets, reviving British influence and helping the increasingly poor balance of payments. It was also a byproduct, of sorts, of the Labour's nationalizing impulse. Yet engineering the nation's technical systems on this scale, however ambitious, created a host of problems for the government; problems which they soon decided would be best forgotten rather than solved.

5.6 Conclusion

By 1970, the "the manpower-hunger of computers themselves as they become more and more sophisticated" meant that staff for government computing installations was growing by at least 30 percent each year.[104] The idea that computer expenditure could be viewed as a replacement for staff expenditure in any clear-cut manner had all but evaporated.[105] Rather, computers were used to perform large-scale data processing projects on timelines that would previously have made these endeavors impossible. Computing jobs' metamorphosis from "backwater" to the cutting edge of government organization clearly turned, at least in part, on technological change. The fact that this change did not occur until well into the computing age, however, indicates that there were a variety of other causal factors.

[104] Annand, "Computers In Government," HN 1/22, TNA.
[105] Ryrie, "Computers," T 316/308, TNA.

The growing effort in the late 1960s and early 1970s to carve out a system of careers in computing was bolstered by university and other institutionalized and credentialed training courses. In 1966, the British Computing Society, in cooperation with City University, set up a group to study the qualifications in operating staff sought by manufacturers, businessmen, and scientific installations and afterward make recommendations about how to formalize and institutionalize future training. Aiming to "establish requirements that borrow from both arts and sciences," in order to legitimize computing expertise, such training signified computer operation's change from an occupation to a vocation. Computer operators now needed not only practical, technical knowledge but also to be versed in the management theories undergirding the larger system of which computing was a part.[106]

In the early 1960s, careers in computing were barely on the radar for most civil servants. Even by 1965, potential recruits for government computing installations from the professional classes of the civil service worried that computing work would shunt them into a "backwater" and remove them from more lucrative and interesting career paths. By decade's end, the position had nearly reversed, with workers in higher grades of the service clamoring to get into ADP fields, and the government sending out hiring calls for computing staff only to high-level, Executive Officer civil servants.[107] "I know several of my brightest SEOs (Senior Executive Officers) and HEOs (Higher Executive Officers) would like to spend the rest of their working lives in programming, and would willingly exchange whatever prospects they have of rapid advancement in other

[106] *Financial Times*, "Grading Staff for Computer Operations," November 29, 1966.
[107] Internal Government Job Advertisements, 1968, LAB 12/1553 Shift Working of Computer Operators: Applications for Vacancies and Other Papers 1966-1969, TNA.

departmental jobs for a more modest progression in a broader ADP field, coupled with the certainty of staying in it," reported one department head.[108]

From 1965 to 1975, Executive Class programmers and systems analysts increased five fold, and Executive Class operators increased by almost fourteen fold, although they were still a minority of all operators.[109] Women formed close to 44 percent of the clerical classes by this point, but still only held small minority of executive positions.[110] Yet, computer worker labor shortages persisted within the public sector.

Executive level civil servants had no especial prior qualifications or education at this point. Few if any in the Executive Class were university-trained.[111] During this period, all training for computing work was either done on the job or at the computing company from which the government bought a given machine. The Wales Dock Board, for instance, successfully trained all of their new programmers and operators at the ICL Customer Center in under three months, as late as 1970. None of the trainees had any prior experience.[112] If chosen for training, the opportunities for advancement were many. "We could perhaps," complained a female member of the Society of Technical Civil Servants, "make a general point about women workers that has relevance to the civil service as well as to industry…. Although there is a constant shortage of people with the

[108] Department of Employment and Productivity, Letter to Treasury, 27 September 1968, LAB 12/1516 General Application of ADP 1965-1968, TNA.
[109] There were still roughly two to three times as many Machine Operator Class computer operators in 1975 as there were Executive Class operators. The statistics are inexact due to the inclusion of Clerical Officers in the pool. "ADP Staff Return," 1970-71, Section E and F, HN 1/62, TNA.
[110] Only 8 percent of the Executive Class of the civil service were women in 1970, and those women were concentrated in the lowest ranks of the class. Meanwhile, 44 percent of the Clerical Class was female, and of these, 54 percent were unmarried. *Civil Service Opinion* 48, no. 557, February 1970, 52, HN 1/67, TNA.
[111] T 216/710 Redundancy Owing to Computers 1961-1962, TNA.
[112] "Novices to Experts in Three Easy Months," *ICL Computer International* 1970, no. 13, 1, BL.

necessary technical background to keep pace with the increasing technological demands of industry, here is a source of supply that has been virtually completely neglected."[113]

Investment in the computing physical plant also grew exponentially, with hardware costs alone expected to stretch towards £100 million by 1975. This outlay excluded the government grants and loans for ICL, the newly-merged company in which all of Britain's computing potential would be concentrated. Not content to simply monitor developments in the British computing industry, the government instead had begun to treat computing as a pseudo-nationalized industry, molding it in accordance with their goals and in exchange providing large amounts of research support. By 1975, 85 percent of the government's machines were expected to be ICL.[114] Indeed, the centralization of the British computing industry into one corporation was an extension of the government's attempts to centralize and rationalize their own computing organization.

Soon the government provided more formal training through the new National Computing Center, an independent organization set up on government initiative in 1969. No longer were computer operators simply trained on-the-job by their peers and managers. By providing formal courses in systems analysis, programming and "ADP appreciation" for executives, they hoped not only to shore up the number of trainees, but also the quality.[115] Formal courses and qualifications, and sometimes aptitude testing, became essential for new recruits. The days when Colin Hobson and his co-workers could informally "train up" the man who served them tea to become a computer operator

[113] Letter from the Society of Technical Civil Servants, 16 November 1962, GB0152 MSS.292B/134/8 Women In Industry, Industrial Charter For Women Workers: 1968, MRC.
[114] CSD, "Computer Planning in Central Government, Note by the CSD," January 1971, HN 1/62, TNA.
[115] CSD, Memorandum, 6 Aug 1969, HN 1/67, TNA.

were rapidly disappearing. Similarly, the computing labor drought that helped Cathy Gillespie and Anne Sayce get chosen, without any experience, for promising computing careers in 1965 had evaporated by the end of the decade, though it was soon to return.

The government's persistent efforts to professionalize and organize computing work as a desirable subspecialty within the civil service, focusing on recruiting high-level workers for the best computing jobs, was instrumental in effecting this relatively speedy transition in computing workers' prestige and importance. As the government made ADP a field of endeavor in its own right, certain machine-inflected jobs were no longer perceived as below genuinely white collar, skilled work. Only a decade and a half earlier, women "stuck" processing data in the machine operator class were denied the equal pay granted to other civil servants because their work was seen as requiring less intelligence and skill. By the late 1960s, the tarnish attached to some machine work had all but disappeared, with operations, programming, and systems analysis positions becoming highly desirable.

New standards for whom to hire and train for these jobs went hand-in-hand with the increasing centralization and standardization of government computing; all of these efforts were borne from a recognition of computing as a revolutionary force in government administration. Labor organization, and management fear of concentrating power in the hands of unreliable, non-executive officers, encouraged a rethinking of which workers were suitable for such jobs. Now viewed as some of the most important jobs within the government bureaucracy, transfers to and from management became possible as lateral moves, and the government began to consolidate an "ADP

subspecialty" to satisfy workers who had chosen to dedicate their careers to the burgeoning but still under-staffed field.

The creation of new standards at the highest levels of government bureaucracy, both on how to choose computing staff and computing hardware, gradually ushered in a very different data processing environment; one that would be integrated into the management chain more than ever before. Despite the imperfect and uneven saturation of administrative computing into British business, government, and industry, computers and computer workers of the late 1960s and early 1970s had begun to fulfill their expected mandates as lodestones of a post-imperial and postindustrial society. Their assigned roles allowed them to function as harbingers of how certain divisions within society would persist in the electronic age, even while work processes became transfigured.

6. The End of White Heat and the Failure of British Technocracy, 1970-1977

> "Besides personnel needs and difficulties of organization, there are two other major constraints on the future development of Automatic Data Processing—the cumbersomeness of government procedure and the often disappointing performance of the British Computer industry."
>
> -Management Memorandum, July 1970[1]

> "So far industrial action by Civil Servants… has only had limited impact upon government's computer-based operations. It would be imprudent, however, to assume that the consequences of any future disputes will be so easily overcome. The Staff Associations have had an opportunity to gauge the strength of the weapon in their hands… and will undoubtedly have learned something from recent experience about how most effectively and quickly they can disrupt departmental data processing at minimum cost to themselves by determined action on the part of a few key staff inside or outside the computer installation."
>
> -Central Computing Agency Report, June 1973[2]

6.1 Introduction

In 1970, the central government used 5 percent of all the nations computers, and heavily favored the output of what it had designated the only competitive British computing firm, International Computers Limited, known as ICL.[3] After the 1968 government-backed merger to create ICL, the state poured grant and loan money into the company. At the same time, the government protected ICL by means of price protections and mandated ICL purchases for the public sector. The centralization of the British computing industry had succeeded in narrowing down the field to only one viable computing company, but far from having had a positive effect, the government's plan had invited disaster by neglecting or destroying all the other competitive firms in a vain attempt to create a computing powerhouse that could be a British version of IBM. One

[1] Head of Management of Computers Division, "Restricted, Staff in Confidence: Memorandum on Computers in Central Government," 20 July 1970, HN 1/22 Computers in Central Government: Ten Years Ahead, TNA.
[2] CCA Study Group, "Industrial Action: Effects on Computing in Government (Secret)," June 1973, para. 32, HN 1/38 Industrial relations in the Civil Service: Government Computing 1973-1979, TNA.
[3] "Down Among the Datacrats," *Civil Service Opinion*, February 1970, 40, HN 1/67 Consultation with Civil Service Staff Association about Automated Data Processing (ADP) 1968-1971, TNA.

conservative leader, recognizing that a death blow had been dealt to the British computing industry by destroying all competition, and exasperated with the loans and favoritism required to keep ICL afloat, reportedly remarked: "The sooner the British computer industry sinks beneath the waves and allows the Americans to get on with the job, the better."[4]

Simultaneously, Britain faced another serious challenge abroad, one that could profoundly alter the nation's economic future. Rejected from entry into the EEC twice already in 1961 and 1967, Britain struggled to gain acceptance in the early 1970s, finally joining in 1973. Entry into the EEC offered immediate economic benefits such as development loans for depressed industrial areas, which would aid British industry, and reduced economic trade barriers which might lead to a larger market for British high technology. At the same time, inclusion in the EEC required a significant rethinking of the British economy and culture.

As a condition of EEC membership, gender discrimination in hiring and employment had to be removed from industry by 1975. Adherence to the ideal of equal pay for work of equal value meant that the position of women in the British workforce would need to change in ways that were not necessarily beneficial for Britain's employers, including the national government. For decades, the number of women in paid work had steadily risen. Employers who had relied on women's less expensive labor, as the government had in the machine grades even after enacting limited equal pay measures, would now have to reorganize and face significant new outlays. In addition to

[4] ICL, "ICL's Relations with the Government," 1975, NAHC/ICL/Aq1, National Archive for the History of Computing, Manchester, UK (hereafter NAHCM).

the economic burden on employers, adjusting women's wages to a higher level threatened to strain the wage controls in place to curtail inflation.

The 1970s saw an imperfect enactment of equal pay and sex discrimination legislation; perhaps the clearest sign that specific classes of female workers, far from "burning up" in the White Heat of Labour's revolution, had become further institutionalized owing to new technology and methods of work organization. The trope of the "working class boy who made good, a member of the new middle class, the meritocratic technocrat," exemplified in the popular consciousness by Harold Wilson himself, was a fiction for most British workers. Most working-class men and women remained segregated in vastly different work and social arenas than those of white collar workers. But even among the categories of white collar workers who might be expected to benefit, making good on this ideal was especially unlikely for female technologists.[5] The mid-1970s attempts to satisfy the EEC's equal pay and opportunity mandates highlighted, rather than materially reduced, institutionalized segregation of work and opportunity by gender.

The legacy of White Heat, while a fleeting memory for labor, continued to inform the government's attempts to reorganize and modernize. By the 1970s and the ascension of the Conservatives to power once again, however, it had taken an increasingly pessimistic turn. Within the government, a centralizing computing policy picked up momentum, and soon ran into a brick wall. Government officials erroneously believed that bigger, more centralized computing technology was best. The government's plan to gain more control over their data processing from the top down involved both centralization within the computing industry and within the civil service. Leaders within

[5] Arthur Marwick, *British Society Since 1945* (London: Penguin, 2003), 126.

the treasury and Civil Service Department consolidated the responsibility for computing throughout the government into the hands of the Central Computing Agency (CCA), required all departments to buy ICL, and made them model their computing practices after the standards set out by the CCA.

Yet, labor for the government's computing installations repeatedly failed to make the grade in the eyes of the treasury and Civil Service Department. The civil service operated continuous training, recruitment, and exchange programs in order to find and groom a class of their ideal computer professionals who would be the human side of this giant, vertically-integrated computing regime. These young men, usually with no more than A-level qualifications, were trained to work with computers on the assumption that they would eventually take a management role high up in government administration. Computers had become the newest tool for government managers to wield power, and one upon which all their hopes were pinned. Using their experience with computerized administration, these young men "who should be candidates for the highest posts in the Service" would ideally construct a new era of scientific management in the governance of an increasingly untidy and data-drowned British state.[6]

Through the 1970s, leaders within the civil service made increasingly iron-fisted attempts to use computing as an extensible management tool that would concentrate power in the hands of particular government workers while removing it altogether from others. This program of action led to a partial masculinization of machine operator work, created a predominantly male programmer-manager class, and paved a rocky path with organized labor. In so doing, it contributed to a losing situation for the British

[6] Working Party on Computer Personnel, "Brief for Meeting with Mr. Cooper on 15 November 1972 on Senior Staff for Computers," 2, HN 1/72 Working Party on Computer Personnel 1970-72, Implementation of Recommendations, TNA.

government. By fundamentally misunderstanding how best to use computers as management tools, the government rigidly maintained that computing must centralize control to a greater degree than ever before. Administrators at the highest levels showed a myopic inability to square their desire for strict central control with the benefits of decentralized computing that were quickly becoming apparent. Giving power and flexibility to lower order managers by using smaller machines could allow civil service departments to control work flow and set administrative agendas more efficiently.

In not trusting departments and their lower-order management to carry out their administrative mission in the most logical or beneficial way, the treasury and Stationery Office tried to constrain departments into strict compliance with a method of central control that was itself still under construction. As with the consolidation of the computing industry, centralized computing in government offered great potential but also great danger. The benefits of central control were indisputable, yet organizing in a way that could make a single point of failure critical was a serious impediment. By whittling down computer centers and concentrating power in the hands of a small percentage of workers, multiple departments had opened themselves up to potentially disastrous computing work stoppages in the event of strike action. Computing hardware installed in the civil service, post office, and nationalized industries, became ideal targets for subsections of the increasingly disgruntled British labor force.

The ideal of centralized control that government leaders held for both the computing industry as a whole and their own computing operations failed to mesh with the nation's economic, educational, and labor resources. In industry, the government wanted a large, internationally-competitive computing company, producing both

hardware and software, but focused on the needs of public sector administration. ICL was supposed to hold its own with IBM in the international market while dominating the British and Commonwealth markets. [7] Meanwhile, the company was also tasked with listening to the government on what type of large mainframe was required for the state's administration. This would give the state control over how to administer from the level of hardware up.

Yet, the government had very little idea of what they actually needed. By the time the highly advanced ICL 2900 series finally made it to market in the mid 1970s, the treasury and Civil Service Department had completely rethought the computing requirements of the civil service. In the end, ICL was able to succeed neither on its own nor with government support. Simultaneously, the same centralizing methodology informed the government's own computing. Here, the magic bullet was expected to be a class of American-style technocratic managers. As in the computing industry, the government chased this ideal to the exclusion of current labor patterns, training resources, and personnel reserves. Britain's experience in the 1970s, from adjusting to its increasingly poor economic position and less beneficial balance of payments, to joining the EEC, undercut these reorganization attempts. Instead, Britain had to accept progressively less control over its own affairs and settle for less economic and political self-determination.

