YOUR COMPUTER IS ON FIRE

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SEXISM IS A FEATURE, NOT A BUG

Mar Hicks

In 2017, I went to Google to speak about my work on women in the history of computing. I explained how women were the field's first experts, though they weren't accorded that respect at the time, and how they were excluded when men in management saw computers becoming powerful tools for control, not of just work but of workers too. Women, of course, weren't considered management material in this era, and so as computers became aligned with management women were shown the door—oftentimes after training their (male) replacements. It was not that women lacked technical skills, or even opportunities to show their skills. It was that their very status as women precluded them from advancing in a new field whose power and prestige was swiftly growing.

In the question and answer period after my talk, I got the predictable question: wasn't it actually that women just *didn't like* computing work as much as men did? And wasn't it true that women who succeeded in computing, both then and now, were somehow less "feminine" and more "masculine"? This is a question I get often, but this time I got it from a woman engineer. She wasn't being hostile; she just appeared to really want to be reassured that she was different, that she wouldn't face the same fate as the women I'd described, and also that women weren't being held down or forced out. She seemed to need to believe that the current state of affairs was somehow the natural order, or else she might have to confront the deeply unfair past and present of her chosen line of work—and the fact that it would likely affect her own future.

This engineer's response is not all that surprising when you remember that the high-tech sector presents itself as the ultimate meritocracy. Silicon Valley is the high-tech version of the American Dream, where anyone with talent can supposedly succeed, even if they start out in a garage. Yet its makeup does not reflect this—it is deeply skewed in terms of gender, race, class, sexuality, and many other categories, toward historically privileged groups.

Gender discrimination, in particular, is a major stumbling block for the high-tech industry—so much so that even some of the most powerful, white women feel they need to admonish themselves and their peers to "lean in" to combat sexism and break through the glass ceiling.[1] This belief in the promise of a more equal future, if only women would try harder, seems alluring if one takes it on faith that Silicon Valley's goal is to measurably improve itself.

But a culture of rampant sexual harassment, persistent racial inequalities in positions of power, and pay and promotion inequalities industry-wide shows that Silicon Valley culture is mired firmly in the past, even as companies claim to be building a better future.[2] From sexist manifestos on how women's supposed intellectual inferiority disqualifies them from tech careers, to golden parachutes for serial sexual harassers at corporations that simultaneously choose not to cooperate with federal equal pay investigations, to platforms that position misogynist and racist hate speech and threats of sexual assault as just a normal part of online discourse, it is no surprise that women workers in the tech industry might internalize sexism and blame themselves—particularly because when they speak out they tend to lose their jobs.[3]

Online, Black women, and particularly Black trans women, are targeted with inordinate amounts of hatred, yet the platforms that enable it refuse to seriously address the harms they are causing. Twitter's moderation decisions routinely allow misogynoir and hate speech that specifically affects Black women, multiplying sexist and racist harms. These gendered harms are also built in to platforms at their core. One of the most highly valued companies in Silicon Valley started out as a site that stole women's pictures without their consent and asked users to rate their attractiveness.[4] Facebook now commands the attention of more than two billion users worldwide and uses its power to influence everything from minor purchasing decisions, to who gets elected, to—in extreme instances—which populations live or die.[5]

That the concept of merit structures our understanding of high technology and its successes, even as a lack of diversity at the top of Silicon Valley corporations creates an echo chamber, means that the infrastructure tech builds actually often worsens social inequalities.[6] As Safiya Noble has shown, existing problems become entrenched and magnified by profit-seeking technologies masquerading as neutral

public resources.[7] Google, for example, presents itself as a neutral information tool when the company's real business model is to sell as many advertisements as possible—Google brings in more than 100 billion dollars annually in advertising revenue, the vast majority of its revenue.[8]

Such technological systems have little incentive to push back against sexism and racism and a strong profit motive to look the other way, or even to lean into them. This is not new: as something that grew out of the Second World War and the Cold War that followed, electronic computing technology has long been an abstraction of political power into machine form. Techno-optimist narratives surrounding high technology and the public good—ones that assume technology is somehow inherently progressive—rely on historical fictions and blind spots that tend to overlook how large technological systems perpetuate structures of dominance and power already in place.[9]

As the United States finds itself in the midst of a "techlash" or backlash against high tech's broken promises, the history of computing offers us a chance to reflect critically on the roots of these developments and the potential dangers that lie ahead. Because Silicon Valley seems to be pointing the way to our national and even global future, it is difficult to critique it and to imagine alternatives. The US tech sector's outsized level of power has a disproportionate influence over the terms of the conversation, particularly as social media platforms replace traditional news outlets. In this situation, comparative history is a powerful tool: by taking us out of our current moment and context and showing us a different scenario, we can better unpack the roots of what has now become normalized to the point of seeming inevitable and unchangeable.

This chapter offers an example from the United Kingdom, the nation that invented the computer. As a close historical cousin of the United States, it is a harbinger of our own current technological troubles, and a prime example of how high-tech economies rise and fall on the cultural ideals engineered into their systems. The British experience offers a compelling example of how a computing industry's failure is intimately linked with social problems that may seem ancillary or unrelated. It shows how the fiction of meritocracy can scuttle an industry and how computing has long been aligned with neocolonial projects that present fantasies not just of national but of global control as being possible through high technology.

Contrary to what we might believe or hope, this history shows us that computing purposely heightens power differences, and that those who commission and control these systems benefit from that. It also shows that this intentional program of concentrating power at the top by discriminating against certain groups paradoxically

lowers the quality and output of what a nation's technology sector can produce. Ultimately this proves to be self-destructive—not only to that technology but to entire economies and democracies.

