Introduction: Britain's Computer "Revolution"

In 1959, a computer operator embarked on an extremely hectic year, tasked with programming and testing several of the new electronic computers on which the British government was becoming increasingly reliant. In addition, this operator had to train two new hires with no computing experience for a critical long-term project in the government's central computing installation. After being trained, the new hires quickly stepped into management roles, while their trainer, who was described as having "a good brain and a special flair" for computer work, was demoted to an assistantship below them.[1]

This situation seems to make little sense until you learn that the trainer was a woman and the newly hired trainees were men. Yet this is not simply an example of unfair labor practices. It is part of a larger story about attempts to shape the newly developing digital economy. This woman's tale is emblematic of broader changes: In the 1940s, computer operation and programming was viewed as women's work—but by the 1960s, as computing gained prominence and influence, men displaced the thousands of women who had been pioneers in a feminized field of endeavor, and the field acquired a distinctly masculine image. How and why this change happened holds important lessons for contemporary economies and high-tech labor markets, yet the change is still poorly understood.

When the gender makeup of a field flips, the first assumption is usually that the content of the work within the field changed. When a field feminizes, people often assume that the work became simpler. When a field becomes male dominated, the assumption is the reverse: that the work became more difficult or complex. Yet as one can see from this example, that was not the case in early computing.

A second, related assumption might be called the "technological switch." This is the idea that a major technological change inexorably alters the labor composition of a field. Usually, more machinery and

automation lead to feminization—a familiar historical pattern seen in everything from textile manufacture to typewriting. Yet the changeover from electromechanical to electronic computers did not result in further feminization, nor did it coincide neatly with computing's masculinization.

A final assumption about gendered labor change is that when women disappear from a field, a lack of interest, a lack of relevant skills, or an inability to get hired plays a major role. This, again, does not account for why women lost out in computing. Like the operator in the earlier example, many women were present in the field, interested in the work, and even had opportunities to prove their proficiency.

A wistful cartoon from the era remarked on this change, noting, "When trains sets become electronic, men are in, and that's ironic."[2] As electronic computing technology improved and became easier to use, women were no longer welcome. Seen from the perspective of the "yearning miss" in

YEARNING MISS

I had a yen to be a boy,
To sit around and play with trains,
Such fun, but not girls' games.
A lady now, but still mechanical
(In Computers and they're satanical)
But when train sets became 'lectronic
Men are in, and that's ironic.

J.C

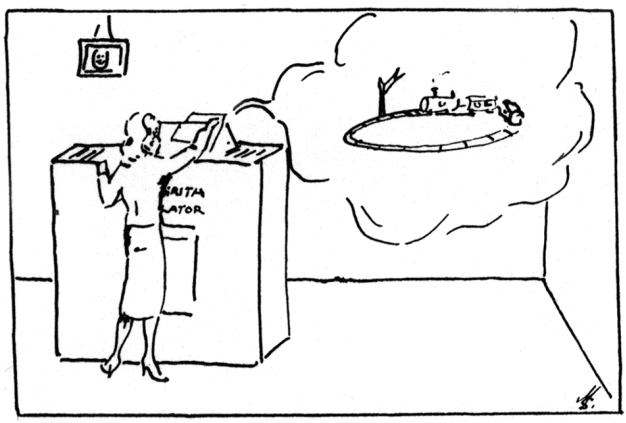

Figure 0.1
"Yearning Miss." Cartoon from *Tabacus: The Company Magazine of the British Tabulating Machine Company*, May 1957, 4.

the cartoon, the flip was arbitrary, sudden, and unfortunate. It was not a natural evolution, but a noticeably quick change during which men were slotted into previously feminized jobs.