6.2 ICL: Already a Failure of Government Consolidation

The government's control over computing in the name of national security and economic growth did not end with their own computers in central government, the

[7] Martin Campbell-Kelly, *ICL: A Business and Technical History* (New York: Oxford University Press, 1989).

military, the NHS, and the nationalized industries. Increasingly, control over the British computing industry, from the objectives of their research right down to their product lines and development timetables, became of critical interest to the central government, at the treasury's urging. From the government-brokered 1968 merger on, International Computers Limited (ICL) became, to the detriment of the British computer industry, an arm of the government's plan to institutionalize computing as a long-term concern of the state.

Throughout the 1960s, the cost for government computing installations had ballooned, with little proof, via cost-benefit analyses, that these outlays were in fact saving money in the long run. From 1965 to 1969, 215 computers, costing £41.2 million were ordered for the government, although only £27.5 million worth had been delivered and installed as of 1969.[8] Most of these computers were British-designed and made, the product of preferential government purchasing.[9] The Ministry of Health, for instance, used twelve computers, with seven coming from the ICT 1900 mainframe range. Only two were IBM machines.[10]

The government mandated a "buy British" policy for the public sector from the middle of the 1960s, with the details kept secret to avoid a confrontation with IBM UK. Assessing the "Britishness" of companies and their output was not as simple as first envisioned. A government report setting out guidelines for computer procurement in 1965 listed six different "Degrees of 'Britishness' in Computer Suppliers," running from British-controlled manufacturers of equipment of British design at the most "British" to foreign controlled manufacturers of equipment of foreign design at the least. In between

[8] United Kingdom, *Parliamentary Debates*, Commons, 5th ser., vol. 787 (1969), col. 361W.
[9] Ibid., vol. 721 (1965), col. 32-3W.
[10] Ibid., vol. 724 (1966), col. 7-8.

there were several different degrees of foreignness, such as foreign controlled companies who manufactured or designed equipment in Britain, and British controlled companies who manufactured equipment of British or foreign design abroad. ICT, the government's perennial favorite, topped the list, even though several other companies—English Electric Leo Marconi (EELM), Elliott, and Ferranti—were deemed equally British. IBM, one of the less British, nevertheless earned points for having some manufacturing and design offices within the United Kingdom.[11]

The "Britishness" of public sector computers became an increasingly important, but increasingly fraught issue, with the government going so far as to produce a list of every single computer available on the UK market and specify whether each was British or not. Most IBM computers were not British according to their criteria, except for the model 1130, which was produced, in part, in the United Kingdom.[12] Multiple charts and lists that were painstakingly drawn up to show which companies had a more "British" business model than others, however, only underlined, in the words of one bureaucrat, "what a jungle this business [of determining Britishness] is."[13] Indeed, the government seemed to be laying the foundation for backing out of their support for ICL through their willingness to consider "Britishness" a fluid category. Through the early 1970s, Honeywell and IBM representatives lobbied the government, trying to "spin" the "Britishness" of their machines to maximum effect.[14] IBM UK pointed out the many British workers they employed and the fact that they did some research and development

[11] CCA, "Procurement of Computers for Government Departments," Annex I, 1965, HN 1/40 Purchase and Supply of ADP Equipment, 1964-1970, TNA.
[12] CCA, "Computers to be Regarded as British" Appendix, February 1966, HN 1/26 Procurement Policy, Use of British Computers 1965-1972, TNA.
[13] J. S. Whyte, Letter from Treasury to Ministry of Technology, 24 September 1965, HN 1/26 Procurement Policy, Use of British Computers 1965-1972, TNA.
[14] R. J. Berger, Letter from Honeywell to the CCA, 4 August 1972, HN 1/26, TNA.

work in the UK, both of which upgraded the company in the government's estimation. The government's other main concern, however, was export potential: "Unless we can design, develop, and manufacture ever more sophisticated products, particularly in engineering and electronics, the import/export balance will certainly get worse."[15]

To sponsor the British computing industry the government enacted a secret 25 percent price protection policy for British computing companies, in addition to the close to 14 percent import tariffs added to the cost of foreign computers.[16] The 1968 computer merger made the government's favoritism for ICT official, with the promise of millions in loans and grant money, and the threat of withheld support if they refused the merger. ICL, in which the government maintained a 10 percent shareholding, was headed in name and spirit by ICT and its mainframe products, the 1900 series, and supplemented by the System 4 range from EELM. The fact that the government gave ICL machines a 25 percent price protection over foreign ones in what was a fair bidding process only in appearance, remained secret, though IBM UK and Honeywell suspected their disadvantage.[17]

The government earmarked millions of pounds in loans for ICL's research and development to produce a successor range to the 1900 mainframe series which would "be fully competitive in world markets" and "meet the expected demand for such a system at home" from the public sector.[18] In focusing on R&D and believing that all other things would follow, the government gravely miscalculated the importance of robust

[15] Maurice Dean, Ministry of Technology, Letter to P. Allen, 6 January 1965, HN 1/26 Procurement Policy, Use of British Computers 1965-1972, TNA.
[16] G. Bowen, Memorandum, 23 July 1965, HN 1/40, TNA.
[17] HN 1/40, TNA.
[18] Ministry of Technology, "Confidential: History of the Computer Merger Scheme, 1964-68," Annex C/6, 1968, T 325/161 History of the Computer Merger, TNA.

manufacturing practices to meet timetables for installation, and of marketing, sales, programming, and customer service in cultivating a market.

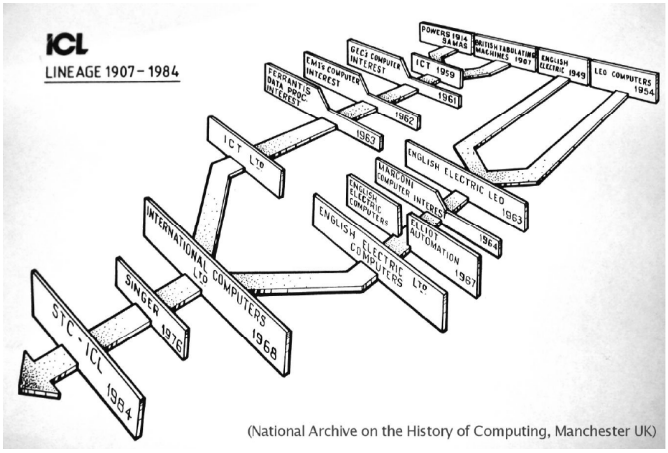

Figure 18: Chart of the Multiple Mergers and takeovers that created ICL. (The company was later bought by Fujitsu.)

By 1970, just two years after the merger, these missteps had become glaringly obvious. Increasingly desperate, the government encouraged ICL to pursue sales even to the USSR and China. Given that successive governments scrupulously kept the wartime Colossi secret until the mid 1970s, when an exhibition at the London Science Museum brought the history out of the closet before the government had a chance to quash it, these actions seemed uncharacteristically incautious. Yet, they represented the urgent desire to renew Britain's global standing through high technology exports.[19] UK computing companies sold British-made computers to both China and the Soviet Union without much hesitation, and with the active help of the government, despite the fact that the US government attempted to block several of these sales.[20] From the perspective of ICL's government backers, such trading relationships "represent[ed] a major breakthrough in technological exports and potential for some years ahead as well as showing very

[19] CAB 163/230 Release of Information on Wartime Computers, 1970-1974, TNA.
[20] Kenneth Owen, "Anglo-US talks on Soviet Sales Bid by ICL," *Times* (London), 21 December 1970.

considerable prospects for business for ICL."[21] As a result, the government was pleased to allow British computers to be exported to China, and allowed ICL to aggressively pursue a close trading relationship with the Soviet Union. Believing that bolstering computing experts outweighed "the possible risk that the computer would be put to improper uses," the government also gambled that granting export licenses for these machines, against the wishes of the US administration, would not significantly "impair Anglo-American relations."[22]

As early as 1971, just three years after the consolidation of the British computing industry, the government was faced with the near-total failure of their technological policies. That year, the treasury actually floated the idea of "cutting ICL loose" to an American company, if one could be found that wanted to buy it.[23] Worse yet, the extra government outlay on ICL systems, which were usually more expensive than comparable IBM systems, was beginning to seem less and less financially defensible. Many government ministers still perceived computing as a potentially money-saving technology, and chafed at ICL's non-competitive pricing and the millions of pounds in loans and grants given them. In one government cost-benefit analysis, one of their large computer installations had a net savings of only about roughly £420,000 over a ten year period.[24] The government's reckoning, however, did not account for the well-established inflationary tendencies of computer installation costs. When adjusting for that, the project in fact represented a net loss of £2.5 to £3 million in operating costs over the same

[21] Anthony Benn, "ICL Computers for USSR, Memorandum by the Minister of Technology," 17 May 1968, CAB 148/37 Cabinet Papers, TNA.
[22] Chair of the Board of Trade, "Computers and Export to China," 19 October 1966, PREM 13/1967 Office of the Prime Minister, TNA; Special Correspondent, "Russia Grants ICL Special Trading Status," *Times* (London), 10 July 1970.
[23] T316/308 Investment Appraisal for Government Computer Projects 1971-1974, TNA.
[24] CCA, "Investment Appraisal for Computer Projects," 1972, T 316/308, TNA.

period. Undeterred, the government adopted a wait-and-see perspective, arguing that staff savings and improved performance laid out in costing forecasts should be checked in several more years' time.[25]

ICL's research and design successes could not make it an IBM-killer, even in its home market. In 1971, IBM sales in the United Kingdom accounted for 38 percent of all systems sold, while ICL sales accounted for 32 percent. Worldwide, IBM supplied more than 70 percent of all computing systems by value.[26] As the government realized that centralization had weakened, rather than strengthened, the home computing industry, ICL quickly became a burden. In a 1972 confidential report on the state of the British computing industry, the government found "no good economic/technological/strategic case for continuing to support ICL" but simultaneously fretted "that the government may be in no easy position to abandon ICL" given their previous actions and rhetoric. Continued support of the company, now the entire British computing industry, could cost from £100 to £150 million over the course of the next decade, far more than France, Germany, or Japan had expended on their native computing industries. Similar expenditure on other aspects of British industry might have been more productive, but it was "inconceivable politically that government, having hooked its own systems heavily on ICL, having encouraged other domestic users to do likewise, and with an eye to the European market, should decide now to abandon them." [27] Propping up ICL was still seen as important to British business and government users who had invested heavily in their

[25] Mrs. J. Percy-Davis, "CCA Central Planning Document on Computers: CGO(73)3," 20 December 1973, T 316/308, TNA.
[26] T 316/308, TNA.
[27] Ministerial Committee on Economic Policy, "Secret: Brief on CPRS Report on the UK Computer Industry," January 1972, 1, HN 1/15 Arrangements for the Setting up of the Central Computer Agency (CCA) 1972, TNA.

equipment, hoping for long-term economies. ICL's failure would result in a lack of maintenance, services, and new products for existing installations, destroying those potential benefits.

Instead of making a formal policy change, the government decided to tacitly and quietly "leave the decision open to Ministers" about whether to continue to buy ICL or not. Thus the treasury and Central Computing Agency began to reverse one aspect of the trend of management centralization through computerization, for the purpose of extricating themselves from an expensive relationship that seemed to be going nowhere. Nevertheless, "In any realistic terms, there is a five to ten year stint to get off the hook" to ICL, treasury officials realized. In fact, they hoped that technical developments in high-level programming languages, emulators, and other tools might sooner strand ICL in a position where it could not reasonably ask for continued government support.[28] In the space of less than four years, the government had gone from being ICL's biggest booster, to secretly hoping its speedy failure would get them out of having to continue their support. Increasingly, they had also begun to realize that the "single-tender" purchasing preference for ICL tended towards "weakening the company's' fiber," losing it credibility in the marketplace, and even allowing it to cut corners and give poorer service to its largest customer, the government.[29]

By the early 1970s, government had discarded their directive to buy British, their single-tender system for supporting ICL, and their 25 percent price preference for British computers. The rationale for these changes was alternately given, by different ministers, as allowing ICL to stand on its own, allowing British industry to gain the benefit of

[28] Ibid.
[29] Ibid.

American know-how, and capitulating to departmental demands to be allowed to buy IBM. In truth, each of these factors played a part, but the largest concern was rapidly becoming price and availability: IBM could supply the same or a superior machine more quickly for a lower cost.[30]

As centralization of the computing industry faltered, however, the government was making the same centralization mistake within its own computing organization, with the setting up of the Central Computing Agency (CCA). Here, the emphasis was on image as well as function, as they focused on putting the new computing center in central London, close to Whitehall, "in a good modern building to show the right image."[31] The technological revolution had now morphed into a question of public relations and consolidation of government power more than any true attempt to reinvigorate British industry or society. The Civil Service Department centralized all authority for computer procurement within the CCA in order to decrease "the independent computer strength of the big departments… at a time when the development of computers was likely to have implications for the Machinery of Government."[32] The constraints of computer procurement placed on the departments by the CCA were not the most efficient and were "by no means always palatable to major users" who often "expressed open dissatisfaction with…the efficiency of their Departmental operations and what they consider to be the loss of technical 'edge' which central policies impose on them."[33]

In the 1972-73 fiscal year, purchases of administrative computers, not including rentals and supplies, were projected to cost £23.5 million, with scientific computers

[30] PREM 15/412 Government Machinery: Computers 1970-1971, TNA.
[31] HN 1/15 Arrangements for the Setting up of the Central Computer Agency (CCA) 1972, TNA.
[32] CCA, "Notes of a Tuesday Meeting Held in Sir William Armstrong's Room, Management in Confidence," 18 January 1972, HN 1/15, TNA.
[33] HMSO, "ADP Common Services: Organization and Articulation," 11 February 1972, 3, HN 1/15, TNA.

costing £3.7 million.[34] By 1973-74 expenditures for administrative and scientific computers were £72.2 million and £18.8 million respectively. The following year, these figures jumped to £83.9 million and £25.6 million. The government was finally beginning to accept that although computer costs had been viewed as analogous to staff expenditures, it was nearly impossible to compare them: "It is difficult to measure the cost effectiveness of a computer because it usually does tasks which were almost impossible without it, as well as routine tasks which were previously done by clerks or scientific assistants. Thus a completely new pattern of information emerges which is difficult to measure with respect to the old."[35]

As the government's computerization projects in industry and the civil service matured, ICL continued to become more an albatross than an attribute. Their new 2900 mainframe series, the product of years of government-shaped and government-financed research and development initiatives, became available just as the civil service began to turn away from large, centralized computing installations.[36] When ICL encountered delays in making the 2900s available to consumers, the Civil Service Department had to restrain several government departments from canceling their orders and defecting to IBM. The fact that the 2900 line was not yet tested and stable, and the fact that software houses specializing in new software for the 2900 were rapidly going out of business as the delays lengthened, spooked even the few remaining supporters of ICL. Some commonwealth companies canceled their orders for the new mainframes, and multiple British firms opted to enhance their old 1900 arrays instead of taking a chance on the newer, more powerful line.

[34] B.S. Smith, Financial Control Branch, "HMSO Estimate 1972-73," 10 January 1972, HN 1/15, TNA.
[35] Percy-Davis, "CCA Central Planning Document," T 316/308, TNA.
[36] STAT 14/4457 Computer Systems-Liaison with CCB-Conversion to ICL 2900 1976-1977, TNA.

Despite these serious problems, however, the centralized computing authority of the civil service did not renege on any orders, or allow other departments to renege.[37] "The size of HMSO's computer commitment and its tradition of use of ICL machinery would oblige it to continue with that company," since the government had spent years anticipating the new ICL mainframe line, gearing their work's organization towards it, and demanding its specific features and capabilities.[38] The CSD consoled itself and multiple other departments with the claim that migration from ICL 1900s would be easiest when upgrading to another ICL machine.

At this juncture, remaining government support for ICL evaporated quickly, though ICL did receive a farewell £26 million in loans. Redundancies and labor problems at ICL's Northern Ireland factory signaled the beginning of the end for Britain's home-grown computing industry, even as the government frantically pursued alliances with European computer manufacturers like France's state-controlled CII. The days when "Britain, through ICL" might have "achieved strategic independence in the area of computer supply, an essential attribute to sovereign power and leadership in Europe," were long gone.[39] In their place came an era of desperate attempts to find a way to keep ICL profitable and operational while reducing the burden for it on the government.