COMPUTING FIRSTS, COMPUTING FAILS

The UK context presents us with one of the most shocking failure stories in the history of computing. In 1943, Britain led the world in electronic computing, helping to ensure the Allied victory in Europe during World War II. By deploying top-secret code-breaking computers—the first digital, electronic, programmable computers in the world—the British were able to use computing to alter geopolitical events at a time when the best electronic computing technology in the US was still only in the testing phase.[10] By leveraging their groundbreaking digital methods for wartime code-breaking, the British conducted cyberwarfare for the first time in history, with great success.

After the war, British computing breakthroughs continued, matching or anticipating all of the major computing advances in the US. But by 1974, a mere thirty years after deploying the first electronic programmable computers, the British computing industry was all but extinct.

Nowhere is the story of a nation undone by a broken high-tech industry more apparent than in the case of Great Britain. Yet this swift decline of the computer industry in the nation that *invented* the computer has for too long been ignored or misunderstood. If the rising power of computing is one of the biggest stories of the twentieth century, then the failure of the nation that broke new ground in electronic computing is undoubtedly one of history's most urgent cautionary tales.

The myth of meritocracy is easier to investigate in the UK, a nation riven by class antagonisms far more obvious and long-standing than those in the US, as the unrealized ideal it has always been. The UK, still influenced by a divine-right monarchy, struggled to remove class from the equation of who could govern.

The British Civil Service was set up to be the ultimate meritocracy, with an elaborate system of exam-based hierarchies and promotions to ensure that those in charge of the country's resources derived their positions from skill rather than social standing and were suitably qualified to hold them. Nothing less than the nation's ability to function was at stake. British leaders realized that a nonmeritocratic system would result in cronyism, corruption, nepotism, graft, and ultimately the destruction of democratic civil society. A strict meritocracy was needed, because if the government

could not be trusted as a fair and just instrument of the will of the people, democracy itself was in danger.

But although the Civil Service claimed to be able to transcend the unfairness of British society, describing itself as a "fair field with no favor" for all of its employees, civil servants were not judged simply according to their own talents and abilities. For most of the twentieth century, being white was a primary assumption and requirement for holding any position of power in the UK, as well as for holding what were then seen as "respectable" office jobs. Although a small minority of mostly lower-level civil servants were Britons of color, they were the exceptions that proved the rule of a system of powerful, unspoken white supremacy.[11]

More remarked upon at the time was the subordinate position of the mostly white women who had to take different entrance exams than men and for much of the twentieth century were not allowed to work in the same offices, use the same lunchroom facilities, or even enter and exit buildings by the same doors and stairwells as their male coworkers. Because of the heteronormative supposition that women would marry and leave the labor force to take care of a family, they were also either expected, or outright required, to leave their jobs upon marriage.

These women also earned less than their male peers for performing the exact same jobs. Men, it was reasoned, needed a "family wage," whereas women were supposedly working to support only themselves. White, mostly middle-class women were treated as a temporary labor force, and their lack of adequate pay or promotion prospects meant that many left upon getting married even if they wished to continue working. For the most part, women's work in the burgeoning information economy was kept separate—and seen as different in type and inferior in kind when compared to men's work. While this was true throughout industry, the inequity of the situation was most obvious within the government's "meritocracy."

It was paradoxically for this reason that women ended up being on the cutting edge of computing in the UK. Women had been the first computer operators and programmers during the war, working on the top-secret Colossus code-breaking computers that allowed the Allies to successfully land on D-Day. Their suitability for these positions was defined not simply by war's labor constraints but by the low esteem in which early computer work was held. Viewed as rote and excessively technical, early computer work was denigrated for its association with machinery rather than elevated by it. It was seen as almost akin to factory work, and the introduction of machines into office environments was often referred to as the "industrialization of the office" by managers.

Despite the fact that these women worked assembling, troubleshooting, testing, operating, and programming the computers that contributed directly to the war's positive outcome for the Allies, their work was hidden and largely unremarked upon for decades after the war. This was not simply due to the secrecy surrounding their work, although the Official Secrets Act played a role. Early computer operation and programming was such a feminized and devalued field that few people singled it out as being historically important or cared to remember and record the names, tasks, and accomplishments of these women. Once the official veil of secrecy started to lift in the 1970s, women wartime computer workers began to tell their stories, but many of them felt that their stories were not worth telling.[12]

Even prior to the term "computer" being a name given to a machine, it had been the name given to job. Originally, a computer was a person—almost always a young woman—who computed complex equations with the help of pen and paper or a desktop accounting machine. A common misperception is that women got into computing during World War II simply because men were at the front, but the gendering of computing work existed before the war, and before computers were electronic. The feminization of this work continued through and after the war, with women returning to the civilian workforce to perform computing work with electromechanical and later electronic systems—everything from programming and operation, to systems analysis, to hardware assembly.

BUILDING A BROKEN SYSTEM

As computers began to percolate out of the military and academia into industry and government more broadly, women's computing work became ever more intertwined with computers, and critical to the functioning of the economy. While women were sent into lower-level jobs, often ones that depended on proficiency with office machines like computers, men were tapped for higher level, supposedly more intellectual work that led to managerial and administrative promotion tracks where machines were nowhere in sight. The latter positions could eventually lead to policy-making roles at the highest levels of government.