Over a decade later, a 1970 article on computer training entitled "Terminals Beat All the Toy Trains" uncannily echoed this cartoon. It claimed boys had a natural interest in computing that needed to be encouraged. The accompanying photo showed three students from Eton College, an elite all-boys boarding school, clustered around the paper printout terminal of a local university's mainframe. They had been given the opportunity to play games on the mainframe simply to become comfortable with computers.[3]

By the time that article was published, the gender of computing work had changed and its class status had risen dramatically. As the earlier anonymous cartoonist had predicted, the computer became the new train set for a generation of privileged young men—electronic training wheels for youngsters who were expected to grow up to become leaders in government and captains of industry. With the help of computers, young men like these would grow up to be far more powerful than the yearning miss could ever hope to be—but not because they possessed any special or higher level of technical skill.

Gender, Power, and Computers

Once computing started to become a more desirable field for young men, women were largely left out, regardless of what they might have been capable of or what they might have preferred. A gendered history of top-down structural discrimination defines the shape of the modern computing industry in the Anglo-American world. It has been the topic of several histories of US computing and has increasingly been a topic of contemporary news coverage.[4] Yet many persist in believing that lower numbers of women in computing are the result of individual choice or inadequate education. Historical examples from the US context show the existence of anecdotal discrimination, but because they focus primarily on computer history from the perspective of industry and use a varied array of business sources, structural discrimination is hard to prove.

The British case is different: In Britain, gendered labor change was part of a top-down government initiative to computerize. Not only women but also the explicit structural discrimination against them played a crucial, formative role in the uptake of computers and in the ultimate failure of the British computing industry. Computing defined the standard

for Britain's postindustrial information economy and powerfully shaped how the nation modernized, all against a highly gender-discriminatory background. It was one of the state's most critical modernization projects, played out in the context of the government's strong control over industry after World War II. Computerization of government and industry was meant to revolutionize how nearly everything within the nation functioned and return Britain to a leading role on the global stage.

In this way, the British case is a parable of how nations can modernize in ways that are not merely uneven but that actively reconstitute categories of social inequality. It shows how new technologies often help certain classes consolidate power while stripping power from others.[5] Perhaps most importantly, the British example elucidates power dynamics that are harder to discern in the US context. It enables us not only to see gender discrimination in action more clearly but also to recognize class as a prime factor motivating change in the history of computing.

During World War II, Britain led the world in cutting-edge computing technology. In the crucible of war, Britain engineered and deployed the world's first digital, electronic, programmable computers. At a time when the ENIAC project in the United States was still not functional, these codebreaking computers actively changed the course of the war, most notably by ensuring the success of the D-Day landings. In the years that followed, British computing paralleled or anticipated many American innovations, and through the 1950s and early 1960s British computers seemed poised to offer strong competition to US offerings by capturing the lucrative British home market along with Commonwealth and postcolonial markets. Yet as the sixties stretched on, Britain's computer industry struggled despite government support. By decade's end, the government was promoting an industry-wide computer company merger in an effort to save the computing industry, to no avail.[6]

Focusing on the case of the British Civil Service and nationalized industries, I will show that gendered labor organization was a key aspect of the nation's drive to computerize. The British example lays bare how computerization molded particular people into a technological underclass to support society's growing technocratic impulse. This history also shows why computerization efforts ultimately ran counter to the modernization projects of the state, hurting industry and the nation at large. As David Edgerton has shown, projecting our obsession with innovation into the past gives a false sense of futurity, obscuring the technological and social continuities that complicate our view of progress.[7] The British case offers

a powerful example of how cutting-edge technologies often run counter to social progress and economic justice.

An analysis like this invites a different perspective on computerization and the shift to an "information" economy by explaining the material effects of gendered labor discrimination. Underlying this change were powerful ideas about women's sexuality. Assumptions that women's lives would be defined by heterosexuality in ways that required them to leave the work force made work outside the home secondary to the dictates of marriage, procreation, and family. This study is not only an example of how gender has molded computer technology but also an example of how sexuality plays a silent but critical role in the history of computing. Expectations about women's lives based on a nearly compulsory form of midcentury heteronormativity stranded most women with limited career prospects. Many women worked throughout their lives in addition to raising families, but society organized itself around a male breadwinner wage meant to support a nuclear family. The result was that sexuality, the organization of labor markets, and the functioning of the economy as a whole became inextricably linked.