Technological supremacy and realigning the balance of trade through computing was no longer at stake; instead simply saving the 33,000 jobs ICL provided in the United Kingdom became paramount.[40] ICL's new engineering subgroup IEL "has some 1700 employees of whom 1340 are men," related a government report, adding "there is an

[37] Ibid.
[38] Ibid.
[39] ICL, "Relations with the Government," NAHC/ICL/Aq1, NAHCM.
[40] Treasury, "Confidential Report: Computers and Electronics," 2 January 1973, 3, T 316/308, TNA.

urgent need to find new work if this level of employment is to be maintained."[41] The men of the British computer industry, however, were subject to the same technological and economic miscalculations as the women of the civil service's computing installations, and the rest of Britain's workers in this new, increasingly technocratic era.

6.3 Labor's Increasingly Strained Connection to the Machinery of Government

The Conservative party's ascension to power under Edward Heath in June of 1970, after close to six years of Labour control under Harold Wilson, reflected a sea change from the hope and promise of the 1960s, during which time British technology still seemed to have the potential to transform society and renew Britain's role as a world power. Now a more pragmatic, less optimistic model of technocracy had taken hold, as the government desperately struggled to keep up with the burgeoning complexity and cost of state programs, and no longer believed British computing could be the panacea for economic or social woes. Rather, computing would be an important tool for government control.

Through the 1960s, the treasury kept lists of every single computer installed in government and closely followed the applications of each machine to various projects. By the early 1970s, the treasury had ceased keeping such careful track of each and every machine, focusing instead on the sixty most important data processing installations. The nature of their oversight had changed as well: rather than concerning themselves primarily with issues of expenditure and organization, the central government had become increasingly concerned about the security of their computing systems. In a secret document, the government outlined how these computers, handling the "work most vital

[41] Stevens to Lewin, Brief from Ministry of Commerce in Memorandum, "IEL Castlereagh," 28 September 1972, CJ 4/630 ICL Ltd. Castlereagh, Belfast, TNA.

to government administration," must be insulated against any potential threats posed by dissatisfied workers, a safety measure they felt could best be achieved by further increasing centralization of government computing and its management.[42]

Labour's inability to gain control over the unions and reduce the growing number of unofficial strikes had helped destroy Wilson's chances in the 1970 general election. The response to the crisis by Wilson's secretary of employment and productivity, Barbara Castle, produced the exceedingly unpopular 1969 government white paper *In Place of Strife* which proposed to curb the right of unions to take strike action.[43] Under Heath, the state's concern for the security of the national government grew, along with the fear of organized labor. Heath's less than four years as prime minister were pocked by significant dock workers' and miners' strikes—he declared states of emergency every year he was in power.[44] The miners' strike in 1974 resulted in a mandated three-day work week in order to conserve electricity, literally throwing the work of the nation, and the machinery of government, into disarray. Heath's mishandling of the dockworkers' strike in 1971 and the miners' strike in 1974 ultimately destroyed confidence in his government.

During this time, central control of industry and government and control of unruly, or potentially unruly, workers became increasingly important. Corralling organized labor into compliance with the government's strict monetarist economic

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[42] Interdepartmental Study Group, "Confidential: Report of Industrial Action in Government Computing Installations," October 1973, HN 1/38, TNA.
[43] Barbara Castle, *In Place of Strife: A Policy for Industrial Relations, 1968-1969*, Cmnd. 3888, LIII. 265, (January 1969).
[44] Heath's four declared states of emergency were the most declared by any British Prime Minister. Although Heath declared states of emergency in response to the dockworkers' and miners' strikes, a panoply of comparatively lesser, but still extremely serious strikes plagued his time in office. These included a major post office strike, transport workers' strikes, and industrial action by several civil service groups.

solutions, primarily wage and price controls to control inflation, contributed to a growing rift between the state and the workers who made it run. The treasury still strongly shaped computing policy, struggling to centralize government computing further and refusing to defer to departments to construct their own computing budgets, assess their own computing needs, and organize and staff their installations as they saw fit. The enormous power of computing, once recognized as a benefit, now threatened to destroy the work of government by concentrating power in the hands of potentially unreliable operatives.

In surveying their own operations, departmental management said, nearly uniformly, that the supply of experienced and suitable staff for Automatic Data Processing (ADP) was "wholly inadequate." Both current and planned data processing projects had suffered greatly as a result.[45] Likewise, staff had not seen their prospects improved substantially. ICL, the favored British computer supplier through the early and mid 1970s argued in a report to the government that, "Computers, to date, have not been applied in any great depth to the improvement of jobs, careers and personnel development of the employed population."[46] Half a decade and hundreds of millions of pounds after the inauguration of Labor's technological revolution, this admission did not bode well for ICL's relationship with the ever more automated civil service and nationalized industries. While the British government increasingly relied on computing to transform the very nature of the government's work and the state's relationship with its citizens, ICL could not offer both adequate training solutions and hardware.

By 1971, for instance, the National Health Service required over £1700 million per year and employed over 600,000 workers whose jobs depended on the workings of

[45] "Down Among the Datacrats," 40, HN 1/67.
[46] ICL, "Some Practical Steps in Advanced Management in Government: ICL Report to the Select Committee on Science and Technology," 1970, 30, PREM 15/412, TNA.

data installations, even if they did not directly interact with them.[47] Although computing—first electromechanical and then electronic—was critical to the success of the NHS from its inception, even there, as late as the early 1970s, "a continuing shortage of capable people who can develop and implement computer systems" continued to manifest, hobbling the massive social services project.[48] In the civil service itself, over 700,000 workers, the vast majority of them clerical and administrative, required over £800 million in wages, all tracked and paid by computerized payroll.[49] Yet, the computers used by these civil servants only amounted to about one-twentieth of the sum of their wages. Staff, not computers, were the overwhelming expense and the primary concern in the government's computerization project. Yet often, staff's interests were largely left out in the cold by the focus on computerization.

In 1971, the Society of Civil Servants, a union covering the middle and upper grades of the civil service, complained bitterly to the computers division of the Civil Service Department that firms in private industry were being given the software-writing responsibilities more properly due to civil servants. Seeing their opportunities for advancement through programming and computing training slipping away as the government gave ICL more contracts to provide software for government computers, the Society of Civil Servants moved a motion to censure the government for "the apathetic manner in which they have dealt with the complex and increasing problems in the ADP field."[50] Their concern, given the labor shortages and training problems surrounding

[47] Ibid., 14. The budget for the NHS was projected to grow by at least 8 percent each year.
[48] Ibid., 30.
[49] United Kingdom, *Parliamentary Debates*, Commons, 5th ser., vol. 793 (1969), col. 427-8.
[50] Doris Lancaster, Assistant General Secretary of the Society of Civil Servants, "Software: A Time for Hard Thinking," 19 April 1971, HN 1/68 Consultation with Civil Service Staff Association about ADP, 1971-1972, TNA.

computing in the civil service, was that civil servants were being gradually cut out of the most lucrative computing work in favor of the simpler solution of outsourcing software writing, systems analysis, and even computer operation to ICL. The result was that relatively deskilled data input and data processing was all that was left to many civil servants. The Pay As You Earn (PAYE) tax system alone called for more than 1000 man-years simply to input the initial data.[51]

One leader of the Society of Civil Servants went so far as to tell her superiors that "peasant work" was all that was left to the majority of civil servants working in automatic data processing. Her attempts to lobby the government on behalf of the society for changes in how programmer training was doled out, and how certain higher-level computing work was outsourced, however, went nowhere.[52] Even as the Society of Civil Servants struggled to keep the black box of government computing open to their interventions, the diminution of the civil servant's role in computing and software solutions was already underway. The increasing centralization of computing oversight in one subsection of the Civil Service Department would soon change the face of government computing from a sprawling in-house project to a largely outsourced one.

In April of 1972, the Civil Service Department, with the aid of the treasury, had created the Central Computer Agency (CCA), a sub-department tasked with overseeing the use of computers service-wide.[53] The mission of the CCA was to centralize government computing organization and procedure as much as possible, but the massive

[51] ICL, "Some Practical Steps," 3, PREM 15/412, TNA.
[52] CCA, "Staff in Confidence," 25 October 1972, HN 1/72, TNA.
[53] HN series, TNA. Less than a decade later, responsibility for computing would again revert to the Treasury. In 1970, the Ministry of Technology was absorbed into the Department of Trade and Industry on Heath's ascension to the office of Prime Minister. As a special Ministry set up by Wilson, Heath was not obliged to maintain MinTech.

responsibility accorded to it exacerbated older problems of procedure and control. The CCA merged, or attempted to merge, the Civil Service Department's Management Services (Computers) Division, which had only recently taken over financial control of computerization in the civil service from the unwieldy alliance of the treasury, the Computer Procurement Division and the Central Computer Bureau of the Stationery Office, and the Technical Support Unit (TSU) of the Department of Trade and Industry. As discussed in chapter five, intractable inter- and intra-departmental quibbling had thus far largely thwarted the goal of streamlined, centralized computing solutions. The year after the CCA's inception, the responsibility for telecommunication use and development in government administration was also added to their sprawling mandate.

The aims of the new department were overly ambitious. In addition to trying to streamline the process of procurement, the CCA was tasked with creating a centrally-organized computing apparatus that would allow, "in the future, the government as a major computer user [to] be able to speak more clearly with a single central voice." In terms of computing labor, the new agency strove to institute and expand a more professionalized, regimented system of computer use. Upon consolidation, the new head of the CCA promptly began proselytizing to other departmental managers about his agency's vast new responsibilities: "The government welcome this opportunity of paying tribute to the work done by computer staffs within the present organizations," he announced, "but [we] are convinced that a single central organization will be more effective and offer greater opportunities to the staff concerned…. The agency itself will

offer greater scope for increased professionalism and for computer careers in government."[54] In fact, it offered neither.

The scientific management of the CCA, he believed, would supersede the well-intentioned, but benighted attempts of both the individual departments and the treasury's previous regime of centralized control. Professionalism, "computer careers," and greater opportunities were all coded references to the fact that these jobs would require management-caliber civil servants from the executive grades from now on. The CCA planned to groom a cadre of high-level technocrats, and as "major government functions become more dependent in ADP, the importance of this small proportion of staff will increase."[55] These workers would be reliable career civil servants who could be integrated into the management structure to participate in implementing the central government's vision of computing, and the state. No longer would it be possible for computing staff to be interchangeable workers, however competent, who were simply trained to do computing jobs.

6.3.1 Securing the Machinery of Government, Literally and Figuratively

While amalgamating these functions into one departmental unit, and increasing the professional standard of technocratic management, made sense in light of the wasteful replication of effort and poor planning under the old model of organization, the theory behind the CCA's mandate also traded on the perceived need to professionalize computing out of organized labor's reach. As nationwide labor unrest in response to wage restraints threatened the government's control over the British economy, maintaining the security of computing systems became an ever more pressing concern. In 1973, machine

[54] United Kingdom, *Parliamentary Debates*, Commons, 5th ser., vol. 833 (1972), col. 363-4.
[55] R. D. Aylward, CCA, "Computers in National Administration," 31 October 1972, 5, HN 1/72, TNA.

operators and data preparation staff at several government computer installations went on strike during different periods, for up to two weeks at a time.

These actions prompted a major re-evaluation of the security of the government's computing installations. In a secret, numbered-copy report whose circulation was tightly controlled, the CCA drew up a list of the sixty most vital computing installations in government, compiled a list of industrial actions in computing centers to date and the effects in each case, and offered appraisals of multiple solutions to potential future disruptions.[56] So important were long-term security goals that the report explicitly stated that security considerations might be "an important factor in determining the appropriate form of computing for particular operations." The use of "cheap, small computers and intelligent terminals could make it possible to process information" without recourse to a large central computer installation. "This has obvious advantage" the CCA reported, "in that it disperses and reduces the target for many forms of physical attack. It would also help to reduce the impact of industrial action – which would have to be mounted and sustained on a much larger scale than would be necessary to achieve maximum disruption at a central installation."[57] The CCA's dim view of computer staff would continue to limit training opportunities for many civil service computer workers through the 1970s.

Most of the critical computing installations were not, as might be expected, in defense. The defense applications of computing were, surprisingly, of little immediate concern to the CCA. Payroll, social security, and the payment of pension or unemployment benefits formed the work of the United Kingdom's most critical computing installations. Stock control, savings bank accounts, VAT, PAYE, tax

[56] CCA, "Industrial Action," HN 1/38, TNA.
[57] Ibid., para. 22.

collection, and driver licensing followed closely in importance. In all of these cases, no reversion to a manual system was possible, and the ease with which the systems could be sabotaged without unions even taking official strike action spooked the CCA enough to suggest that government staff should potentially be laid off and the computing work of government privatized. It would be very easy, for instance, to sabotage a full day's work by "switching labels" on output disks and scratch disks, or cause "damage to sensitive magnetic components and to easily accessible parts of the central processing unit or ancillary equipment," CCA report warned. In some cases, a simple "disregard of operating instructions" would be enough to severely handicap the work of an installation, all the while remaining under the radar as a deliberate action of organized labor.[58]

Had the work been privatized, ICL may have gotten a significant share, but a more likely beneficiary in 1973 would have been the UK office of IBM, whose larger staff was better equipped to deal with such an influx of new work. As an added bonus, no portion of the staff at IBM UK was unionized, or likely to unionize.

IBM UK took aggressively anti-union measures to protect its offices from unionization even in the face of significant worker pressure. In 1975 through 1977, both professional and manual employees had tried to use the 1975 Employee Protection Act to unionize. IBM UK fought the unionization attempt bitterly, and over the course of several years spent thousands of pounds on internal and external public relations campaigns aimed at painting the trade unionists as outsiders and troublemakers who would ruin the current, beneficial system of corporate paternalism and merit pay for IBM staff. The unions were thwarted from ever presenting their case to IBM employees, while internal memoranda warned managers and workers alike about the dangers of allowing in unions,

[58] Ibid., para. 9.

intimating that IBM UK's corporate paternalism would abruptly end, and the company would be forced to take an adversarial role, if workers organized. In 1977, workers voted down the ballot on unionization by an overwhelming margin.[59]

The defeat of the unionization attempts at IBM had as much to do, however, with the fact that most IBM workers saw themselves in a light that made unionization an unlikely goal. Having been carefully groomed into a "professional," management-aspirant identity, IBM workers from the lowest to the highest represented the government's ideal technologists. So identifying, most of the IBM workforce predictably wanted nothing to do with unions, finding them distasteful accoutrements of a lower, working-class background. Even those who did not identify as professionals sometimes shared these ideals, as in the case of one self-proclaimed "working-class, non-management" IBM staff member who wrote a letter to the editor proclaiming his distaste for the unions. It was a testament to the reach of IBM's disinformation campaign that the letter-writer felt the need to assert that he was not a "paid, professional letter-writer" on behalf of the company.[60]

The government did not outsource its computing to IBM UK or ICL in any large measure by the mid 1970s. As a result of the treasury and Civil Service Department's desire to keep computing in-house for maximal control, the solution could not be that simple. The government recognized the need to carefully groom and maintain good staff relations with the increasingly important technical staff, "but we have to find more of the right people to meet immediate needs and those who, in a decade or so ahead, will be the

[59] CW 2/30-34, Employment Protection Act 1975: IBM UK Ltd. London and Greenock, 1975-1977, TNA.
[60] Ibid.

senior administrators in a highly technological environment."[61] The CCA kept a service-wide register of management-level ADP staff, and encouraged these workers to take time off for training courses paid for by the government.[62]

Yet these staff were not the whole story.[63] In assessing the difficulties posed by potential strike action, several government departments found that the centralization of their computing resources had put them at a major disadvantage. The Department of National Savings, for instance, feared the effects of even a limited puncher or operator strike because if their main accounting computer were taken down for any period it would "bring the business of the National Savings Bank virtually to a complete standstill," during which "updating of all computerized accounts and manual accounts would be impossible," hugely increasing the risk of fraud and overdraft, to say nothing of the inconvenience to customers.[64] Their other, smaller computer installation processed fortnightly dividends for British Savings Bonds, and so could not take on the work of the main computer. A strike at either of their two computer installations would have had the effect of halting their business, leading to major disruptions for their customers, and potentially losing the public's trust and future business. Even a relatively minor strike action involving no more than one hundred unionized computer staff at the bank "would be little short of disastrous," they believed.[65]

[61] S. W. Spain, "High Quality Staff for ADP Work, Table I: Forecast of Numbers of Staff Required, 1972-1977," 21 December 1972, 7, HN 1/72, TNA.
[62] R. Gapp, "Staffing," 3 November 1972, 3, HN 1/72, TNA.
[63] This report projects the numbers of ADP staff rising from about 9000 to 16,600, with data preparation making up about half, operations making up about 20 percent, and systems and programming making up about 30 to 40 percent of the total. Spain, "High Quality Staff," 7, HN 1/72, TNA.
[64] Department of National Savings to CCA, letter, 11 January 1973, HN 1/38, TNA. The National Savings Bank was known as the Post Office Savings Bank before 1969.
[65] Ibid.