In 1959, one woman programmer spent the year training two new hires with no computer experience for a critical long-term set of computing projects in the government's main computer center while simultaneously doing all of the programming, operating, and testing work as usual.[13] At the year's end, her new trainees were elevated to management roles while she was demoted into an assistantship below them,

despite her longer experience and greater technical skills. In this era, the idea that women should not be in a position to hold power over men made it highly unlikely they would be promoted into management positions.

Women also continued to earn less money for doing the same jobs. For women who worked with computers, their economic worth was tied to their identity as women but largely unmoored from their proficiency on the job. One of the earliest UK civil servants to come out at work as a trans man found his pay immediately raised after his transition in the late 1950s, simply by virtue of his employer now recognizing him as a man. At the same time, another civil servant, a trans woman, was given advice by her managers to hide or delay her transition so that her pay would not go down.[14]

For decades, the government fended off increasing pressure from workers to grant women civil servants equal pay. In 1955, an equal pay plan was slowly phased in over a period of several years, but only for job categories in which men and women held identical job titles, not jobs in which they did similar work. Since the Civil Service had been so highly segregated into men's and women's jobs, this meant that the majority of women working in government would *not* actually get equal pay. The largest block of these workers were the women in the "Machine Grades," the class of workers who did the computing work of the government—at the time the nation's largest computer user.[15]

These women were explicitly excluded from the provisions of the Equal Pay Act, and as a result the Machine Grades became known as the "Excluded Grades" after the passage of equal pay. The Treasury reasoned that because so few men worked in computing, women's significantly lower pay rate had now become the market rate for the work. Because women had been doing machine-aided computation work for so long, and in such majority, their relative lesser worth in the labor market had attached to this work and lowered the jobs' *actual* worth, not just culturally but in a literal, economic sense.[16]

By the 1960s, however, the power of computing was becoming more apparent to those in charge. The woman in the earlier example was required to train her supervisors not because there were no longer enough women to do the work, but because computer systems were expanding to take over more aspects of government. Although the complexity of the work did not suddenly change, the perception of its worth skyrocketed. As such systems became recognized as more than merely technical, government ministers realized that computers would be important tools for consolidating and wielding power over workflow, workers, industrial processes, and even the shape of government itself.

With computing work becoming aligned with power, women computer workers who possessed all of the technical skills to perform the jobs found themselves increasingly squeezed out by new hiring rubrics that favored untested men trainees with no technical skills. Despite its "meritocracy," the government explicitly forbade women from the former Machine Grades from applying for the newly created class of management-aligned computer jobs designed to help management gain greater control over the mounting number of computerized processes poorly understood by those at the top levels of government and industry.[17]

Though these women could easily do the work in a technical sense, they were not allowed to occupy the positions of managerial and political power that computing jobs were suddenly becoming aligned with. At the same time, the men who were tapped for these jobs lacked the technical skills to do them and were often uninterested in computing work, in part because of its feminized past.

LOWERING STANDARDS TO CREATE AN ELITE

As a result, government and industry began a major push to recruit men into these technical positions while simultaneously grooming them for management positions. This process entailed lowering standards of technical proficiency to create an elite class of management-level computer workers, above the old Machine Grades in name and power, but beneath them in technical skill. It was supposed to result in the construction of a cadre of high-level, management-aligned "computer men"—technocrats who would be able to manage people as well as machines and make informed decisions at the highest levels about the future of computerization.

Instead, this recruitment change resulted in a devastating labor shortage. Promising young men tapped for the positions usually had little interest in derailing their management-bound careers by getting stuck in the still largely feminized "backwater" of computer work.[18] At a time when computing was tied up with ideas about the "industrialization of the office," many still saw machine work in general as unintellectual and liminally working class.

Most young men who were trained for these new computing positions, at great government expense, left to take better, noncomputing jobs within a year. Government ministers in charge of the changeover were blindsided by the results and the problems caused by hemorrhaging most of their computer staff. This trend continued throughout the 1960s and into the 1970s, even as the status of the field rose,

and computing work began to professionalize. Young men who were trained for the new positions often did not want them for long, while young women who had the skills were forced out through turnover, demotion, or by being strongly encouraged to "retire"—in other words, marry and leave the workforce—before the age of thirty. Not coincidentally, thirty was roughly the age at which all promotion for a woman computer worker in the public sector ended.

FAKE IT UNTIL YOU (CAN GET A WOMAN TO) MAKE IT

As a result, the programming, systems analysis, and computer operating needs of government and industry went largely unmet. The government was the biggest computer user in the nation, and its inability to train and retain a technical labor force had national reverberations. It slowed and complicated computerization and modernization plans throughout the country, holding back Britain's economy, and even causing political problems for the UK on the international stage.[19]

One way that corporations and the government attempted to satisfy this dire need for more programmers was to turn to outsourcing the work. At this time, software was still something that normally came bundled with a mainframe, rather than being seen as a product that could be sold separately. Software either came with the machine, direct from the computer company, or was written by the employees who ran the mainframes. People who started companies in the nascent software services industry in the 1960s were making a big gamble that companies would pay for software as a standalone product after spending hundreds of thousands of pounds to buy a mainframe.

But some people who set up software companies in this period did so because they felt they had no other choice. The most famous and, eventually, most successful of these software startups was headed by Stephanie "Steve" Shirley—a woman who had previously worked for the government until the glass ceiling had made it impossible for her to advance any further. Born in Germany, Shirley had been a child refugee during World War II. She was saved from being murdered by the Nazis when she was brought to England with 10,000 other Jewish children on the Kindertransport.[20]

Shirley often credited her escape from the genocide in Europe as a primary reason for her later drive to succeed: she felt she had to make her life "worth saving."[21] After leaving school, she went to work at the prestigious Dollis Hill Post Office Research Station in the 1950s, the same government research center where Tommy Flowers had built the Colossus computers, and she worked with Flowers briefly. As a young,

technical woman worker, Shirley recalled that the sexism of the time usually dictated that she follow orders without much independent thought.