Although this history has been told from the viewpoint of British computer manufacturers and from the perspective of how American companies influenced the British market, a key missing element in most of these narratives is labor. Specifically, the labor of the everyday people whose work made computer deployment possible and determined what computers could do has received little attention. As important as hardware may be, computing systems functioned due to vast arrays of human workers, expressed through workflow organization, operators' actions, and software. Networks of labor and expertise extend into the systems themselves, constructing the social and technological bedrock on which all computing projects rest.[8] Ultimately, these factors determine which computer projects succeed or fail.[9] These less tangible components of computing systems play a formative role in what paths and priorities gain momentum and what kinds of impacts and accomplishments are possible—both in the immediate sense and for decades afterward.

Feminization, Mechanization, Automation

Because technologies are inseparable from the history of their utilization, the impact of gendered labor change on the history of computing is difficult to overstate.[10] Although a fairly recent topic of interest, studies on gender and computing have begun to proliferate in the past decade.

Jennifer Light reoriented our understanding of programming's origins by applying a gendered analysis to the ENIAC project, and Jean Jennings Bartik's recent memoir has fleshed out the details of Light's account.[11] Nathan Ensmenger has shown how management's understanding of labor is the necessary connective tissue between the political, economic, and technical elements 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."[12] In addition, multiple books in sociology, history, and other fields have tried to connect computing's past to the field's current labor problems.[13] Most recently, Janet Abbate wrote back into history many of the highly successful women programmers in the early decades of US and British computing, showing how programming initially was not a male domain.[14]

With this work, scholars have begun to unpack how normative constructions of gender play a key role in computing history. Histories like these allow us to contest the fiction of a neatly binary system of gender that continues to structure economies and political systems today. They also begin to show how computerization is an explicitly hegemonic project built on labor categories designed to perpetuate particular forms of class status. Gender's intersection with multiple other social and economic categories—particularly class, race, nationality, ability, and sexuality—defined the supposedly feminine traits that attached to women operators and programmers and played a major role in the construction of modern computing.

The British case provides an indispensable example for extending the work on women and gender, and on technology and power, by showing how gender changes the core historical narrative of computerization just as it did the history of industrialization.[15] Deskilling, labor rationalization, and feminization have defined work processes throughout the history of automation. The ability of low-level labor—shaped by management—to determine technologies' paths has a prehistory in literature on the industrial revolution and in histories of twentieth-century manufacturing work. Maxine Berg has shown that the conceptual utility of the term "industrial revolution" in fact turns on the existence of feminized and feminizing fields of work.[16] In discussing the British economy in the eighteenth and nineteenth centuries, she points out that industries that posted the most economic gains and seemed the most progressive technologically, like textiles, were those in which mechanization relied on women's labor.

Although lower wages have historically played a role in women's dominance in many industries, other rationales underlay the preference for women (and children) as industrial workers. Feminized labor extended management's power and made the reorganization required for automation easier.[17] As a class of workers in the nineteenth and early twentieth centuries, women had lower rates of trade union participation, less flexibility and control over where and when to work, and less ability to demand higher rates of pay. In certain industries, relatively high wages for women allowed upward mobility, and in others men were increasingly drawn into deskilling processes. Nonetheless, gender-segregated categories of work persisted in defining women's economic position as lower than men's, and in making women's economic lives secondary for most of the twentieth century.

Even though many quintessentially "revolutionary" industries within Britain's long industrial revolution turned on feminization, women's work was not performed by women because it required a particular set of physical or mental aptitudes. Instead, socially and economically constructed characteristics of women workers in the aggregate defined what work they were allowed to do in particular time periods. With the growth of the information economy, gender and class became increasingly important in defining the worth of particular skill sets.[18] Many characteristics of women industrial workers, such as their association with machines, bled into the new types of white- or pink-collar work that came to define the postindustrial economy.