The government's fears were well-founded, as computer strikes did become a significant problem in the 1970s, and a powerful weapon of organized civil service labor. In March of 1973 a series of selective one-day strikes by the Civil and Public Services Association (CPSA) and Society of Civil Servants closed down twenty-six installations, including several listed as highest priority, and significantly disrupted nine other computer centers. The short duration of these strikes made them "more an irritant" than a significant problem, but the effectiveness with which the unions shut down so many of the computing installations by withdrawing relatively small numbers of workers pointed to the potential for significant future problems. Equally worrisome for department heads was the fact that a clerical union, the CPSA, was colluding with a mid-grade and executive class union. As government workers in the lower, middle, and portions of the upper echelon of the service all joined together to make their displeasure with the government's computing regime known, the CCA's organizational and management agenda became more urgent.

Even worse than the initial, brief strikes were the labor slowdowns and instances of passive resistance that followed. Computer center workers at several dozen government installations refused to perform mandatory overtime and other work that was not explicitly spelled out in their job responsibilities. Both performance of mandatory overtime, or the removal of overtime opportunities were a major point of contention for computer workers, highlighting the fact that the workers concerned were still largely wage-earners, rather than salaried employees.[66] The slowdown significantly hindered through-put at each computing installation, causing several projects to miss their target dates, which in turn caused a snowball effect that made other projects impossible for the

[66] CCA, "Industrial Action," para. 21, HN 1/38, TNA.

time being. Secondary and tertiary projects that relied on these targets were slowed or scrapped, while at the same time new projects that required these bottle-necked computer installations were forced to reschedule.

Finally, and most seriously, the CPSA organized strikes of data punching staff and operators for periods of seven days or longer. Ten installations were inconvenienced by a delay of their work, among them the Department of National Savings, but the VAT computer center was critically affected, and the implementation of the new VAT system was not completed on time as a result. In most cases, the departments were able to use the extended downtime to perform essential systems maintenance; still, these prolonged walkouts heightened the fear that a more extensive strike might in the future hobble multiple computing installations at once.[67] The CCA and treasury became increasingly concerned; every hour computing power was not maximized, the government lost money. The unpopular shift-work schedules were themselves an attempt to keep these expensive machines running as much as possible. Staff wages, computing infrastructure, and reduced productivity at these slowed sites cost the treasury tens of thousands of pounds each day.

With ADP (Automatic Data Processing) staff increasing by 25 percent or more each year in the decade between 1960 and 1970, thousands of workers within central government were responsible for running, programming, or preparing data for computer installations. The government's most valued ADP staff—the Executive Officer class operators, programmers, systems analysts, and computer center managers who collectively made up roughly 32 percent of the whole civil service computing workforce by 1972—were the fastest growing cohort of technologists, and were slated to increase by

[67] Ibid., para. 18 and App. II.

30 percent within the next year, and by more than that each following year.[68] Yet, these posts were plagued by vacancies and high turnover. On average, over 6 percent of the posts were vacant, primarily in programming and the executive trainee grades. Shortages of advanced computing project managers, though smaller, were more critical, and recruiting competent people for these posts was even more difficult. So short-handed were many installations that the required training for computing employees was neglected or postponed indefinitely, just in order to keep the machines running.

This intractable situation created a cycle of perpetual shortage and amateurism. The Civil Service Department and treasury considered contracting the computing work of the civil service out to computing companies in order to solve this problem, but ultimately demurred. In addition to angering the civil service unions, this solution could not get to the root of the problem.[69] The service needed native, career-long specialists "of very high caliber" to "specify, monitor, and control" the work, even if it were done by contractors. Computer company contractors could run the machines, but they could not and should not be the state's resource for administrative and management personnel. As a result, the civil service created a subgroup for "highly professional" computer workers in the executive class. They would be a specialized cadre of technocrats on whose skills the government's computing projects would prosper or falter.[70]

These men would be the vanguard of a new model of governance: "Administrators have come to depend on computers not only as permanent replacements for large numbers of clerks, but as tools, and will increasingly look to computers to

[68] Indeed ADP staff had been growing at a rate of at least 25 percent per year for 12 years. CCA, "Management in Confidence: Report of the Interdepartmental Working Party on Staffing of Computer Projects," September 1972, HN 1/72, TNA.
[69] HN 1/68, TNA.
[70] CCA, "Staffing of Computer Projects," 7, 13, HN 1/72. TNA.

improve the foundations of policy decisions… and the quality of service to the public"[71] Increasingly the highest ministers of the civil service ascribed to an image of government in which "increasing dependence on computers was an essential part of the administrative system in which they operate." Although computing hardware solutions were becoming more stable and flexible with each passing year, the problems of constructing work for these machines was becoming ever more complex. "Computing is still in its infancy and new technologies and techniques no doubt lie ahead," wrote a high CCA official, but, he pointed out, "For the immediate future there is much which has yet to be fully exploited to the benefit of administration." While "technical problems are gradually being surmounted," nevertheless, "the managerial and social" issues "are likely to be difficult."[72] Making attractive career ladders for the most desirable computer professionals, like programmers and analysts, would help ease the problem and integrate individuals with these critical skills into the government's executive structure.[73]

The government faced a growing, potentially intractable problem: they needed more data workers, but were unable to pay the fair market rate for this scarce commodity, regularly incurring the wrath of the civil service unions. The problematic nature of this position was heightened by the fact that there was no longer any possibility of a temporary manual fall-back in many cases, and furthermore, these computer workers possessed competencies that their managers often did not, making it difficult or sometimes impossible to temporarily substitute non-unionized Higher Executive Officers for striking computer workers, as had been done in earlier strikes.

[71] Aylward, "Computers in National Administration," 9, HN 1/72, TNA.
[72] Ibid.
[73] HN 1/22 Report on Development Of Computers In Government: Forecast For Next Ten Years 1969-1971, TNA.

6.3.2 Gender as Class

In computing strikes, unlike the mining and dockworkers' strikes, the delineation of a large proportion of workers from managers was not only one of class, but of gender.[74] In July 1970, the newly-agreed pay scales for machine operators raised wages by roughly 12 percent above 1969 rates. This was the largest rate change in several years: wages had only gone up by 3 percent in 1968, and by roughly 6 percent in 1967.[75] Even so, machine operator jobs in government were not highly paid when compared to industry. More problematic, however, was the fact that when the machine operator pay scales ended around age twenty-five, there was no where to advance.[76] The candidates for higher computing jobs were rarely, if ever, promoted from within the machine grades, who were firmly stuck on the operative, rather than the administrative side of government computing.

Departments had begun to self-consciously market higher machine operating posts to young men in the 1960s. By the 1970s, all recruitment for higher-level computing staff was done in the Executive Officer Class meaning that no clerical or machine workers could move up in computing.[77] This resulted in a bifurcated machine class: operator jobs were almost evenly divided between young men and women, while data preparation and data input staff remained exclusively female. Programmers and systems analysts were predominantly men. The most damaging labor action against

[74] Laura Lee Downs gives an example not only of the existence of gendered classes of workers in British industry, but of British companies' explicit interventions to perpetuate such classes of female workers in her article on Rover's abortive attempt to concede equal pay in order to institute a Fordist model: "Industrial Decline, Rationalization and Equal Pay: The Bedaux Strike at Rover Automobile Company," *Social History* 15, no. 1 (1990): 45-73.
[75] CAOG 16/213 Pay: Machine Operator Grades, 1957-1970, TNA.
[76] Previously, promotions ceased around the age of thirty, but the promotional scale had to be sped up in order to allow the government's wages for computer staff to be at all competitive with industry.
[77] HN 1/72, TNA.

government computing was taken by the all-female punching grades, and the gender-integrated operator grades, confirming the CCA's worst fears. [78]

In many ways, the situation in government computing was an artifact of larger social and labor trends. In large part the problems plaguing the modern office turned on changing work methods, such as increasing automation, that tended to alter long-established management routines. But they also owed a debt to the changing shape of the office workforce. By the 1970s, the decades-long feminization of clerical labor forces had begun to take a significant toll on the civil service. An article in a 1967 issue of *Office Methods and Machines* magazine, a publication aimed at the interests of managers and executive staff in industry and government, warned that according to a recent government report shamefully few of the 25 percent of young school-leavers who went into office work were given anything more than rudimentary training. Considering clerical work "an unavoidable but increasingly costly evil," managers had begun to ignore the importance of the workers, even as they gained relatively more power and importance.[79]

The "balance of the sexes," the author pointed out, had become reconfigured in the field of office work in general and the civil service in particular. In only the past fifteen years, the proportion of young men entering offices remained flat, while the proportion of young women had risen from 31 percent to 40 percent. These large numbers of female office workers were not, in the main, being absorbed into typing or data entry work. Census figures show that women entering clerical work excluding

[78] CCA, "Industrial Action," para. 18 and App. II, HN 1/38, TNA.
[79] "To Train or Not to Train?" *Office Methods and Machines*, September 1967, 15-17, T 222/1314, TNA.

typing and data entry rose by just under 26 percent from 1961 to 1971.[80] "While boys are taking advantage of the opportunities for further education and of entry to jobs in the new technologies and are thus lost to office work forever," the need for professional and specialist office supervisory staff was rising. The result was a growing over-production of the wrong kind of worker for the modern office.[81]

From 1950 to 1966 wages and salaries in the aggregate had nearly trebled, while gross trading profits of companies had little more than doubled.[82] A wide array of business literature, consumed by management in industry and government, grappled with the paradox of how to make workers more efficient and valuable while simultaneously avoiding any unnecessary training outlays for employees who would likely leave before employers could get a full return on their training.

The need for more specialist staff, like computer operators, and more supervisory staff, like managers and systems analysts, had resulted in an increase in training, but, "in practice this really means training for male office staff only," the author noted. This group comprised a new and growing "administrative" class, requiring "education in complex techniques and business practices as well as a wide knowledge of the overall activities of the employing company." By contrast, the "operative" group within office staffs "receives training mainly in the manual skills needed to work individual office machines." Not surprisingly, he relates, "most 'operative' jobs are performed by female

[80] Office of Population Censuses and Surveys, *Census 1961, Great Britain, Summary Tables* (London: HMSO, 1966), 67; Office of Population Censuses and Surveys, *Census 1971, Great Britain, Part II, 10 % Sample* (London: HMSO, 1974), 54.
[81] "To Train or Not to Train?", 15-17, T 222/1314, TNA.
[82] Ministry of Labour, *Statistics on Incomes, Prices, Employment, and Production,* No. 19 (London: HMSO, December 1966), 4-5.

staff, and this group is absorbing the majority of the present 40 percent of girl school-leavers entering office work." [83]

These young women, he pointed out, might have previously gone into factory or retail jobs, "which again indicates that *different people* are now being recruited for office jobs" (italics mine). "It can be argued that this is not inappropriate," he reasoned, "since many 'operative' jobs involving the use of office machinery now closely resemble the sort of light production work that these entrants might have done on the factory floor." [84]

From the perspective of a government having increasing difficulty controlling just these sort of manual, industrial workers, however, this shift was a major problem. If the entry of such workers into the higher echelons of the civil service were not restrained, they might upend the system itself. The perceived diminution in office worker quality had as much to do with gendered training regimes, as it did with the rising proportion of women, many of whom came from a different class background than previous office work recruits. Even so, these social and economic changes during the 1960s and 1970s did little to significantly alter institutional preference for certain young men trainees for career-long development. That is, until UK employers suddenly found themselves actively discouraged from maintaining current patterns for gendering jobs in industry as a condition for EEC integration.

A review of the Machine Operator grade in the civil service conducted from 1961 to 1970 showed pervasive institutional reluctance to admit women to roles other than "operative" ones, or indeed to admit that women were performing work that could be

[83] "To Train or Not to Train?", 17, T 222/1314, TNA.
[84] Ibid.

categorized differently.[85] Industry-wide, nearly nine times as many men as women held jobs that were classed as "professional." Over three times as many men held executive positions in the civil service as women, while in industry men in office management positions outnumbered women by almost six to one. Amongst machine operators in industry and government, however, there were still more than six and a half times as many women as men in 1971. [86]

During the same span of time, women's trade union participation leapt, bringing women trade unionists from a quarter of all union members nationwide up to a third.[87] Treasury and Civil Service Department officials inspected over twenty-eight departments in the late 1960s for evidence that a new, higher promotional outlet was required for workers in the Machine Operating grade. Even as women's collective voice in organized labor grew louder, government and industry policy did not cater to them. Instead of adding a higher grade to the Machine Operator's career scale, more effort was made to bring Executive Officers into these better automation jobs.[88]

Despite the fact that higher positions in government and industry increasingly required the technical skills that many machine operators possessed, most operators were cut out of such career progression. Rather than promoting people up from within the machine grades, the government still chose to train operatives of a different class to fill the newly-computerized machine grade's highest and most responsible posts. The government's actions, justified from the perspective of what it believed to be sound

[85] STAT 14/2765, Review of Machine Operator Grades 1961-1970, TNA.
[86] Office of Population Censuses and Surveys, *Census 1971, Great Britain, Economic Activity, Part IV, 10% Sample* (London: HMSO, 1974), 52, 54, 64.
[87] *Equality for Women*, Cmd. 5724 (September 1974), 2.
[88] Treasury, "Notes of Confidential Interdepartmental Meeting held on 28 May 1962," T 216/710 Redundancy Owing to the Introduction of Computers, TNA.

management practice, underscored the contention of the House of Common's study on women and work equality three years later: "The restricted nature of the opportunities open to young women to train for skilled work reinforces the tendency for women to fill the lowest paid, least satisfying jobs…. They are less likely to be promoted than men and are generally treated as unsuitable to be in authority over men."[89]

6.4 Gaining Equal Pay, Again

In 1969, the Central Office of Information for the Department of Employment released an animated public service film called "Job for Young Girls" that implored young women and their parents to take careers for women seriously.[90] Between 1961 and 1971, the proportion of women in the workforce had rocketed up by 18 percent, even as men's workforce participation slightly declined (by 2 percent).[91] The film presents the cautionary tale of a woman left to fend for herself after her husband and children are gone. It depicts her rise and fall beginning when she takes a job in a factory as a young person, earns good money, and has an active social life. She leaves her job when she gets married and has children, but after raising her children she is left on her own, and has to return to the same unskilled factory work that she was doing all those years ago when she had just entered the workforce.

The film's message, addressed as much to the parents of the potential school-leaver as to the young woman herself, was clear: society was changing, and they had to adapt. It was no longer the best option for a young woman to get a job that paid well in

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[89] *Equality for Women*, Cmd. 5724 (September 1974), 2.
[90] Central Office of Information for Department of Employment, *Jobs for Young Girls* (1969), 49 sec.; from TNA, *Public Information Films, 1964-1979.*
Quicktime, http://www.nationalarchives.gov.uk/films/1964to1979/filmpage_jobs.htm (accessed 17 March 2008).
[91] Censuses and Surveys, *1961, Summary Tables*, 64; Office of Population Censuses and Surveys, *Census 1971, Part I*, (London: HMSO, 1974), 4-5.

the short term if it lacked room for life-long advancement. The narrator of the film attempted to persuade the target viewers of the wisdom of this course of action, rather than offering much material insight into how girls might go about getting careers rather than jobs, or even what sort of work might be suitable or available.[92]

Despite the government's propaganda, the idea of equal job opportunities for women still had yet to gain significant traction in British society. Indeed, actions taken by the highest-level ministers in the civil service, from the exclusion of the machine grades from equal pay to the limited promotional outlets available to large sections of the feminized clerical and machine grades, perpetuated informal segregation of jobs. The government's reluctance to equalize pay in industry for fear of triggering inflation, contradicted their propaganda about equal opportunity in careers for women.