Animated by her drive to succeed, Shirley went to school for her university degree at night while working full time, and sought to raise the responsibility level and difficulty of the work she was assigned. But she began to realize, as she put it, that "the more I became recognized as a serious young woman who was aiming high—whose long-term aspirations went beyond a mere subservient role—the more violently I was resented and the more implacably I was kept in my place."[22] After being passed over multiple times for a promotion she had earned, she found out that the men assigned to her promotions case were repeatedly resigning from the committee when her case came up, rather than risking having to give a woman a promotion. Her ambition was seen as a liability, even though in a man it would have been rewarded.

Realizing there would be no chance for her to get ahead in the Civil Service's false meritocracy owing to her gender, Shirley left her job and after a brief stint in industry, where she encountered the same sexist prejudice, she decided to quit and start her own computing company while raising her son. In 1962 she founded Freelance Programmers, which was unique not only because it was one of the first companies to recognize that software as a standalone product was the way of the future but also because she learned from the mistakes that government and industry were making with computer workers.

While government and industry starved themselves of programmers because they refused to hire, promote, or accommodate women technologists, Shirley scooped up this talent pool. Shirley considered her business a feminist enterprise—one that would allow women like her to continue working in computing and use their technical skills. One of her first job advertisements read, in part, "many opportunities for retired programmers (female) to work part-time at home," and described the jobs as a "wonderful chance, but hopeless for anti-feminists."[23] In other words, there was a woman boss.

By giving her employees flexible, family-friendly working hours and the ability to work from home, Shirley's business tapped into a deep well of discarded expertise. Desperate for people who could do this work, the government and major British companies hired Shirley and her growing team of mostly women programmers to do mission-critical computer programming for projects ranging from administrative software and payroll to programs designed to run industrial processes.

Initially, having a woman's name at the helm of the company prevented Shirley from getting work. But when she started using her nickname "Steve" for business

purposes, her letters to potential clients were no longer ignored. From there, she could get her foot in the door long enough to impress potential clients. Shirley also took pains to hide the infrastructure of her startup. Although she worked from home with her child, often accompanied by other women employees and their children, she presented as polished and professional an image as possible, playing a recorded tape of typing in the background whenever she took a phone call in order to drown out the noise her young son might make, and instituting a strict, conservative business dress code for meetings with clients.

One of the most prestigious contracts Shirley and her team were able to win was the Concorde's black box project. The programming for the Concorde was managed and completed entirely by a remote workforce of nearly all women, programming with pencil and paper from home, before testing their software on rented mainframe time. Dubbed "Europe's version of the Space Race," the Concorde remains the only passenger supersonic jet to go into service, and its creation pushed the limits of what was possible in terms of international technological cooperation (it was a UK–French collaboration). Perhaps even more importantly, British cooperation on the project served as a political concorde as well, and effectively paved the way for the UK to finally be accepted into the European Economic Community, the forerunner to the EU, boosting the nation's flagging economic fortunes.

In the image below, one of Shirley's employees, computer programmer Ann Moffatt, sits at her kitchen table in 1966, writing code for the Concorde's black box flight recorder. Moffatt was the technical lead for the Concorde programming project and managed the project while working from home, taking care of her young child at the same time. She would later become technical director at the company, in charge of a staff of over 300 home-based programmers (fig. 6.1).

Steve Shirley's company functioned, and indeed succeeded, by taking advantage of the sexism that had been intentionally built into the field of computing. By utilizing a portion of this wasted talent—capable women computer professionals who were being excluded from contributing to the new digital economy despite having all the skills required—Shirley employed thousands of workers over the course of her company's lifetime whose skills would have otherwise been discarded. Her feminist business model allowed many technical women to fulfill their potential, and in the process also serve the nation's ever-growing need for computer programmers.

For every woman Shirley employed, however, there were always several more applicants vying for positions, looking for a place that would allow them to use their computing skills and judge them on their capabilities rather than their gender.

Figure 6.1 Computer programmer Ann Moffatt sits at her kitchen table in 1966, writing code for the black box flight recorder for the Concorde. The baby in the photograph is now over fifty years old. Photo courtesy of Ann Moffatt.

That the women Shirley could not employ were usually unlikely to have computing careers elsewhere, particularly if they needed working hours that could accommodate their family responsibilities, meant that their productivity and talent was lost to the labor market and the nation as a whole.

The irony that these women were not perceived by their male managers as good enough to keep in formal employment but at the same time were so indispensable that the government and major corporations would outsource important computing projects to them was not lost on Shirley and her workers, but the realization seemed to sail over the heads of most men in management. Her startup eventually became an international billion-dollar company and produced some of the most important software used in British business and the public sector.

Shirley's success gives some clue as to why sexism was bound to create major problems for the computing industry. Her successful business model not only highlighted

the fact that sexism was part of the way the field functioned but also showed how these operating parameters hurt computing's progress. Managers in government and industry saw their sexist labor practices as a positive and necessary feature of creating the new high-tech digital landscape—as something that would ensure computerization proceeded smoothly, along the lines they intended, and with the right people in control. In point of fact, however, it was a hindrance, and it would turn out to have serious and wide-ranging negative consequences.