Women's twentieth-century roles outside the workplace also owed a cultural debt to industrialization. In the nineteenth century, British society increasingly codified separate spheres of endeavor for men and women in response to the changes brought about by industrialization. Factory acts began to restrict where and when women could work, ostensibly to preserve their more delicate natures.[19] Middle-class women were corralled in the home so as not to have their femininity tainted by the industrialized city. The "angel in the house" ideal circumscribed middle-class women's lives and strongly discouraged them from seeking paid work in an expanding economy. If required to work, the modesty expected for their future roles as mothers and wives limited middle-class women's options: "They should not flaunt their independence like the mill girls did."[20] In the twentieth century, most women who aspired to middle-class existence therefore found their choice of job dictated not only by gender but by class.

Office Work: The Girls in the Machine

Clerical work, so prevalent in London's concentrated environment of government offices and businesses, became the repository of middle-class Victorian notions about women's proper role within society. As Meta Zimmeck has shown, hiring managers consciously redefined clerical work from a male- to a female-coded occupation in order to slot middle-class women into respectable jobs. During the latter half of the nineteenth century, the number of workers employed as clerks exploded. From 1851 to 1911, their numbers increased ninefold from 95,000 to 843,000, making clerks nearly 5 percent of the total British workforce.[21] Although ideally dependents, growing numbers of single, middle-class women had to, or chose to, maintain themselves and others both before and after marrying, and the growing British economy demanded their labor.

Male clerical workers increased only sevenfold from 1850 to World War I, whereas the number of women increased by eighty-three times, boosting their proportion of the total clerical workforce to 20 percent in 1911.[22] This large pool of female labor did not mesh seamlessly into the modernizing office. Instead, British offices were reorganized to comport with the changing shape of the labor market, carefully segregating women from men. Women took different entrances and stairwells in and out and dined in separate lunchrooms so that they would not encounter male colleagues even in passing. The prospect of men interacting in potentially sexual ways with these young, mostly single women was so unseemly that until 1911 the General Post Office in London forbade its female workers from leaving the premises at lunch.[23] This physical segregation mapped onto the organization of office work, changing work processes. Certain office work became gendered feminine, while other work remained a masculine preserve.

The way work was reorganized by gender in the modernizing office was nothing new. Factories had long divided mixed-gender workforces to better exploit women's labor. For example, in her study of British autoworkers, Laura Downs shows the speciousness of the concept of deskilling, which was used to segregate and devalue women workers.[24] The car manufacturer Rover classified women's work as unskilled despite its skilled nature by dividing work by gender. Rover's efforts to Taylorize its assembly line, and downgrade women's work even more, provoked an equal pay protest that ultimately succeeded, but women could not undo the way their work had been classified as lower skilled than men's.

Management used the gendered organization of the work to construct a hierarchy of labor, with "women's work" at the bottom.

A similar dynamic operated in white collar workplaces. In 1874, the post office received seven hundred applications for only five "woman clerk" posts. This flooded labor market greatly privileged employers and allowed managers to deskill women's office work from the start. Managers quickly developed the idea that competence working with machines was a feminine attribute to differentiate it from the supposedly more intellectual work done by male clerks. Soon, women became synonymous with office machine operators and their work became tied to typewriters, desktop accounting machines, and room-sized punched card equipment installations. Not coincidentally, women's entry into office work in large numbers occurred at the same time as the "industrialization of the office."

Clerical work continued to expand rapidly and by the 1950s women made up a majority—60 percent—of all clerical workers. By the 1970s the figure was over 70 percent.[25] Yet women workers still lacked the right to a wage on which they could live, whereas men were entitled to demand a family wage that could support a wife and children. Even within the nation's premier meritocracy, the Civil Service, white-collar women workers were treated as short-term and unskilled, had lower pay scales, and had few opportunities for promotion or a career.[26] Their alignment with machine work in offices persisted through waves of equipment upgrades and eventually through the changeover from electromechanical to electronic systems.