Ultimately the film tended to underlined young women's uneasy place in the modern British economy, given the conflicting dictates of the role within society and the family they were expected to fulfill. It also rehashed well-worn stereotypes about out-of-control girls who, once given a wage and their freedom, would lead irresponsible and self-destructive lives. The girls targeted by the movie were encouraged to see their career counselors at school for career information. Yet counselors, by and large, continued to

[92] In 1961, the number of divorced women, 183,000, or roughly one out of every 65 married women, was still negligible. More statistically significant was the number of widows at just under 3 million, although these were concentrated in the over 65 age group, while the highest numbers of divorcees were clustered in the 25 to 55 age range, peaking in the 35 to 45 age group. Divorced women, therefore, peaked in the age range where women would still be most likely capable of going to work. By 1971 the number of divorced women had increased by more than 60 percent, still peaking in the 35-49 age group. This public information film no doubt hoped to allude to the rising number of divorcees as a cautionary message for young women who might previously have imagined that they could leave the workforce permanently if they married well. By 1981, the number of divorced women had exploded, more than quadrupling the 1961 figure, with over 850,000, or 1 out of every 15 married women getting divorced. Their numbers also peaked in a younger age group, from 30-34 years old. Censuses and Surveys, *1961, Summary Tables*, 4-5; Office of Population Censuses and Surveys, *Census 1971, Great Britain, Age, Marital Condition and General Tables* (London: HMSO, 1974), 26-27; and, Office of Population Censuses and Surveys, *Census 1981, National Report Great Britain, Part 1* (London: HMSO, 1983), 15.

send most girls down the path of least resistance, and into the same jobs the film warns against—traditionally feminized work that held little room for career advancement. While well-meaning, the film highlights the schizophrenic paradigm professional women were advised to enact by carefully maintaining (limited) career prospects while spending equal effort maintaining a home or raising a family.

At roughly 8 million in 1965, the number of women in the British workforce was slightly less than half of the number of working men. Over 2 million women, 25 percent of all working women, were concentrated in clerical work. By contrast, under 10 percent of all men worked in offices; men office workers, numbered under 1.5 million in 1961, and their numbers were falling. Between 1961 and 1971, the number of men clerical workers fell by 5.6 percent, while the number of women in clerical work shot up by 26 percent.[93] By 1971, 41 percent of all women worked, and the number of working women had grown to more than 8.7 million, making women 36 percent of the total workforce.[94] In the London area, the highest workforce participation rates were recorded, with more than 60 percent of women in the workforce. [95] Amongst younger age groups, higher proportions of women worked, with the exception of the thirty to thirty-four age group, in which workforce participation dipped dramatically. Over 80 percent of the roughly 10.5 million single women worked, while just under 45 percent of the roughly 13 million married women had paying jobs, nearly half of them full-time. At the same time,

[93] Censuses and Surveys, *1961, Summary Table*, 64, 67, 4-5; Censuses and Surveys, *1971, Economic Activity: Part I*, 1.
[94] Office of Population Censuses and Surveys, *Census 1971, Great Britain, Economic Activity: Part I* (London: HMSO, 1973), 1.
[95] Audrey Hunt, *A Survey of Women's Employment: A 1965 Government Social Survey* (London: HMSO, 1968), 22-23.

more than 75 percent of all working women were responsible for running a household, highlighting the dual role that the majority of women played within British society. [96]

Despite growing representation in the labor market, only one in every 20 women earned more than £20 per week. [97] A yearly salary above £1000, often achieved by men, was a relative rarity for women. While women in the civil service fared better than most, the attainment of such salaries by members of the former machine grades sounded alarms for government hiring managers. The salaried women whose job categories in the administrative, professional, and clerical grades of national and local government (including teachers and NHS employees) or the nationalized industries had roughly equal numbers of men kept pace with men's wages, owing to the 1954 Equal Pay Act for government workers.[98]

By 1971, women's participation in the labor market had changed significantly from just a decade earlier. Yet occupational segregation by gender within the labor market, had not changed much. Feminized occupations showed little sign of integrating, and only women who worked for the government or nationalized industries in non-feminized job categories were legally entitled to equal pay with men. Women in industry or in machine jobs within government did not have any applicable equal opportunity or equal pay legislation. At the same time, the increasing feminization of clerical work threatened to downgrade the respectable office jobs to which greater numbers of women aspired each year.

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[96] Hunt, *Women's Employment*, 22-23.
[97] Ibid.
[98] Women's salaries in these areas lagged by only 1.4 to 1.6 percent in 1967. These figures covered roughly equal numbers of men and women (approximately a million each). They did not, however, account for part-time workers, or employees paid by hourly wage instead of salary. Ministry of Labour, *Statistics on Incomes, Prices, Employment, and Production*, No. 23 (London: HMSO, December 1967), 49.

A tumultuous 1968 strike of women at two Ford manufacturing plants in the United Kingdom was the public relations lynchpin for the successful hearing of the bill to create a national Equal Pay Act.[99] Female sewing machine operators at Ford had been re-categorized as "unskilled" workers, despite doing work identical to men classed as "semi-skilled." This sparked outrage and brought work at Ford's plants to a halt for three weeks. In negotiations, the women won 92 percent of the men's rate, but their work classification was not upgraded to "semi-skilled," undercutting the principle behind their protest. With the Ford women's strike leveraged as a parable, labor MPs, like Barbara Castle, were able to bring equal pay legislation into the national consciousness more successfully than had been possible earlier in the 1960s. Castle, an outspoken Labour reformer who had unsuccessfully attempted to integrate equal pay for women into the prices and incomes policies of the mid 1960s, successfully moved the Equal Pay Act of 1970. [100]

While guaranteeing women workers equal pay with men throughout industry, the act had several serious flaws. In an effort to secure its passage, no provision was made for equal employment opportunity, only equal pay where men and women were already doing the same work, or "work rated as equivalent" or "of equal value."[101] In order to gain equal pay, women had to compare their work and wages with those of a man working within the same company contemporaneously. In feminized fields where there were no suitable and immediate male "comparators," equal pay would remain impossible. In Britain's largely gender-segregated workforce, where millions of women were

[99] Downs, "The Bedaux Strike," 45-73.
[100] Barbara Castle, *The Castle Diaries, 1964-1970* (London: Weidenfeld and Nicolson, 1984), and *Fighting All the Way* (London: Macmillan, 1993).
[101] *Equal Pay Act 1970*, c. 41, para. 4, 5.

concentrated in under a quarter of industries and only certain jobs, many could not benefit from the provisions of the Equal Pay Act.[102]

In addition, the act did not have specific enforcement machinery built into it, in order to meditate claims for equal pay. Class action complaints were not allowed, so the onus and expense of bringing an equal pay complaint rested squarely with the individual employee, who could take her case to the industrial tribunal for arbitration.[103] Even after going to these lengths, one could only be granted remuneration in arrears for up to two years prior to the date of the complaint.[104]

Britain's acceptance into the EEC in 1971 made the enactment of sex discrimination legislation a requirement. As Prime Minister, Edward Heath had made entry into the EEC a key part of the conservatives' platform in the June 1970 general election; that British legislation against sex discrimination would be a necessity for integration had been long understood.[105] Although 1970 saw the passage of the Equal Pay Act, the provisions of the act would not be made law until December 29, 1975. This was so government and industry could have time to bring their operations into compliance with the new law. The five-year delay in enacting the Equal Pay Act, however, also had the effect of allowing employers time to change the organization of work in ways that would make jobs in the highly feminized segments of their workforces incomparable with

[102] Jean Martin and Ceridwen Roberts, Office of Population Censuses and Surveys, *Women and Employment: A Lifetime Perspective* (London: HMSO, 1984), 25.
[103] Margherita Rendel, "Legislating for Equal Pay and Opportunity for Women in Britain," *Signs* 3 no. 4 (1978): 897-908.
[104] Bill [passed, cap. 41] To Prevent Discrimination, As Regards Terms And Conditions Of Employment, Between Men And Women [As Amended by Standing Committee H] (Equal Pay (No. 2)), 130, 1969-1970, I.1173.
[105] David Gowland and Arthur Turner, *Britain and European Integration, 1945-1998: A Documentary History* (London: Routledge, 2000), 127-135.

jobs done by men. In so doing, they could avoid the prospect of having to increase the pay of vast numbers of women workers where only one or two men did the same work.[106]

Yet such dodges were not necessary in most cases. The limitations of the act meant that employers had to do relatively little in order to be in compliance. The existing segregation of men's and women's jobs meant that equal pay was much less far-reaching than the backers of the original bill had intended. Fewer than a third of women in industry were doing the same work as men, and in cases where a woman argued that her work was the same or broadly similar to work done by a man for higher pay, her claims were subject to a high level of scrutiny; the industrial tribunal, in fact, could decide to hear the employer's arguments only before ruling on whether to hear the case on its merits.[107]

The most effective measure instituted by the Equal Pay Act of 1970 was the elimination of separate wages for men and women in collective bargaining agreements.[108] This resulted in a jump in earnings for women in 1975 when the act came into effect. In 1970, women industry-wide earned only sixty-three pence on the pound compared to men. In 1975, and the two years following the enactment of the Equal Pay Act, this shot up to seventy, and then seventy-four pence for every pound earned by men. By the late 1970s, however, it had begun to creep downwards again.[109] Perhaps more important to women's pay in these years was the effect of incomes policy, which increased wages by a flat rate rather than a percentage.[110] As a result, incomes policy helped the lowest paid

[106] Baroness Beatrice Nancy Seear, Interview by Betty Scharf, February 1991, 8/NLS/4, WL.
[107] Z. Tzannatos, "Narrowing the Gap: Equal Pay in Britain 1970-1986," *Long Range Planning* 20 no. 2 (1987): 74.
[108] Ibid.
[109] Audrey Hunt et. al., *Women and Paid Work: Issues of Equality* (New York: St. Martin's Press, 1988), 106.
[110] Seear, Interview by Scharf.

workers, among whom there were more women than men.[111] Indeed, the government carefully orchestrated equal pay within industry in order to make sure that raises for employees under the equal pay provision did not undo their strict control of wages through income policy and lead to inflation.[112]

In 1974, after the re-taking of the premiership by the Labour Party under Harold Wilson, a government white paper "Equality for Women" reviewed the shortcomings of the act on the eve of its accession into law. As a result, in 1975 a separate Sex Discrimination Act brought in additional legislation and enforcement machinery, but failed to adequately strengthen the original act. Indeed, the EEC brought infringement proceedings against the United Kingdom on the basis that their equal pay act did not adequately account for institutionalized job segregation, and failed to comply with the Treaty of Rome by not including provisions for equal pay for work of equal value.[113] Despite the scramble to upgrade women workers to fully equal status in the 1970s, the feminization of certain jobs and industries, and even the vertical job segregation within industries and offices was not affected.

At the same time, the 1970s saw a decline in full-time jobs and a rising proportion of part-time workers became a major feature of the British economy.[114] This contributed to an overall "feminization" of the labor market; that is, many workers increasingly were slotted into work opportunities and structures that had previously been taken for granted only by working women. Between 1971 and 1984 several occupational categories

[111] Orley Ashenfelter and Richard Layard, "Incomes Policy and Wage Differentials" *Economica*, New Series 50 no. 198 (May 1983): 127-143.
[112] LAB 112/95, TNA.
[113] This resulted in Britain passing the 1983 addendum to the Equal Pay Act, which came into force in January 1984.
[114] Hunt et. al., *Women and Paid Work*, 198.

underwent major gender shifts. Clerical occupations continued to feminize, with women's participation growing by another 11.5 percent during this period, while the numbers women in health and welfare professions rose the most – by 46.8 percent. Meanwhile, men's participation in clerical work dropped by close to 20 percent, rose by roughly 28 percent in engineering and scientific jobs, and by 21.5 percent in management and administration jobs.[115]

Consequently, men's employment expanded the most in areas that were generally higher-paid, higher-status, and full-time. Women's employment expanded in lower-paid and part-time employment in the service sector and in areas of employment like clerical work whose long-term feminization had led to depressed wages compared to other industries requiring similar worker qualifications. While women's employment within the United Kingdom was above the EEC average when women's jobs were counted without regard to full or part-time status, their share of employment dropped below the EEC average when part-time work was instead viewed according to full-time equivalencies. Indeed, by the mid 1980s, 45 percent of all employed women were engaged in only part-time work.[116]

According to a 1980 government-backed study, 29 percent of all female clerical workers (encompassing computer operators, data processors, and punch card operators) worked part time, while only 19 percent of all female intermediate non-manual workers (encompassing higher civil servants, computer programmers and analysts) did.[117] The necessity of shift work for computer operators through the mid 1970s ironically may have made such work more conducive to part-time working women, while full-time

[115] Ibid., 199.
[116] Ibid,. 200-201.
[117] Martin et al., *Women and Employment*, 21-25.

professional jobs remained less attainable. Such logical labor trade-offs, however, had an extremely negative effect within a relatively small working population. The government's report on equal pay and equal opportunity correctly discerned that this "unequal status of women is wasteful of the potential talents of half our population in a society which, more than ever before, needs to mobilize the skill and ability of all its citizens."[118]

6.5 Microelectronics and the Final Bifurcation of Government Computer Workers

On the operative side of civil service computing, new technology had begun to allow decentralization of lower-level operatives in a less disruptive fashion. The days when punching staff would be moved around from installation to installation in order to take up excess data entry work were rapidly disappearing.[119] Yet the institution of more decentralized computing technology, such as terminals connected by data links, brought with it other problems for lower-level computing workers. Decentralized computing technologies required re-training, but the civil service refused to accept that the new technologies required any higher level of skill. In fact, because the facilities for timing and measuring work output were greater with the new, linked terminals, many data input staff found themselves doing more work, faster, for the same amount of pay.[120] Clerical unions' resistance to these new methods was mostly futile, particularly because an estimated quarter million clerical jobs were slated to be eliminated as a result of the new methods.[121] Mainframes and their attendant centralization were on the way out by the late

[118] Home Office, *Equality for Women*, Cmd. 5724, (London: HMSO, September 1974), 4.
[119] HN 1/25 Management Issues Arising From Introduction of Data Preparation Work 1970-1979, TNA.
[120] HN 1/1 Effects on Staff of Technical Developments in Computing, 1979, TNA.
[121] C. J. Hancock and Working Group, "Personnel Implications of New Microelectronics Technology," 22 August 1979, para. 4, HN 1/1 Effects on Staff of Technical Developments in Computing, 1979, TNA.

1970s, while microcomputing was beginning to revolutionize government data, allowing departments to use computing more flexibly, and for smaller, less expensive tasks.[122]

Likewise, relatively more skilled computer operators, those who still worked with mainframes, had reached a dead end. Computer operation in the civil service had never been a university graduate's job, instead requiring passes in four O-level (ordinary level) subjects. These criteria limited the mobility of computer operating staff from the inception of their job class, but as computing professionalized and educational qualifications in computer science and programming became available, the "rigid barrier" between operation jobs and higher level jobs became impenetrable for many of those who did not hold formal qualifications, at least in the public sector. A review of the Executive Class grading structure several years earlier had in fact done an about-face, removing all operating work from the executive grades, and had created a new assistant programmer grade at the Clerical Officer level, making it inaccessible to computer operators.[123]

Supervisory computer posts and many programmer jobs now all but required a degree. These outlets were usually unavailable to operators because managers felt "most operators are unsuitable for such progression." [124] As a result, day release for further training was rarely offered to operators. While salaries within the civil service went as high as £7,000 to £10,000 per year by 1980, computer operators could only hope to attain half to 65 percent of that amount. Prospects in industry were better, by anywhere from 3 percent to 20 percent, contributing to high wastage—over 60 percent annually in some

[122] STAT 14/2972, TNA.
[123] Society of Civil Servants, *Annual Report*, 1972, 30, HN 1/72, TNA.
[124] P. J. Walsh, "Notes of Visit to University of London Computer Center," 3 November 1980, para. 5, CSPR 5/52 University Computer Operators: Background Papers 1980, TNA.

computing centers.[125] Computer operation in government, however, still a job with a high proportion of women in it, had hit a dead end. Now, only degree qualifications and escape onto programming work allowed operators to upgrade their position in the civil service hierarchy. In a situation where training for computer operators was still minimal, good computing workers could not usually be spared for further training or day-release study. As a result, computer operation in the civil service and nationalized industries, two of the largest employers in the nation, had come nearly full circle to pre-electronic machine operation jobs status-wise.