EMPIRE 2.0

While Shirley's company and staff of mostly women provided the know-how and programming labor to keep the nation's computers running, and keep the process of computerization expanding, another national conversation was going on. Leaders in government and industry viewed the progress of computing as being about more than just improving standards of efficiency or revolutionizing work inside the UK. As a once-powerful empire, the British government saw computing as a powerful new tool in its international political arsenal.

Where it had once dominated by gun and boat, Britain now saw that as its empire shrank, it could only revive its power abroad by dominating the informational infrastructure of other countries and their economies. Computers had started out as powerful weapons of war, funded heavily by the US and UK militaries. Even as swords turned to plowshares, computers and the government interests that largely controlled them continued to be tools for wielding power over other nations. The UK believed it could gain influence and economic power through technological exports, and even use British computers and computing expertise as a back door into the governments of other nations that were becoming politically independent from British rule.

For this reason, the UK insisted on British computers to run all UK government work. They presciently understood that foreign powers could gain a foothold through foreign computing technologies being inserted deeply into the structure of British government. American computers running the British government would present a national security issue, even though the US was an ally. Computers could give a foreign power a back door into the highest levels of the state.[24]

While the British government was determined not to allow this to happen to them, they actively planned to use these same techniques against other nations, particularly former colonial nations, in order to gain power and political influence.[25]

Narratives and images of British computing abroad confirmed this agenda. Supported by the government, British computing companies embarked on a worldwide program of aggressive expansion, attempting to sell computing technologies, and the idea of their necessity, to countries with little need for labor-saving calculating machines. While United States companies, particularly IBM, balked at selling the latest technologies to nations that they considered underdeveloped—only deigning to sell India, for instance, older models in IBM's line—British companies seized the opportunity to get as much British technology as possible into the hands of Indian companies, educational institutions, banks, and government agencies, in order to forge relationships and accustom Indian consumers to buying, using, and relying upon British computers.[26]

As part and parcel of this, the UK exported to these other nations the gender roles that it had put into place for its own labor forces. When British computing companies set up a computing installation for a company in India, for example, the gendered contours of the labor force followed those in Britain. But when Indian companies purchased a British computer and set it up for themselves, they more often staffed it with a mixed-gender model or sometimes even gave "feminized" jobs like punching to all-male workforces.[27]

The British plan to dominate through technology was symbolic as well as material: advertisements for computing extended the rhetoric of Britain's "civilizing mission" from its imperial period, and used sexualized images of exoticized "foreign" women to portray the triumphs of British technology abroad. In figure. 6.2, the obvious sexual caption plays upon a deeper preoccupation with colonial power. In these images, women often stood in as symbols of the national cultures the UK expected to dominate with British technology, extending the nation's imagined international might in a cultural as well as political sense.

These tactics laid bare the power implications of computing and used high technology to continue the logic of British imperialism, even as nations that had been subjugated by the British fought for and won their independence from British rule in a political sense. It was no coincidence that the UK put so much faith and effort into computing technology during a time when its empire was contracting and its power on the world stage was diminishing. Computing technologies, then as now, were expected to be the new lever to move the world.

Figure 6.2 An Ashanti Goldfields computer worker in Ghana. *ICL Marketing* (February 6, 1970).

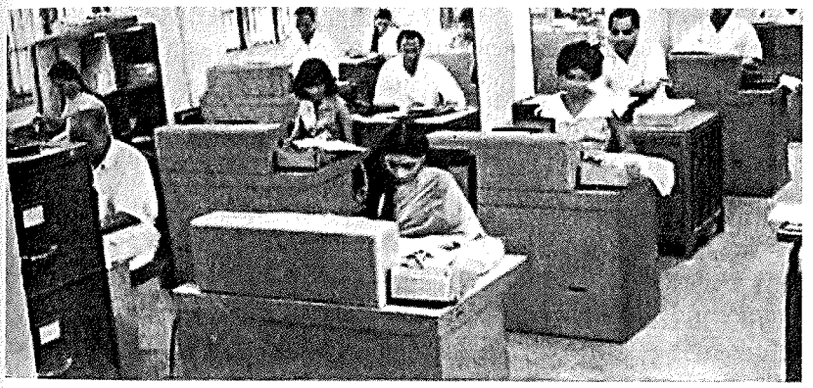

Figure 6.3 The punch room at Air India employed both men and women as operators, something British-run computing installations would not have allowed. "ICT in India," *ICT Magazine* 9 (1961).

A BUG AFTER ALL

Despite recognizing the enormous power of computing technology to reshape British fortunes at home and abroad, by the mid-1960s the UK government had allowed the nation's computer labor shortage to sharpen into a crisis that threatened to undermine all of its plans. Despite instituting career paths in the civil service for the ideal model of male, white-collar, management-oriented computer workers, the state continued to struggle to even get qualified candidates to train. Given this, its commitment to hire only management-aspirant young men began to soften, and in the mid-1960s a number of women programmers were able to get jobs in the new, higher-level technical grades of the civil service, as long as they came from the service's white-collar office worker grades and not from the "pink collar" machine grades.

But this brief wave of more egalitarian, meritocratic hiring, in terms of gender if not class or race, did not last long. By mid-1967, the labor crisis had abated just enough to allow a return to previous gendered hiring practices, and the government simultaneously decided to embark on an alternate plan for fixing its computing problems. If labor shortages could not be easily fixed, then a different part of the system would need to be changed to ensure the success of Britain's computerization.