Office managers did not see anything unusual about the association of women with increasingly complex machines, because the association of women with automation was nearly a century old by this point. As one organizational expert put it while discussing the ever-growing numbers of women "mechanicals" in the 1950s and 1960s, many women who would have gone into factory work in earlier decades now sought work in offices: "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."[27] Positions like these proliferated in the massive bureaucracies of the state: Most people working for the nation's largest employer, the Civil Service, worked in office environments.[28] Yet women's work in government offices was not considered firmly within the realm of the white collar. Instead, it was constructed as almost industrial—and therefore liminal to the "real" work of offices.[29]

Accounting for the Total Labor Force

Even as women's workforce participation continued to rise—it skyrocketed during World War II and grew steadily after the war—women as a class remained the lowest-earning and lowest-achieving participants in the paid workforce. They were generally limited to deskilled (or ostensibly deskilled) work at low rates of pay, hurting their ability to contribute to the nation's economic growth.[30] Legal, economic, political, and social independence from a heteronormative family unit was not feasible for most women in this context. The moral burdens of a particular historical construction of womanhood continued to shape women's lives for much of the twentieth century.

Not only work organization but also technological organization piggybacked on these assumptions. The process of computerization in the public and private sector actively relied on explicitly feminized workforces, constructed under an umbrella of technocratic control. A technocratic heteronormativity relied on the structures of patriarchy and the nuclear family to produce the ideal staff for Britain's modernizing, information-based economy. In a very real sense, this arrangement defined what information technology and office-automating technologies could do.

Computerization and the job categories it created were intentionally and explicitly built around a particular mid-twentieth-century sexual status quo. Computer work grew on top of state measures that strengthened sexist labor patterns predicated on binary gender, compulsory heterosexuality, and the equation of womanhood with motherhood. The provisions of the postwar welfare state, for instance, institutionalized women's benefits based on a model that assumed their dependency on a husband's wage.[31] This contributed to the government deferring equal pay for its many women office workers for decades on the grounds that the women did not "need" it.

Despite economic rationalizations like these, biases that had nothing to do with the bottom line shaped managerial conduct. The practice of firing women immediately upon marriage, for instance, was a cultural dictate with no economic benefit for employers, because it removed trained workers from the labor market. The negative effects of this practice on the GDP show that the government's attachment to labor segregation by gender and marital status often made little economic sense.[32] Still, so important was women's dependent role to the maintenance of British societal norms that economic drawbacks like this were seen simply as an unavoidable cost.

Computing and the State

In addition to its major impact on private industry in Britain, computerization was also deeply enmeshed with the modernization objectives of the mid- to late twentieth-century British state. In her work on computing in Chile, Eden Medina discusses how states try to marshal technologies to reshape national economies in line with their political agendas.[33] In the case of Chile, a socialist government tried to use computing for a radical social justice project that would give greater economic and political power to the working class. In the case of Britain, however, the goal of computerization was the reverse: to consolidate as much power as possible in the hands of a small technocratic elite, removing it from unreliable machine operators as the power of electronic computers became clear. Medina's example shows that Allende's government used computing to intentionally decentralize decision-making and share power by constructing systems that privileged the working classes. However, examples of governments using computing technology to proactively share or decentralize power within a nation are exceptional: For most of the twentieth century, computing functioned as a centralized—and centralizing—technology that lent itself to the further consolidation of power in the hands of a few.