Since the intense need for computing staff with management potential had not lessened throughout the 1970s, the civil service had initiated a series of exchanges with industry that operated until 1980. Young men from the age of twenty-eight to thirty-eight, the age range of civil service Executive Officers, were recruited to come into the civil service and further develop their skills. That these young men were able to acquire these skills much more readily in industry than in government, after years of a centralizing, professionalizing project for computing workers within government, pointed to the serious flaws with the civil service's computing methodology and organization. A typical candidate had several years experience on ICL or IBM machines, knew machine code and at least one programming language, and most importantly, had staff reporting to him and was "clearly fitted for increased responsibility."[126] In all but the last respect, the members of these computing skills exchanges had similar capabilities to most government machine operators. The prime difference was the ability to manage people, in a time and place when women were still generally not viewed as suited to be in authority

[125] CSPR 5/52, TNA.
[126] HN 1/30 Exchange of Computer Staff Between the Civil Service and the Private Sector, 1968-1980, TNA.

over men.[127] Counterintuitively, the technical side of the job, working directly with machines, was not where women fell down.

As the decade wore on, the feminization of clerical work in the civil service, the end of highly centralized computing, and the diminished strength of clerical unions resulted in relatively poorer pay and fewer opportunities. Scrambling to prevent wastage of staff from their new ADP grade—the last incarnation of the machine operator class—without improving pay or opportunities, the government struggled to offer more flexible and part-time work to trained female technologists who left to care for families.[128] The once-feminized machine operator grade, briefly a stepping stone to higher computing work in government or industry in the 1960s, had once again become a feminized dead-end, despite the government's EEC-mandated commitment to equal opportunity.

6.6 Conclusion

In 1969, Labour MP Eric Moonman told the House of Commons that "a recent study in the United States by the Department of Commerce shows that only one-quarter of the cost of launching the average invention into industry is absorbed by research, development and design…. Thus, it is essential to look to outside R. & D. for greater product reliability, better quality and increased productivity." [129] Like few in government at the time, Moonman realized the wrong-headedness of the government's attempts to rule the digital age by focusing on research and design for commercial success. Furthermore, as a student of management science, he also recognized that the failure of the government's internal computing policies had to do with their inability to look beyond immediate objectives. Management systems were fertile ground for ancillary

[127] Home Office, *Equality for Women*, 2.
[128] HN 1/85, TNA.
[129] United Kingdom, *Parliamentary Debates*, Commons, 5th ser., vol. 787 (1969), col. 1301.

benefits, but reaping these required a flexibility the British government lacked. “Quite apart from the objectives achieved, there is a spin-off factor… all the business associated with a good, efficient management system bringing together a great deal of experience,” Moonman argued.[130]

Unfortunately, the British government did not learn much as they were forced to back away from the idealized versions of computing, computer workers, and the computer industry that had gained currency in the 1960s and ossified in the 1970s. In trying to consolidate management skill and technocratic authority, the treasury, the Civil Service Department, and successive ruling parties managed to make poor, and in some cases the worst possible, choices for their own operations and the computer industry’s related output, neglecting available skilled workers and their training to focus on an unlikely version of the technocratic manager; a *deus ex machina* who was to transform the entire system.

Pursuit of this ideal required centralizing computing from the level of the computer industry down to the level of labor and hardware within government, to the detriment of industry, government, and workers alike. The civil service over-consolidated most computing, with multiple mainframes in each installation to winnow the number of high-tech management staff needed for oversight and systems analysis. By systematically, though unintentionally, neglecting and mismanaging all pre-extant talent, from the lowest operators to the companies at the top of the computing industry, the government focused on remaking the image of government computing in a new mold that ignored existing structures and misunderstood how best to implement technological advances in computing. Despite the best efforts of several departments and

[130] Ibid.

administrations, the government virtually hobbled its own technological project from the outset.

Wilson's socialist technological utopia, after capturing the country's imagination but failing to live up to its promise, gave way to a less altruistic technocratic ideal under Heath. By the time Labour controlled the country again, under Wilson and then under James Callaghan, restive unions, dissatisfied with the nation's economic situation, signaled the end of the age in which computing had been seen as a potentially positive development for labor. Instead, they had simply become viewed as tools for enhancing managerial control and speeding workflow. British computers, likewise, had lost their ability to enthrall the nation with now-defunct promises of a new kind of technological empire.

"It is no secret that operators are not always satisfied that British computers are the best for the job," wrote one Civil Servant in 1970.[131] Yet, machines were only one part of the system. The government's failure to be satisfied with the available operators, to invest in training and grooming them for desperately-needed higher technological and management positions in government and industry, and in fact instead designing policy around the premise of centralizing control out of their hands, caused as much or more difficulty in their implementation of computerized methods than any perceived lack in the native computing industry. The British government struggled intensely to succeed in White Heat's mold in the 1960s and 1970s, and re-engineer society itself, yet too often neglected the labor side of these new systems, succumbing eventually to the outside forces operating on the nation, and the internal labor market problems that made IBM,

[131] "Down Among the Datacrats," *Civil Service Opinion* 48, no. 557, February 1970, 1, HN 1/67, TNA.

with their service and software solutions, the better choice for most of British business and government.

Technological change in Britain had often been unkind to women workers, more so when it was combined, as it invariably was when applied to industry, with new management techniques and philosophies. The modern example of computing is little different. Lashing computerization to centralization and enhanced authority for the few, and perceiving computing primarily as a management tool worked to the disadvantage of female technologists and potential technologists. Despite being in the majority in pre-electronic computing work, and present in large numbers in electronic computer operation work, women were not expected or ordained to wield authority in the workplace or in government. As a result, their fortunes as workers regressed rather than progressed as computing became more significant as a management tool.

That this happened in an era during which European nations were self-consciously re-appraising women's work on a national and international basis, trying to reskill and upgrade feminized jobs through equal pay for work of similar value, and in a work arena—British government service—that had declared equal pay for women several decades earlier, illustrates the point that equal pay legislation could not systematically alter the institutional structures and customs that shaped most men's and women's working lives. Equal opportunity, a far more subtle, fungible, and elusive concept remained key, yet out of reach. Early computing, as a centralizing technology designed to concentrate power, was necessarily antithetical to equal opportunity in this era, despite women's long experience working with and within the machinery of government.

Technologies often cement, re-entrench, or widen existing social and economic divisions rather than exploding them. Ultimately the government benefited little from their vast, multi-institutional, technological project. Britain's last great hope for the twentieth century failed to usher in the changes promised by Wilson's White Heat, or even the security and efficiency promised by Heath-era technocracy. Given the United Kingdom's strong early lead in business computing, this may seem surprising, but not when the position and problems of the labor associated with computing are taken into account.

7. Conclusion: Staff Shortages, Reskilling Struggles, and the Failure of the British Government's Vision for Computerization

> "To a certain extent now, and to a total degree in time to come, computer-based information systems will be the nucleus of all successful large organizations. Success will be dictated by the intelligent use of such systems…."
>
> -Sir Arthur Humphreys, Managing Director of International Computers Ltd.[1]

> "The importance of the computer industry lies not only in its economic output but in its far-reaching effects on the whole economic, industrial, and social structure of a country."
>
> -The Select Committee on Science and Technology[2]

7.1 Letting Go of British Computing

When the Conservatives regained power in 1979 with the election of Margaret Thatcher as prime minister, the image of a technologically-advanced Britain based on public sector patronage and guidance had all but evaporated. Thatcher instead focused on cutting government administration costs, from the civil service and nationalized industries to the apparatus of the welfare state. Now believing that private industry and modified free-market policies could succeed where the socialist and protectionist policies of the past had failed, the Conservatives no longer idealized the British computer industry as potential savior of the economy.[3] Likewise, the government's attempts to mold the industry's output to the British state's specific needs for control were over. Increasingly, the government focused on outsourced expertise, notably from IBM, to construct and program their systems.

Minicomputer technology was on the rise, another development that largely left out ICL. By the mid 1970s, IBM was already responding to the market need for more

[1] *Times* (London), "Government Ordering Criticized by ICL," 10 March 1970.
[2] Select Committee on Science and Technology (Sub-Committee A), session 1970-1971, *Prospects for the United Kingdom Computer Industry in the 1970s, Vol. I Report* (HC621-I) (London: HMSO, 1971), viii.
[3] Upon taking power Thatcher sold off the government's interest in ICL. Martin Campbell-Kelly, *I.C.L.: A Business and Technical History* (Oxford: Oxford University Press, 1989), 333.

small business systems, as opposed to very large mainframes. Indeed, in the early 1970s ICL was already being criticized for their mainframe-centric product line and research agenda. The government committee convened to study the prospects of the British computing industry, the Select Committee on Science and Technology, took the computer giant to task for this.[4] The committee failed to take into account, however, the fact that ICL had been strongly encouraged, and to a certain extent was still being encouraged at the time, to focus their research and output on advanced mainframe systems for highly centralized government computing, rather than the smaller systems that lent themselves to decentralized control.

The plans for British computing to succeed on its own merits throughout the world steadily contracted in the 1960s and 1970s. Soon, even the prospect of maintaining a majority share of the British market was too daunting. Attempts to partner with French or German state-supported computing companies to sustain a strong, European computer hardware and services industry fizzled. These final attempts to prop up the industry were Britain's last chance to construct a company that could compete with IBM. As Fujitsu gradually bought a majority of ICL, taking on the responsibility for the upkeep of ICL's workers and relieving the British government from having to grant more loans to keep ICL afloat, the government was finally "off the hook" to the computer giant they had created.[5]

[4] By the early 1980s, ICL's mainframe division soaked up two-thirds of their R&D budget, but constituted less than a third of the company's turnover. Campbell-Kelly, *I.C.L.*, 316, 339.

[5] After taking over the international portion of Singer Business Machines in 1986 in an attempt to expand its presence in the world minicomputer market, ICL merged with Standard Telephones and Cables in 1984 in an effort to better incorporate telecommunication into their computing product line. Throughout the 1980s, Fujitsu Corporation steadily gained a greater share of ICL, initially partnering with ICL to provide lower-cost hardware for minicomputer ranges. By the late 1980s Fujitsu owned a majority of ICL, rising to 84 percent in 1993, and in 2002 the ICL name was dropped. Government officials discussed how to get "off the hook' to ICL as early as 1972 in the Ministerial Committee on Economic Policy, "Secret: Brief on

In merging Britain's computer hardware and services industry into one company to maximize funding and make the most of available brain power, the innovations of several strong computer companies all but ground to a halt. Simultaneously, competition within the British market was shut down as a result of preferential treatment for ICL. The white-hot technological revolution of the Harold Wilson's first government in fact consolidated power in very old-fashioned ways; into the hands of the few at the highest levels of industry and government.

In *The Government Machine*, Jon Agar discussed the centralization and decentralization of the machinery of data-processing within the civil service and how these technological movements were keyed to organizational ones. The government's ideal of bureaucratic organization did not necessarily mesh with the ideal technological organization for its needs. Nonetheless, the bureaucratic ideal defined its computing endeavors. Decentralization in particular was thwarted because it ran counter to the government's understanding of bureaucratic best practices that demanded as much centralization as possible.

As a result, Agar shows, "skills were not in the right place" to take advantage of, or even recognize, "the potentiality of small computers and networks." No group within the civil service could competently "claim authority on the dual aspects of administration and technology," even in the 1970s.[6] The workforce that the government had been trying

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CPRS Report on the UK Computer Industry," January 1972, 1, HN 1/15 Arrangements for the Setting up of the Central Computer Agency (CCA) 1972, TNA.

[6] Jon Agar, *The Government Machine: A Revolutionary History of the Computer* (Cambridge, MA: MIT Press, 2003), 367.

to create all along, to smooth the integration of electronic computing into their ideal model of bureaucracy had failed to materialize.[7]

7.1.1 Computerization in Government: A Labor-Starved Technological System

As the government's project to transform itself through electronic computerization continued to falter, high turnover and rampant job dissatisfaction plagued the new Automatic Data Processing (ADP) Class. The successor to the machine operator grades, the ADP Class represented the legacy of feminization within government computing. The new class failed to make staffing and maintaining the government's huge, centralized computing installations any less difficult and costly. Trained ADP workers, operators and programmers alike, could find better pay and prospects in the private sector, oftentimes after taking advantage of the government's initial on-the-job training.[8]

To ease the situation, managers reconsidered allowing lower clerical officers to do some of the simpler programming, and consistently made use of temporarily-promoted workers who would be demoted again once more suitable executive-level ADP workers could be recruited. Throughout, the central Civil Service Commission refused to delegate any authority to departments to promote ADP workers to the Executive Class, maintaining strict centralized control over labor even as the situation worsened. Through the early 1980s, high tech labor shortages continued to cause the government significant

[7] In *The Control Revolution: Technological and Economic Origins of the Information Society* (Cambridge MA: Harvard University Press, 1986), James R. Beniger investigated the history of the control of work processes to argue for its importance to the eventual construction of the modern concept of the information society. Beniger believed that data processing within bureaucracies represented a revolution in generalized control. The control revolution is the term Beniger gives to the vast, co-constitutive changes in business and technology that occurred in the late nineteenth to early twentieth century, which, he argues, led to the synthesis of the structures required for modern systems of information processing and the top-down control allowed by these systems.

[8] F. E. R. Butler, "Chessington Computer Center: Staffing Situation," June 1982, HN 1/85 Wastage of Automated Data Processing (ADP) Staff from Government Computer Installations 1978-1983, TNA.

alarm, and led to wasted outlays on training for many ambivalent would-be ADP workers from the executive grades.

In response to the renewed labor shortages at their main computing installations, the government once again turned towards, not away from, hiring more women into positions that had formerly been earmarked for male executives. Earlier, women had been considered a black hole for training, due to high turnover associated with marriage. But the very executive-level workers that the government had sought to recruit from industry to staff its centralized computing installations turned out to have such high wastage that they were all but useless. As a result, the government turned back to the origins of the ADP Class, for the first time considering active recruitment of former women employees who had left to have families: "We are mindful that an untapped source of trained staff may be women who have left us to start families, but who still live locally," pointed out one report on the worsening staff shortages at one government computer center, adding "we are actively investigating ways of facilitating their continued or renewed employment (for example, by increasing part-time working) as part of a wider study of these issues in the treasury as a whole."[9]

Once again, in a time of crisis, the government tried to utilize a feminized labor force that was partly of its own creation and maintenance. Unlike most previous attempts, this one envisioned married former employees as a useful source of trained labor, actively recruiting them. This obvious step had rarely been taken in the civil service in peacetime. In addition to already being trained, married women had family in the area that would prevent them, the government thought, from having high turnover. In return, the government would accommodate them by offering part-time work and other incentives.

[9] Butler, "Staffing Situation," para. vi, HN 1/85, TNA.

Yet, this workforce was utilized only as a result of a labor shortage that precluded the hiring and retention of the government's first-choice workers.