By the late 1960s, the government's fear of losing control over the country through losing control over the technology that ran it was perilously close to becoming a reality. The power that technical workers held, given the interwoven nature of computing processes with all of the functions of the state—from the Bank of England to the Atomic Energy Authority—meant that they were becoming increasingly indispensable. A strike by keypunch staff doing data entry for the new value added tax (VAT) computer system, for instance, brought that project to a halt and sent high-level officials scrambling.[28] The computers that enabled the sprawling bureaucracies of the state to function were unreliable and consistently understaffed, unable to maintain the level of programmer and operator labor required to make them work most effectively.

It was in this context that the Ministry of Technology, backed by other government agencies, hatched a plan to reconfigure the computing infrastructure on which the government relied. Training more young men had not worked; it simply resulted in more turnover and wasted outlay, and outsourcing was only a temporary solution. Returning to a feminized computer labor force was a nonstarter given the rising power and prestige now attached to the jobs. This meant that the only solution was to re-engineer the computing systems to function with a much smaller labor force.

Managers at the top of the government therefore decided they would need ever more massive mainframes, so that all of the nation's computing operations could be

centralized to the greatest extent possible. This would allow a far smaller technical labor force to control Britain's digital infrastructure. The government forced a merger of all the remaining viable British computer companies in order to literally gain more control over the shape of British computing. The merger created a single company, International Computers Limited (ICL), indebted to the government, giving government technocrats the power to demand that the company produce product lines that would best accommodate the government's needs.

The central government would fund the new merged company's research program and, even more importantly, would promise to purchase its computers exclusively. Since solving its computing problems through labor and software had not worked, the government asserted that the very design of the systems themselves would need to change. In return for government grants and contracts, ICL accepted a high degree of government control over its product line and embarked upon the project of producing the huge, technologically advanced mainframes the national government believed it needed to solve its computer labor problems.

Unfortunately, this move began right as the mainframe was losing its pride of place in business computing. Massive, expensive mainframes were on the way out, with smaller mainframes and more flexible, decentralized systems becoming the norm. By the time ICL delivered the requested product line in the mid-1970s—the highly advanced 2900 mainframe series—the British government no longer wanted these expensive and complex machines, and neither did any other potential customers. As a result, the company was effectively dead in the water. Moored to its advanced but effectively unwanted new mainframe line, ICL could not compete with the offerings of foreign companies like IBM. ICL was now—thanks to the merger—the majority of the British computer industry. Because the company had neglected the development of its smaller, and better-selling, lines of mainframes in order to focus on developing the 2900 for the government, its failure effectively took down the whole of the British computer industry.

LOOKING FORWARD BY LOOKING BACK

The discrimination that produced the technical labor shortage in UK government and industry in the twentieth century was a highly constructed and artificial feature. It was not an evolutionary or somehow natural change: nor was it a particularly logical one. The gender associated with computing jobs changed in this period because the idea that the work was appropriate only to one gender or the other was a defining element in how computing systems were organized. The sexism that made

women the go-to labor force for computing early on also meant women were seen as an unreliable or inadequate group of workers once the power of computers became more apparent.

But the gendered structure of the field heavily influenced its growth and possibilities. Sexism was intended to keep power out of the hands of those deemed unworthy of wielding it, but it ended up devastating Britain's computing industry and the country's global technological standing.

This history is of crucial importance today because it is not that unusual: the British reliance on sexist hiring and firing practices, and on the association of technical work with low-status workers but powerful managerial work with high-status workers, has been a common pattern in the postindustrial West. The manner in which government leaders and industry officials worked together to standardize and codify a gendered underclass of tech workers, and then to later upskill that work once the managerial power of computers became clear, was not evolutionary or accidental. It was an intentional set of systems design parameters intended to ensure that those who held the most power in predigital society, government, and industry continued to hold that power after the "computer revolution."

It is also not a coincidence that once computing became seen as powerful and important, more than merely "technical" work, it began to exclude white women and people of color except in times of labor crises, like war or severe labor shortages in peacetime.[29] High technology is often a screen for propping up idealistic progress narratives while simultaneously torpedoing meaningful social reform with subtle and systemic sexism, classism, and racism. As Margot Lee Shetterly points out in *Hidden Figures*, Black women workers were only brought into critical jobs in NASA when Cold War tensions made their labor too valuable to ignore—too important to continue to exclude on the basis of their Blackness.[30] But even once included, people who were not seen as worthy of wielding power were deliberately engineered out of newly powerful and profitable roles, even when they had the required technical skills.[31]

From the beginning, societal biases have played a major role in constructing and deploying computer systems because high technology is not the radical agent of change that those in power often profit from presenting it as. The computer revolution was not a revolution in any true sense: it left social and political hierarchies untouched, at times even strengthening them and heightening inequalities. That the US in the twentieth century escaped the fate of the UK has more to do with the relative size of its labor force, and its relative wealth following World War Two, than

with differences in sexist hiring practices. But currently the US is being forced into competition with rising superpowers like China and India, which have far greater available labor forces, and it simultaneously finds itself confronted again by Russian technological power and political warfare. In this context, the US as a fading empire mirrors the UK in the twentieth century, and we have begun to see Silicon Valley corporations, and US society as a whole, hurt by an inability—or refusal—to solve deep, structural problems with discrimination.

This is largely because this aspect is an intentional feature, not an accidental bug. Computing was designed to help those at the highest levels of government and industry wield power. Powerful technologies like this often heighten inequalities not by accident but specifically because they they are designed to protect the interests of the powerful actors who control them. The contours of this story may change in different national and temporal contexts, but the idea that technological systems normally preserve existing hierarchies and power structures, rather than being revolutionary, holds true much more often than we recognize.