Electronic computing systems that often provided solutions to managerial problems in the private sector were closely linked to top-down governance in the public sector. This period in computing's history prefigures many of the trends toward the manipulation of ever-greater amounts of data for centralized decision-making and control today. Early electronic computing greatly increased governmental power on the national level.[34] This machine-aided revolution in management across the public and private sectors has resulted in histories of computing that often focus more on the mostly male scientists, designers, engineers, and businessmen who created or sold machines than on the mostly female workers responsible for their deployment and successful day-to-day functioning.[35]

In a broader sense, the computing revolution also offered Britain a final chance to reclaim the power of a fading empire and revive the flow of capital from overseas that it had enjoyed in the past. Both Conservative and Labour governments agreed on the need for government intervention in 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 went along with it throughout the mid- to late twentieth century. The government's keen interest in computing was not an issue of short-term efficiency or labor cost savings, though it was often publicly explained as such. Upgrading the farrago of older data-processing and office-automating machines promised benefits of control rather than price, and supporting the British computing industry offered the possibility of once again raising Britain's global political standing via technological innovation.

Neither the state's project to computerize itself nor its support of the computing industry achieved its intended goals, however. As a result, the British case is both an alternative history to the triumphal story of American technological progress and a cautionary tale for future technological development. In the US context, narratives that include women have enhanced our understanding of diversity but sometimes struggle to show how gender is a formative category for postindustrial labor markets and how gendered analyses alter the main contentions of the historiography of computing. Britain's experience tells us very different things about the relationship between technology and empire and about the essential, hidden role that gender plays in shaping industries and defining economic modernization itself. It forces a radical rethinking of the "revolutionary" narrative of the history of computing, and a reappraisal of the explanatory value of positivist histories of the information age.

Narrative Outline

The chapters that follow chart two related, overlapping changes: The first is the diminution of women's contributions in computing. The second is the increasing inability of the British government—and by extension, Britain itself—to make good on promises of a technological revolution that would help the nation maintain world power status and equalize Britain's highly class-stratified society. The chapters are organized to give a bird's-eye view of the change to a modern information landscape, grounded in specific details of government initiatives to deploy computers and mold workers. The book starts with the promise of a new technological order during World War II, proceeds to the "technological revolution" of the mid-1960s proclaimed by Prime Minister Harold Wilson, and ends in the late 1970s, when the idea of Britain refashioning itself as a technological superpower had largely crumbled. The narrative explains why gendered labor struggles prevented the nation from leveraging the mass of

its trained technical workforce and shows how this resulted in negative consequences.

Chapter 1 delves into the origins and consequences of wartime work in computing. The "total war" style of combat included conscription of women's labor, resulting in a wartime intelligence establishment that was overwhelmingly female. The training and use of women workers at Bletchley Park ultimately won what at times seemed like an unwinnable war for the British. Yet, the thousands of women who worked in these skilled roles were erased from the historical record due to British wartime secrecy and postwar paranoia as the Cold War loomed. This chapter shows how the gender integration of Britain's high-tech labor force enabled the nation's wartime successes, and why the women who worked with the world's first digital, electronic, programmable computers had a critical, material impact on the outcome of the war.

After the war, women's technical abilities dropped in value. Instead of helping women prosper in an increasingly machine-dependent and data-driven economy, these skills actually hurt them. Chapter 2 traces the creation and institutionalization of a feminized underclass of women machine workers within the sprawling bureaucracy of the Civil Service and nationalized industries. Many women operated and programmed electromechanical and, later, electronic computers because of the perception that these machines made work rote. Yet this was not a natural progression but an intentionally instituted set of labor practices that defined both the public and private sector. These newly formed "machine grades" were a job classification that ensured computing stayed low paid, feminized, and a dead end careerwise within the Civil Service. "Subclerical" women workers could therefore be kept away from the more important and legitimate work of government offices. Women's proficiency with machines meant they largely lost out on equal pay, and this wage inequality would alter computing for decades to come.