The shortage was not only a problem for the public sector. Reports commissioned by the government in the late 1970s and early 1980s to study computing manpower in industry presented evidence that did not bode well for Britain's future progress in the electronic information age.[10] The Institute of Manpower's study, begun in 1978, declared that the availability of "skilled computer manpower" was inadequate at every level of industry and government. From computer hardware and software companies on down to institutions that used computers, Britain lacked the proper labor in the proper quantities. "The rapid expansion in the demand for computers and related products has resulted in a serious shortage of skilled manpower," stated the report in no uncertain terms.[11]

But why had this change in the technological landscape resulted in recurring labor shortages, rather than just an initial period of shortage? To answer this question, the Institute of Manpower researchers referred to both quantitative and qualitative data, focusing on the qualitative. There was, they found, an "enormous" number of people in "the potentially eligible population who could be trained in DP (data processing) skills." And the British schools produced three-quarters of a million new graduates each year. Nonetheless, adequate numbers of trainees could not be found as a result of, they believed, "the inherited attitudes about engineering, a national 'generalist' culture, past mistakes in the schools system, and also future demographic trends."[12] As a result, their

[10] Institute of Manpower Studies, *Computer Manpower in the 80s: The Supply and Demand for Computer Related Manpower to 1985* (London: National Economic Development Office, 1980), FG 4/968, TNA; Select Committee, *Computer Industry in the 1970s.*
[11] Institute of Manpower Studies, *Computer Manpower in the 80s*, iii, FG 4/968, TNA.
[12] Ibid., xvi-xvii.

conclusion was that there was no way of solving the problem by 1985 as the government had hoped.

By unpacking the generalized language of these reports with an eye to the historical construction of office machine work, and the feminization of twentieth-century data processing work in particular, one can see echoes of the government's own staffing agendas coming back to haunt it. Negative "inherited attitudes" about engineering fields referred to the slightly working-class taint that was still attached to this work in the British middle-class consciousness. The "national generalist culture" on the other hand, was something explicitly cultivated by the government and civil service. Their selection of higher clerical officers and executives did not demand special skills but rather general aptitude; and the two were often seen as mutually exclusive.

In particular, the selection of computer workers reified these long-standing divisions between the technical and the general, the manual and the professional. Even during the labor shortages of late 1970s and early 1980s civil servants having all the technical qualifications and adequate work performance were regarded as unsuitable for promotion to vacant, higher ADP positions.

Some candidates for promotion at the government's Chessington computer center, for instance, had not been allowed to advance "because the [promotions] board considered that they did not match up to the general criteria for promotion to Higher Executive Officer as distinct from their specific expertise in ADP."[13] Yet, the department used these same workers, who were judged inadequate for promotion, to indefinitely cover the vacant Higher Executive Officer posts that it was unable to fill.

[13] Butler, "Staffing Situation," para. i. Such distinctions seemed pointless and confusing even to some managers within the civil service by this point—the report section in question was flagged with a big question mark by one of its management-level readers.

Public sector workers in computerized offices were asked to walk a fine line between categories that had historically been constructed as diametrically opposed. The "past mistakes" in the school system referred to in the report discussed the extension of these class-based mores privileging general knowledge over technical knowledge into secondary education. These social mores in large part contributed to the construction of a class of subclerical, predominantly female workers in office machine operation; more desirable workers often did not want these jobs, which were constructed as ill-suited to them by government hiring rubrics.

But the final problem mentioned in the report was the most critical, and also the least specific or well-explained. It encapsulated the other problems to a great extent and also pointed to the crux of a historical labor problem. The "future demographic trends" mentioned in the report refer to the rising number of women in the workforce, particularly in the office workforce, where much of the new technology under discussion was employed. In 1980, 41 percent of all women worked in clerical occupations, meaning that women made up nearly 78 percent of the total clerical workforce.[14] Women's overall workforce participation had been steadily rising since 1951, with married women making the highest gains, while men's workforce participation declined slightly.[15] (See Table 2.)

The explosive growth of women in clerical jobs put them into direct contact with the computerization of office work and made their labor integral to the data-handling bureaucracies on which the British economy increasingly relied. Hiring for computerized office work from the 1960s through the 1970s, particularly in government, took place

[14] Jean Martin and Ceridwen Roberts, *Women and Employment: A Lifetime Perspective* (London: Office of Population Censuses and Surveys, 1984), 23; Jane E. Lewis, "Women Clerical Workers in the Late Nineteenth and Early Twentieth Centuries," in *The White Blouse Revolution: Female Office Workers since 1870*, ed. Gregory Anderson (New York: St. Martin's Press, 1988), 34.
[15] Rosemary Crompton, *Women and Work in Modern Britain* (Oxford: Oxford University Press, 1997), 26.

from the same general labor pool relied upon for clerical workers. During this period, the government trained workers both to operate large mainframe computers and to program specialized office software solutions, in contrast to later in the twentieth century when almost all programming was outsourced to software companies. These workers, under-utilized and under-valued throughout the period of early office computerization in government, comprised the majority of the "other abundant pools of labor available."[16]

At a time "when industry [was] short of skilled labor and unemployment high," and when the government was extremely concerned about education and training for computerized data management systems, the failure to utilize these workers for much beyond data input and low-level computer operation seemed illogical.[17] Certainly the Institute of Manpower Studies, instructed to devise solutions to the problem, saw that leveraging this pool of workers was critical to the government's future success. At the same time, in fact, the treasury was coming to a similar conclusion, as evidenced by its offering more flexible schedules and family benefits for potential married women workers, the fastest-growing group of clerical labor.[18]

Although the British government realized the major benefits that could accrue by leveraging women's labor in times of military conflict or economic strife, for the most part, the state ignored the power of this labor force to remake the British economy in peacetime. By encouraging more than half their clerical workforce to cluster in low-level, often temporary jobs, the state largely neglected the lessons of labor rationalization learned during the two world wars as well as those gleaned from the outcome of hiring practices during recurrent, late-twentieth century economic crises.

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[16] Institute of Manpower Studies, *Computer Manpower in the 80s*, xvii, FG 4/968, TNA.
[17] Electronic Computers SWP, *Manpower Subcommittee: Second Interim Report*, 1976, 2, FG 4/820, TNA.
[18] HN 1/85, TNA.

The whole point of the government's attempts to cultivate ICL and protect British computing was to eventually have a world-class computing industry. This industry would not simply produce hardware and software, but through intelligent, expert application of computing to the problems of management and large bureaucracies, it would transform other industries at home and abroad. The government, specifically the civil service, was a self-conscious proving ground for these new methods and techniques. Its computerization of the public sector was to convince the private sector to modernize, provide a template for success, and support this vision of the British computer hardware and services industry to eventually allow it to succeed world-wide. The benefits to the British state, both narrowly and broadly defined, would be transformative for the British economy, now struggling to keep up in the global marketplace. In addition to requiring a strong home computing industry, this required home-grown, technically-minded management talent, particularly in government, that was well-versed in the workings of pre-electronic and electronic computerized office systems.[19] This was the very same labor that the government systematically squandered in the civil service.

7.1.2 The Origins of the Domestic "Brain Drain" in High Technology

In 1992, a University of Wales researcher produced a report for the Commission of the European Communities. The subject was women's under-representation in jobs created by the proliferation of new digital information technologies, especially positions of power and responsibility. In it, she attempted to explain and offer solutions for the

[19] In the late 1970s, the increased introduction of terminal displays for data link work and the increasing use of word processors came alongside massive planned redundancies for clerical workers—up to a quarter of a million over the following half-decade. These developments had the effect of sharply reducing intermediate-level computing jobs, bifurcating the office computer workforce into high-level work and drudgery. This process of reconfiguration in the late 1970s and 1980s follows from developments discussed here, but it is beyond the scope of this history. HN 1/1 Technical Developments In Computing: Effects On Staffing 1979, TNA.

problem of skill shortages in information technology fields like business computing management, programming, and systems analysis by investigating the under-utilization of women in those fields, and trying to uncover the reasons for it.

Culturally constructed roles for women and men in Britain, and European society more broadly, she reported, tended to focus on men's technical competence to the exclusion of women. As a result, a powerful popular image—sometimes accurate and sometimes not—of technically incompetent or maladroit women workers fed a cycle of perpetual skill shortage, as well as a general lack of acknowledged technical achievement for women.[20]

By the time this report was written, working with computers had already acquired a distinctly masculine image within British society. So much so, that as Cynthia Cockburn, an influential labor researcher noted, "for a woman to aspire to technical competence is, in a very real sense, to transgress the rules of gender."[21] Despite decades of equal pay and significant investment in educational strategies designed to change this situation on both sides of the Atlantic, patterns of female underachievement and the perception of female technical maladroitness persist within Anglo-American culture, business, and higher education.

Yet, however seemingly timeless and powerful, the perception of the history of computing as a masculine realm is belied by multiple, and important, historical examples.

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[20] Teresa Rees, *Skill Shortages, Woman and the New Information Technologies* (Luxembourg: Office for Official Publications of the European Communities, 1992), 26-27. Far from being confined to the European context, similar processes have constructed technical skills in other large industrialized, western nations. Ruth Oldenziel makes a similar argument for the American engineering context in *Making Technology Masculine: Men, Women and Modern Machines in America, 1870-1945* (Amsterdam: Amsterdam University Press, 1999) while J. McGrath Cohoon and William Aspray investigate the issue transnationally in the collection *Women And Information Technology: Research on Underrepresentation* (Cambridge, MA: MIT Press, 2006).

[21] Cynthia Cockburn, "Women and Technology: Opportunity Is Not Enough," in *The Changing Experience of Employment*, ed. Kate Purcell et al. (London: Macmillan, 1986), 185.

British computing labor in the sprawling public sector is one arena that contradicts this image, while offering insight into why this perception took hold. The history of computing in the British public sector reveals how computing was first institutionalized as a feminized sphere of work, and then very self-consciously re-engineered as a field of masculine endeavor as a result of new ideas about how to wield power within the apparatus of the state. The reasons for this change, while historically specific, nonetheless shed light on many of the institutional processes that have resulted in the gendering of postindustrial workforces worldwide.

In a more general sense, the expectation of women's dependence and failure in career-long employment, paired with the opposite expectation for men, became a self-fulfilling prophecy. In the case of careers in computing, this was especially disappointing because there was an initial period where the work was seen as well-suited to women, and this era overlapped with more than a decade during which the field had not yet rigidly professionalized.

Owing to labor shortages and the fact that specific educational qualifications were not yet in place for such jobs, this period of time was beneficial for women who made their way forward through aptitude tests or promotion from other machine work. Though some women, and men, benefited highly from this unique historical situation, lasting career gains were only possible for those who had uninterrupted careers and who seemed suitable for supervisory roles. These two criteria tended to privilege traits more commonly associated with male workers.

7.1.3 Gender, not Women, as a Category of Historical Analysis

Queer theorists, notably Judith Butler, have convincingly argued that gender, as a category of social difference that structures society, is not a static category but a performative one; one that by its very nature requires change and reinterpretation in order to retain its analytical and cultural utility. Gendered mores have the ability to construct and order social relations as historical circumstances change.

Yet, as a category made real by social performance, gender can neither be understood as something natural and unconflicted, nor as something consciously assumed by individuals choosing freely between identities. Rather, gendered categories represent the aggregate of a series of actions, social negotiations, institutional practices, and constantly-changing cultural understandings which, far from being purely descriptive, actually strongly tend to produce the phenomena they set out to describe or accommodate.

This discursive model of gender analysis, wherein description, iteration, and reiteration of categories, standards, and ideals tend to produce their own subjects means that "power is not only imposed externally but works as the regulatory and normative means by which subjects are formed."[22] The perception of a masculine ideal for computer workers is, in and of itself, an issue that has been recognized by researchers, educators, and even businesses as a critical stumbling-block for industries struggling to find and retain talented, highly skilled workers.[23]

As a result, a historical period in which computing was not yet a "man's job" can offer important insights into how and why this masculine ideal was self-consciously

[22] Judith Butler, *Bodies that Matter* (New York: Routledge, 1993), 22.
[23] See, for example, the business study by Sylvia Ann Hewlett, et al., *The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology* (Cambridge, MA.: Harvard Business Review, 2008).

constructed. In the case of the British public sector, undoing the long-standing feminization of the data processing workforce was considered critical to the success of the government's computing projects. In undoing the feminization of this labor force, however, the British government simultaneously handicapped the majority of its women workers from being able to succeed in the new categories of work constructed by its office computerization projects. This in turn hindered the success of those projects by removing the largest pool of technical workers from consideration for higher-level work.

These patterns are all the more relevant to current experience because of the British government's long-standing commitment to equality of pay and opportunity in the civil service. Since the 1950s, women who worked in the public sector had received "equal pay." The government's employment practices were the apogee of meritocracy in a nation that did not adopt equal pay industry-wide until 1975. Yet, the "fair field with no favor" of the civil service and nationalized industries was an ideal that could not translate directly into reality.[24] Instead, it was mediated by a host of cultural assumptions about gender, power, governance, and national identity.

The conflict between the ideal of British meritocracy and the reality of hiring practices and workers' lives shows how seemingly equitable policies can have different effects on men and women. As the sex discrimination legislation enacted in the 1970s for all of British industry aged, for instance, the problem of equal pay was shown to pale in comparison to the related problems of equal opportunity. Indeed, in 1984 the European Court of Justice determined that Britain had failed to adequately comply with European Economic Community standards: the British government's narrow interpretation of the

[24] Civil Service National Whitley Council Committee, *The Marriage Bar in the Civil Service* (London: HMSO, 1946), 4.

concept of economic equality did not adequately take issues of equal opportunity into account.[25]

Because of the size, scale, and importance of computerization to the British state, computing in the British public sector represents a critical historical laboratory for computing labor patterns. By the 1970s, Britain expended more than 40 percent of their gross domestic product on the public sector, and had created data-intensive services as part of the modern cradle-to-grave welfare state that could not have existed without early and brisk integration of electronic computing.[26] Integral not only to the government's massive social welfare projects, but to the functioning of the nationalized industries and civil service, computing defined the British state both in terms of how it could organize itself, and what it could achieve. As a result, the similarities of institutionalized gender discrimination across the public sector are instructive for a historical understanding of the state's trials and tribulations not only with computerization but with the entire process of modernization in the twentieth century.

7.2 Conclusion

Within machine operation and early computing jobs in the British public sector, women held a clear majority. By systematically excluding the majority of the relevant workforce from consideration for the most responsible and difficult-to-staff computing positions, government hiring and training rubrics seriously undermined not only the long-term position of women in high technology in the British economy, but also the eventual health of their own technological projects.

[25] "EEC Rules Against UK Sex Discrimination Laws," *Accountancy* 95, no. 1085, January 1984, 19.
[26] Cynthia Cockburn, "Opportunity Is Not Enough," 136.

The periods in which government computing faced economic crises and labor shortages provided the most opportunities for women to excel in new, non-feminized job categories within early computing work. This did not produce a long-term institutional change, however, only a short-term situation that benefited certain, young individuals within a very limited time frame. In some sense, this is not surprising. Historical exigencies have brought women into myriad positions in industry during wartime, for instance, that were not considered ideal jobs for women in peacetime. Yet, the hiring models employed in such crises are often undergirded by similar beliefs as non-crisis hiring models, and the ends of such crises usually mark a self-conscious return to previous staffing models. Despite the British government's obsession with enhancing productivity throughout the decades following World War II, the state was never prompted to leverage women's labor, through hiring and training techniques or wage policy, as effectively as it had during the conflict.

As periods of economic crisis and high tech labor shortage lessened, a reversion to hiring and promotion best practices that favored young men and management-level operatives, where available, took hold in public sector computing, forcing women applicants to the back of the queue for the most desirable jobs. Barbara Reskin and Patricia Roos have discussed this phenomenon in their research on feminized and male-dominated fields of paid work, in order to understand why women lose out in the labor market. Particularly in well-remunerated or traditionally male fields, they argue that we must redirect our inquiry away from the "characteristics of female workers, to the structural properties of labor markets," which are, for the most part, "shaped by the

preferences of employers and male workers" who have the most power in establishing the shape of labor markets in the most desirable fields.[27]

The association of computing in Anglo-American tradition with some of the most lucrative and powerful positions in industry may continue to work to exclude women, in the aggregate, from the field. Institutionalized perceptions of the most desirable workers and managers are still in general perceived to be men, as a result of historical labor market trends and government policies. As a result, this history holds applicable lessons for other high technology workforces within institutions constructed in the varied, but often broadly similar, cultural molds of Anglo-American tradition.

Stereotypes about women's technical incompetence, however, seem not to have been a major issue in this historical case, proving that women can nonetheless lose out in a technical field, and a nation can lose a significant portion of its technical workforce, for reasons other than a straightforward lack of technical competence. For governments of socialized countries the problem of this underemployment is double: not only do they lack the benefit of the output of more skilled workers, but they simultaneously may have to pay greater benefits to unemployed and under-employed women who have opted for an institutionally-sanctioned domestic role.