Though Britain's actions backfired and had highly negative effects on its computing industry, its entire economy, and even its political standing in the wider world, the actions themselves were fully intentional.[32] At the time, UK leaders in government and industry generally believed that there could be no other way to design such systems—that this mode of operation represented a kind of natural social order, despite vast evidence to the contrary.

THE POWER OF THE STORIES WE TELL ABOUT TECHNOLOGY

Historians of technology can point out the many ways in which status in high tech is arbitrary, how categories of prestige swiftly change, and how pay and rewards are often unmoored from the specific skills the industry purports to value.[33] Yet, as a field, the history of computing has often taken for granted the ideal of meritocracy as an implicit structuring element in narratives of technological progress and the lessons drawn from those narratives.[34] Because technological success stories map to the idea that computing's history is one of social progress, even when it is not, the main narrative of meritocracy-driven progress in the history of computing needs to be rethought, with an emphasis on the important historical lessons gained from technological failure.

By privileging stories of corporate success and the ingenuity of high-status individuals, historians have often constructed narratives that seem to support the

fiction of meritocracy.[35] White, heteronormative, male, and cis professionals crowd the pages of most histories of computing, while Black and white women programmers, Navajo women semiconductor manufacturers, LGBTQIA technologists and computer users, and many others have been regarded, up until recently, as interesting but marginal characters in the main narrative of computing history. Yet history shows us that these "nontraditional" actors not only were present but in fact played a much larger role in shaping the history of computing than previously understood. And through shaping computing, these groups also altered social, economic, and cultural contexts to the point of determining the fortunes of entire industries and nations.[36]

The United States today finds itself in a similar position to the UK in the twentieth century, as a technologically advanced but socially regressing late-imperial power. We would do well to look at the British example and commit to studying failure instead of focusing only on success in our technological history. Failure narratives highlight the ways we have gotten things wrong in the past, guiding us to better outcomes through deeper understanding of negative examples. If we look at the decline of British computing critically, we can recognize it as a harbinger of what is already occurring with our own technological "successes" in computing. As the CEOs of major platforms like Facebook and Twitter begin to openly struggle with how their companies have impacted, and continue to alter, the course of democratic elections and civil rights in the US, we can begin to see how tech's tendency to concentrate power in the hands of a few wealthy individuals is inimical to democracy and tends to heighten inequalities and exacerbate existing problems. For years, marginalized voices tried to raise the alarm about this important, destructive aspect of techno-optimism but were ignored. We can also see how the ahistorical technolibertarianism favored by Silicon Valley elites—most of whom come from similarly privileged backgrounds—ensures that their technologies are neither radical nor forward-thinking.[37]

By understanding the racism, sexism, and classism that formed and torpedoed our closest historical cousin's dreams of a modern, technological society, we can also begin to address how these inequalities have constructed the bedrock of our computing industry for decades, rather than being a simple mistake or an unintentional afterthought. We can begin to see that even though Silicon Valley still profits from these inequalities today, there is a clear connecting line between these features of technological economies and negative consequences for the whole of society. The power-centralizing and authoritarian tendencies of computing systems

were indispensable for warfare and strong government control of massive amounts of data, but these same systems, in the hands of those determined to escape democratic oversight, become inimical to functional democracies and civil society.

As our technological systems become increasingly destructive to our professed social and political ideals, we can no longer afford to collectively fail to understand the layers and decades of intentional decisions that have led to these supposedly unforeseen consequences. The current situation shows us clearly how, as large computing and telecommunications systems have scaled, the power imbalances they foster have altered all of our social institutions, including our political process. These imbalances go far beyond the tech industry, and they help determine who holds power at every level within our society and government, altering the future of entire nations. This problem cannot be fixed without breaking up the systems in place, because these failures are not simply accidents: they are features of how the systems were designed to work and, without significant outside intervention, how they will continue to function. Our task for a better future must be to foster a willingness to subdivide and reengineer failing systems at a basic, structural level, rather than contenting ourselves to simply patch existing failures in our digital infrastructures—leaving the broader systems that created these problems largely unchanged.

NOTES

1. Sheryl Sandberg's *Lean In: Women, Work, and the Will to Lead* (New York: Alfred A. Knopf, 2013) admonished women to try to overcome structural sexism through sheer force of will and individual action, ignoring the enormous privilege that this kind of message takes for granted. The *Guardian*'s Zoe Williams described it as a "carefully inoffensive" book that was not "about how women could become more equal, but about how women can become more like Sheryl Sandberg." Zoe Williams, "Book Review: *Lean In*," *Guardian* (February 13, 2013), https://www.theguardian.com/books/2013/mar/13/lean-in-sheryl-sandberg-review. It is perhaps not surprising that Sandberg, chief operating officer of Facebook, wrote a supposedly feminist book that nonetheless endorsed and sought to maintain all of the exclusionary power structures that, on the surface, it claimed to critique.

2. Google Walkout for Real Change, "Google Employees and Contractors Participate in Global 'Walkout for Real Change,'" *Medium* (November 2, 2018), https://medium.com/@GoogleWalkout/google-employees-and-contractors-participate-in-global-walkout-for-real-change-389c65517843; Matthew Weaver et al., "Google Walkout: Global Protests after Sexual Misconduct Allegations," *Guardian* (November 1, 2018), https://www.theguardian.com/technology/2018/nov/01/google-walkout-global-protests-employees-sexual-harassment-scandals; Susan Fowler, "Reflecting on One Very, Very Strange Year at Uber," personal blog (February 19, 2017), https://www.susanjfowler.com/blog/2017/2/19/reflecting-on-one-very-strange-year-at-uber; Maya Kosoff, "Mass Firings at Uber as Sexual Harassment Scandal Grows," *Vanity Fair* (June 6, 2017), https://www.vanityfair.com/news/2017/06/uber-fires-20-employees-harassment-investigation.