Positioned as deskilled and feminized going into the sixties, electronic computing work seemed low level by its very nature. Chapter 3 shows how British companies used the image of this feminized labor force to market the systems they were trying to sell both at home and abroad, intentionally exporting British gender norms to other nations as they marketed their systems. Computer work occupied the opposite end of the spectrum from nontechnical office work, which was seen as more intellectually demanding. But as computer use expanded, the machines' rising price tags helped alter management's understanding of their power and potential. Suddenly, taking cues from the highest levels of government,

leaders within the Civil Service began to regard computers—and therefore the workers associated with them—as more important than previously thought. Those who had the technical proficiency to command computers could, by extension, gain power over vast swathes of information and therefore people.

In 1964, Prime Minister Harold Wilson initiated a "white-hot" technological revolution meant to burn up inequalities within British society as it modernized the country. White Heat raised the profile and importance of computing and provided more encouragement to insert executive-level men into computer work. Yet, the feminization of computing made this nearly impossible. As a result, labor shortages slowed computing's progress and helped give women an early lead as the status of the field rose. While these jobs began to command higher wages, however, a popular discourse emerged that created false messages about women's actual roles. In an era when few understood what computer work was, advertisements showed women's computing work as simplistic in order to better sell machines. This powerfully shaped mainstream ideas about computing and affected how women were hired. By contrasting oral histories and government records with advertisements and computer companies' publications, chapter 3 shows the exciting opportunities available to workers, both men and women, in the era of White Heat—and how these workers were represented in the media.

This period of plenty did not last, however. Chapter 4 discusses why the revolution was doomed to fail. Although the twin forces of luck and labor shortage rapidly propelled many women into higher-level jobs as the field professionalized, there was a catch: Those high-level jobs were thought to be inappropriate for women. Technical workers were still seen as liminal to the white-collar hierarchy of the Civil Service, and women were viewed as unsuitable for management roles, particularly when the staff to be managed included men. As computers became the chosen instrument of government power at home and abroad, government hiring managers redoubled their efforts to create a class of technocratic elites to take over all computer programming and operation. Chapter 4 explains how these new recruitment efforts focused on changing who performed this work and on aligning machine workers with management. When high-level government ministers realized that technical work was more important than previously assumed, they aimed to construct a talent pool of career-minded, management-aspirant young men. These new technically minded managers were supposed to be able to manage machines as

easily as people and have the skills to go effortlessly from machine room to boardroom.

This gendered labor shift was not a side effect of computerization but a core goal of the project to computerize the state—and ultimately the nation. Chapter 5 explains why just as efforts to construct a new technocratic class floundered, so too did British computing. In consolidating a male-identified ideal for computer work, the government also whittled down the available labor pool for computer jobs. Most computer work in government was still done by women. By no longer considering this labor pool for computing posts, the government neglected most of its trained technical workforce. The ideal technocrat was extremely hard to find at large in the labor market, and these new hiring standards had the effect of draining training budgets and exacerbating labor shortages.

At the same time, the national government—the largest buyer and most important supporter of British computers—demanded systems that fit its needs. Government support was meant to strengthen the computer industry, but it also put the government in the driver's seat. The government's evolving vision of computing relied on a small cadre of technocratic managers who would orchestrate all computing from a centralized perch and take control out of the hands of a feminized class of workers seen as inherently unreliable and increasingly unruly. This organizational model dictated ever more powerful and centralized mainframe computing solutions. In an effort to ensure that the supply of British-made mainframes met this need, government officials became increasingly involved in the computer industry, eventually orchestrating a merger of the most promising companies into one large corporation that would supply the needed machines in return for full government support.

Although it seemed that such machines would solve the government's computer labor troubles, the focus on expensive, highly centralized computing solutions did not work, and the consolidation of computer companies hurt the industry's ability to compete at home and abroad. The concluding chapter explains why the problems that the government was trying to solve—Britain's "shortage" of skilled technical workers and difficulty competing in the global high-tech marketplace—were worsened by the actions government leaders took to alter their hiring pool and mold computer technology. The restrictions borne of gendered labor shifts imbued organizationally conservative ideals into the new field as Britain moved into the seventies. The promise of meritocracy through technological change had not been fulfilled, and it continued to hinder the modernization of the British economy. With equal pay complaints

once again bubbling to the surface and computer workers going on strike, British leaders realized that centralizing computing had been a double-edged sword. With it, they had unwittingly cut the legs out from under the British computer industry and wrought havoc on their own computerization projects.