The key requirement, it seems, is to dispense with the idea of individual bias, and individual culpability, either on the part of managers or workers. As this history shows, management acted as a bloc to create different hiring rubrics for men and women, on the assumption that this was necessary for institutional preservation in different economic circumstances. Individual managers had little opportunity or ability to dissent. These

[27] Barbara Reskin and Patricia Roos, eds. *Job Queues, Gender Queues: Explaining Women's Inroads into Male Occupations* (Philadelphia: Temple University Press, 1990), 108-109.

management practices and forms of labor control, once institutionalized, gained a powerful momentum that produced unexpected results. Meanwhile, women's failure to excel in computing jobs was not an issue of individual women not being technically proficient or not wanting to perform technical work, but was rather due to the fact that their work was undervalued in relation to men's, as a result of expectations about women's and men's career patterns and social roles in the aggregate.

In *Science in Action: How to Follow Scientists and Engineers through Society*, Bruno Latour follows what he terms "technoscientists" through their wranglings to create technological artifacts which, when finished, will stand on their own, obscuring the complex ideas and ideologies that went into creating them and determining their functional roles. The creation of such a technological "black box" results in the embedding of a network of relations between technologies and the expectations of user need into a technological artifact or system.[28]

This study has attempted to unpack the sociotechnical system of British computing by investigating the historical circumstances surrounding the closure of its black box. While the "missing masses" are the "social links sturdy enough to tie us all together," or the "moral laws that would be inflexible enough to make us behave properly," in Latour's estimation, this is because those in control of a technology's closure progressively designate human responsibilities, and even character traits, to nonhuman objects and systems created for the purpose of acting for, or in place of, people.[29] Latour goes on to show how the deconstruction of these objects and systems

[28] Bruno Latour, *Science in Action: How to Follow Scientists and Engineers Through Society*, (Cambridge, MA: Harvard University Press, 1987).
[29] Bruno Latour, "Where are the Missing Masses? The Sociology of a Few Mundane Artifacts," in *Shaping Technology/Building Society*, ed. Wiebe E. Bijker and John Law (Cambridge: MA, MIT Press), 227.

holds the key to understanding the implied power relations that structure all of modern society by maintaining the fictive divide between the technoscientific and the social.

The solution to British computerization problems in the public sector was contained in the construction of this divide: in order to leverage office computing technology most efficiently, the British government first had to alter the social ideals on which men's and women's work was predicated. In this way, a social problem became a technological problem that hastened British decline in the twentieth century.

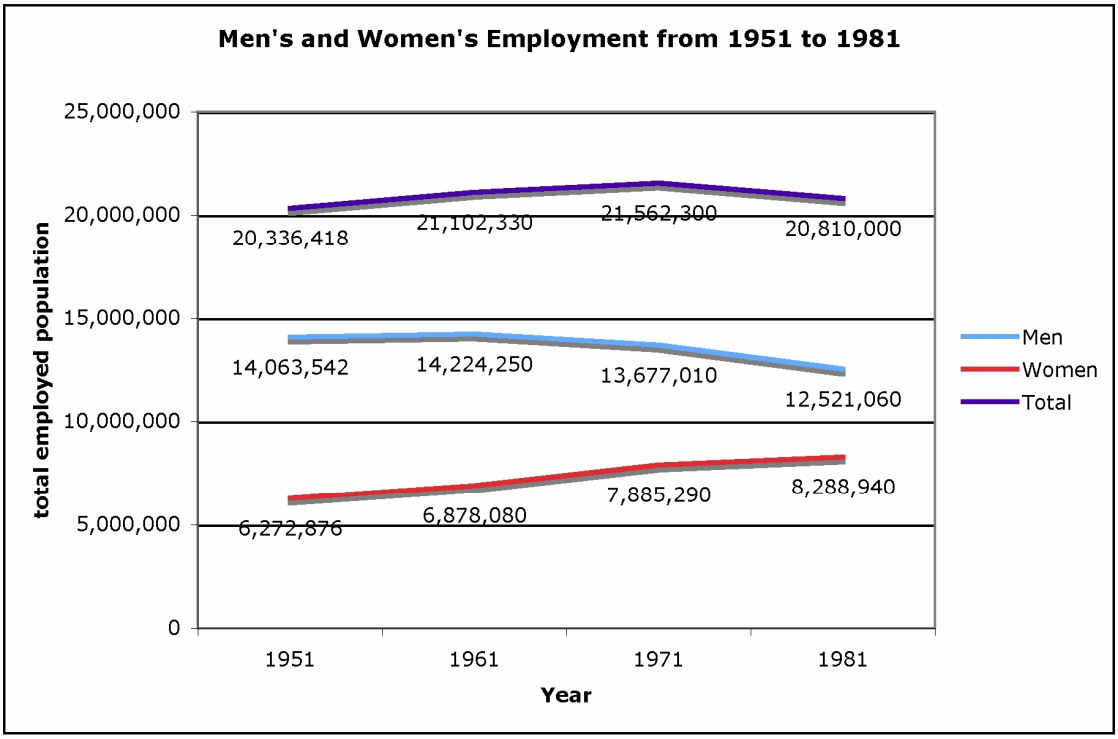

Table 2: Men's and Women's Employment from 1951 to 1981.

Office of Population Censuses and Survey, *Census 1961, Great Britain, Summary Tables* (London: HMSO, 1966); Office of Population Censuses and Survey *Census 1971, Great Britain, Economic Activity: Part 1* (London: HMSO, 1973); Office of Population Censuses and Survey, *Census 1981, National Report Great Britain, Part 1* (London: HMSO, 1983); Office of Population Censuses and Survey, *Census 1951, England and Wales, General Report* (London: HMSO, 1958).

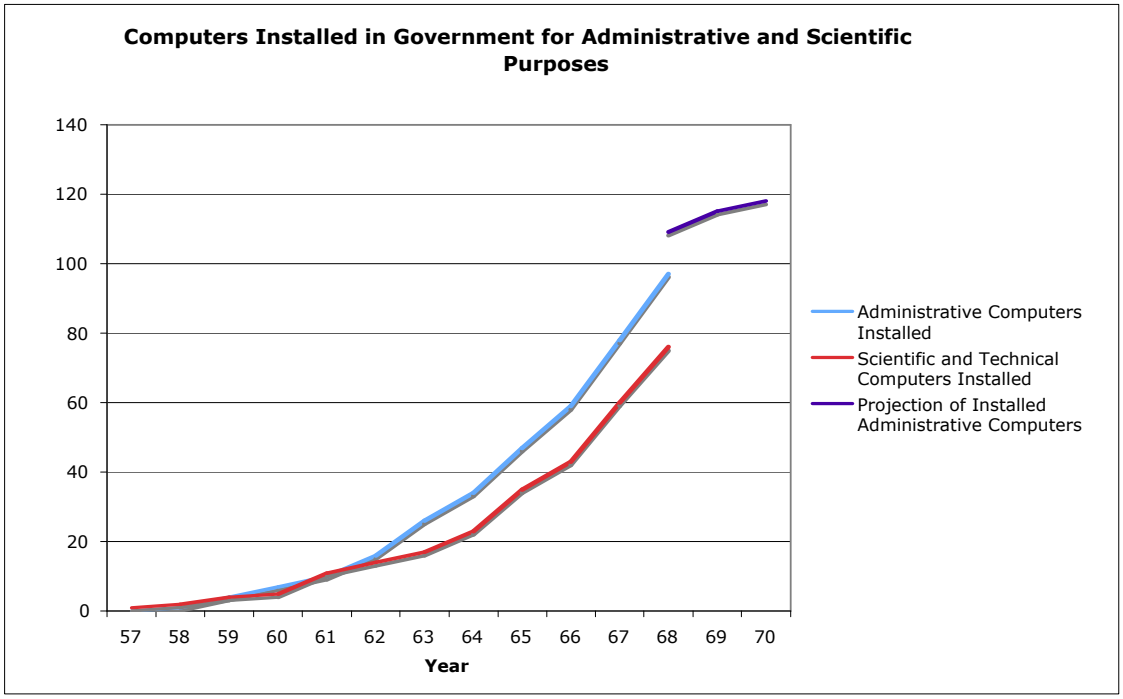

Table 3: Computers Installed in Government for Administrative and Scientific Purposes.

CCA, "Schedule 1A: Computers for Administrative Purposes Installed in Departments up to 30 December 1968," 22 October 1968, HN 1/67, TNA.

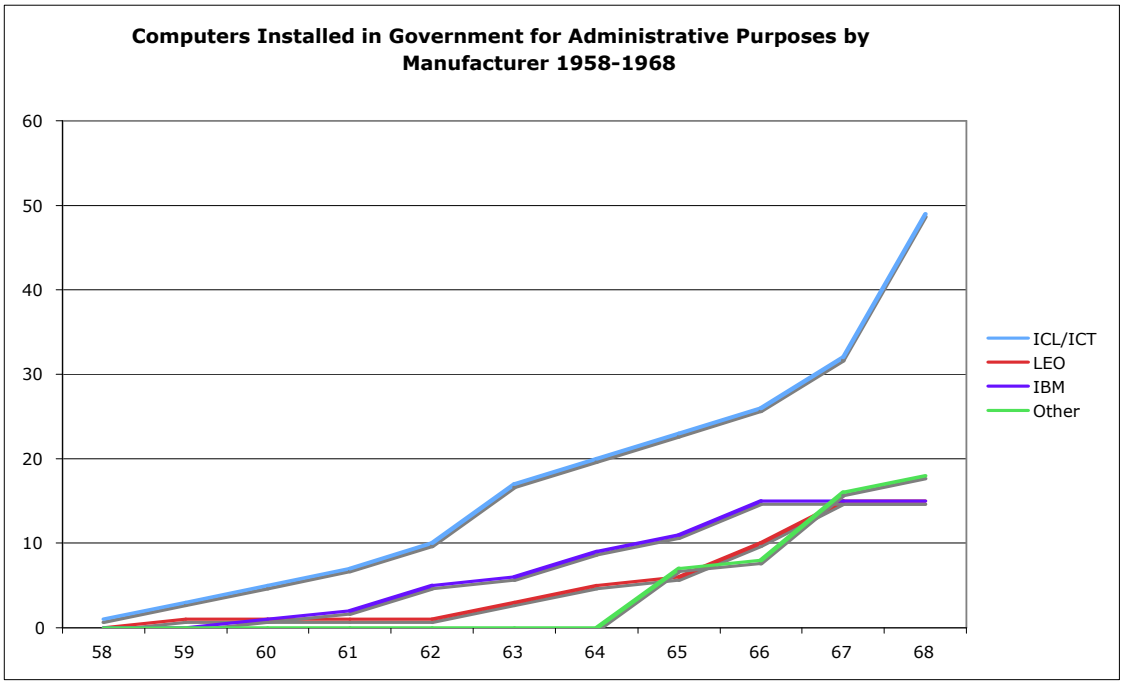

Table 4: Computers Installed in Government for Administrative Purposes by Manufacturer 1958-1968.

CCA, "Schedule 1A: Computers for Administrative Purposes Installed in Departments up to 30 December 1968," 22 October 1968, HN 1/67, TNA.

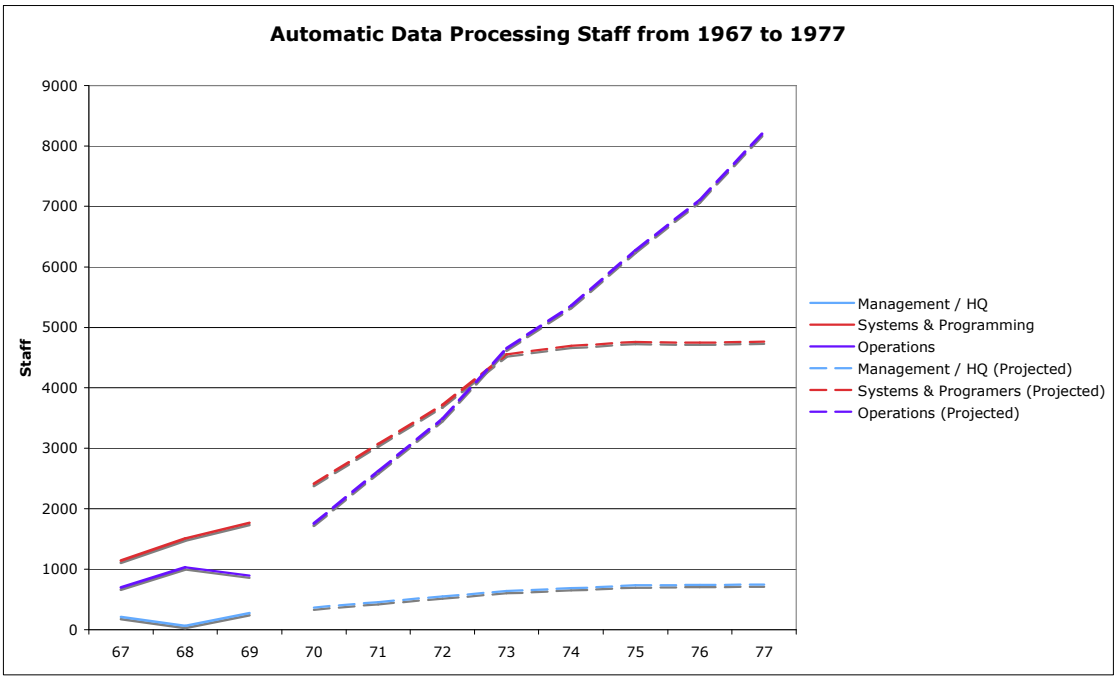

Table 5: Automatic Data Processing Staff from 1967 to 1977.

Projected numbers starting from 1972 found in S. W. Spain, "High Quality Staff for ADP Work, Table 1," 21 December 1972, 7, HN 1/72, TNA.

Actual staffing levels found in: "Staffing of Government ADP Projects as of 31/3/69," HN 1/72; "Staffing of ADP Projects, Civil Service Staff at 31st March, 1968," HN 1/72; "Staffing of ADP Projects, Civil Service Staff at 31st March, 1967," HN 1/72, TNA.

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(All individual files consulted at the National Archives are too numerous to list. Below is a list of the file series that were utilized, followed by a listing of specific files referenced in the footnotes.)

Series:

AB Series: Records of the United Kingdom Atomic Energy Authority and its predecessors.

AIR Series: Records created or inherited by the Air Ministry, the Royal Air Force, and related bodies.

AN Series: Records created or inherited by the British Transport Commission, the British Railways Board, and related bodies.

BA Series: Records of the Civil Service Department.

BT Series: Records of the Board of Trade and of successor and related bodies.

CAB Series: Records of the Cabinet Office.

CAOG Series: Records created or inherited by the Crown Agents for Overseas Governments and Administrations.

CJ Series: Records created or inherited by the Northern Ireland Office.

CSC Series: Records of the Civil Service Commission.

CSPR Series: Records of the Civil Service Pay Research Unit.

CW Series: Records of the Advisory, Conciliation and Arbitration Service.

DSIR Series: Records created or inherited by the Department of Scientific and Industrial Research, and of related bodies.

ED Series: Records created or inherited by the Department of Education and Science, and of related bodies.

FG Series: Records of the National Economic Development Council and National Economic Development Office.

HN Series: Records of the Central Computer and Telecommunications Agency and predecessors.

HO Series: Records created or inherited by the Home Office, Ministry of Home Security, and related bodies.

HW Series: Records created and inherited by Government Communications Headquarters (GCHQ).

LAB Series: Records of departments responsible for labor and employment matters and related bodies.

MH Series: Records created or inherited by the Ministry of Health and successors, Local Government Boards and related bodies.

NSC Series: Records created and inherited by the National Savings Committee, the Post Office Savings Department and the Department for National Savings.

OS Series: Records of the Ordnance Survey of Great Britain.

PREM Series: Records of the Prime Minister’s Office.

PT Series: Records of the Public Trustee Office.

RAIL Series: Records of the pre-nationalization railway companies, pre-nationalization canal and related companies, the London Passenger Transport Board, and successors.

STAT Series: Records of the Stationery Office.

T Series: Records created and inherited by HM Treasury.

Selected Files:

AIR 77/384 Recruitment and Retention of Machine Operators.

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