Government records and the records of the nationalized industries provide the details of this history. They are complemented by the records of British computing companies, staff association and labor union records, and media from both trade and popular publications. Census data and oral interviews provide perspective on the symbiotic relationship between the public sector's labor force and the private sector.

Although women figure prominently in the pages of this book, most of the women were not themselves prominent. Throughout the narrative, the focus shifts from women's work to men's work, and from labor to management, as the gender of the field changes. Fundamentally, this is a history less about women than about how changing constraints of gender, class, and sexuality mold labor forces, industries, and nations. Most women in this study did not make major contributions as individuals, but they were important as a class of workers on whose shoulders was laid incredible technological responsibility with little corresponding economic or social status.

Understanding this labor as a class, rather than through the lens of a few remarkable individuals, sheds light on the importance of gender as a formative category in technological organization and design. It forces us to rethink many of the assumptions of computer history narratives that hold up individuality and innovation as key explanatory elements. It also provokes a reconsideration of how histories of computing sometimes reflexively and unconsciously privilege those with the most power and implicitly endorse an ahistorical fiction of technological meritocracy. That the workers in this field were disproportionately white is no more a coincidence than the fact that they were overwhelmingly women. Throughout history, it has often not been the content of work but the identity of the worker performing it that determined its status, and these workers, while below their male peers, still occupied a position of privilege compared to many other women.

This study attempts to avoid further lionizing computing skill in a way that gives automatic approval to its worth. Instead, it complicates how our impression of the high value of computer programming has been historically constructed by class, gender, nationality, and race, and it is skeptical about the technological boosterism that sometimes attaches to narratives seeking to unearth women's contributions to computing.

The book focuses on workers rather than professionals to highlight the classes of women who often could not, or would not, take on the neat identity of "programmer" but who did the work nonetheless.[36]

This history holds lessons for other postindustrial nations whose economies and societies are becoming ever more reliant on computing and computer workers. The experience of Britain in the twentieth century has many similarities to the US context in the twenty-first century. The problems that ultimately scuttled the British computing industry—and helped exacerbate the nation's slide into second-rate world power status—formed in a sociotechnical context where gender and an assumption of heterosexuality were primary organizational factors that shaped everything from the deployment and usage of electronic computers to their design and provisioning. The British case shows how these social categories played a surprisingly large role in shaping computing technology, right down to the hardware, and how economic modernization turned on enforcing hierarchies of social difference through technology. Contrary to popular belief, high technology is often as socially regressive as it is technically revolutionary or progressive. Histories like this offer examples that help us think about where increased dependence on computerization and digital labor forces may lead in the future. The construction of classes of ostensibly deskilled high-tech workers continues to enable the boom-and-bust cycle of technical advance and shape the social patterns that cohere around these systems.

In the end, the treatment of labor in the British case created severely limited horizons for both those at the top and those at the bottom. Gendered labor's "butterfly effect" began at the lowest levels of British computing and reached all the way up, drastically altering decisions about technology made at the highest levels of government and industry. The failure of Britain's thriving midcentury computer industry serves as an unhappy reminder of the ways in which technologies can rarely fix social or economic problems and how they instead often make real the limited and myopic goals of small but powerful segments of society. Technologically determinist solutions—in which technologies are wielded to determine the course of a nation—always use the raw material of the status quo and therefore often fail to bring about meaningful change. In the case of British computing, the reasons for this failure remained invisible, because critical parts of the system were never considered salient factors in the first place. As the *Times* of London put it in 1970, "computers need people."[37] This is a history of why that need went unmet, and what emerged as a result.