3. For instance, many of the leaders of the Google Walkout have been forced to leave the company. See Alexia Fernández Campbell, "Google Employees Say the Company Is Punishing Them for Their Activism," *Vox* (April 23, 2019), https://www.vox.com/2019/4/23/18512542/google-employee-walkout-organizers-claim-retaliation; Julia Carrie Wong, "'I've Paid a Huge Personal Cost': Google Walkout Organizer Resigns over Alleged Retaliation," *Guardian* (June 7, 2019), https://www.theguardian.com/technology/2019/jun/07/google-walkout-organizer-claire-stapleton-resigns; Nitasha Tiku, "Most of the Google Walkout Organizers Have Left the Company," *Wired* (July 16, 2019), https://www.wired.com/story/most-google-walkout-organizers-left-company/.

4. Katharine A. Kaplan, "Facemash Creator Survives Ad Board," *Harvard Crimson* (November 19, 2003), https://www.thecrimson.com/article/2003/11/19/facemash-creator-survives-ad-board-the/; Kate Losse, "The Male Gazed: Surveillance, Power, and Gender," *Model View Culture* (January 13, 2014), https://modelviewculture.com/pieces/the-male-gazed.

5. On the last point, see Alexandra Stevenson, "Facebook Admits It Was Used to Incite Violence in Myanmar," *New York Times* (November 6, 2018), https://www.nytimes.com/2018/11/06/technology/myanmar-facebook.html. For a general overview, see Siva Vaidhyanathan, *Antisocial Media: How Facebook Disconnects Us and Undermines Democracy* (Oxford: Oxford University Press, 2018).

6. Tasneem Raja, "'Gangbang Interviews' and 'Bikini Shots': Silicon Valley's Brogrammer Problem," *Mother Jones* (April 26, 2012), https://www.motherjones.com/media/2012/04/silicon-valley-brogrammer-culture-sexist-sxsw/; Mar Hicks, "De-Brogramming the History of Computing," *IEEE Annals of the History of Computing* (January–March 2013), https://doi.org/10.1109/MAHC.2013.3. Also see, for instance, the seriousness with which the claims of the sexist "Google Memo" written by Google programmer James Damore were considered by major news outlets, prompting historians to write refutations of the memo's blatantly false premises. Daisuke Wakabayashi, "Contentious Memo Strikes Nerve, Inside Google and Out," *New York Times* (August 8, 2018), https://www.nytimes.com/2017/08/08/technology/google-engineer-fired-gender-memo.html; Abby Ohlheiser, "How James Damore Went from Google Employee to Right-Wing Internet Hero," *Washington Post* (August 12, 2017), https://www.washingtonpost.com/news/the-intersect/wp/2017/08/12/how-james-damore-went-from-google-employee-to-right-wing-internet-hero/; Mar Hicks, "What the Google Gender 'Manifesto' Really Says About Silicon Valley," *The Conversation* (August 10, 2017), https://theconversation.com/what-the-google-gender-manifesto-really-says-about-silicon-valley-82236; Mar Hicks, "Memo to the Google Memo Writer: Women Were Foundational to the Field of Computing," *Washington Post* (August 9, 2017), https://www.washingtonpost.com/opinions/memo-to-the-google-memo-writer-women-were-foundational-to-the-field-of-computing/2017/08/09/76da1886-7d0e-11e7-a669-b400c5c7e1cc_story.html.

7. Safiya Noble, *Algorithms of Oppression* (New York: NYU Press, 2018).

8. Jake Swearingen, Can Google Be More Than an Advertising Company?" *New York Intelligencer* (February 5, 2019), https://nymag.com/intelligencer/2019/02/google-earnings-show-it-needs-to-be-more-than-an-ad-company.html.

9. See, for example, Amy Slaton, *Race, Rigor and Selectivity in U.S. Engineering: The History of an Occupational Color Line* (Cambridge, MA: Harvard University Press, 2010).

10. Mar Hicks, *Programmed Inequality, How Britain Discarded Women Technologists and Lost Its Edge in Computing* (Cambridge, MA: MIT Press, 2017), chapter 1.

11. See, for example, Hazel Carby, *Imperial Intimacies* (New York: Verso, 2019) on the struggles of the "Windrush generation" to prosper and gain their civil rights in the UK.

12. In my conversations with women who worked in computing at Bletchley Park, and also after the war, I have been repeatedly greeted with responses to the effect of "Are you sure you want to interview me? I don't think what I did was that important." Part of my task in recording this history has been to convince these women that their contributions were important and that historians do value what they have to say.

13. Hicks, *Programmed Inequality*, 1–3.

14. For more on this, and a case study of one of the earliest examples of mainframe-era transphobic algorithmic bias, see Mar Hicks, "Hacking the Cis-tem: Transgender Citizens and the Early Digital State," *IEEE Annals of the History of Computing* 41, no. 1 (January–March 2019): 20–33, https://doi.org/10.1109/MAHC.2019.2897667.

15. Hicks, *Programmed Inequality*, 90–93.

16. Hicks, *Programmed Inequality*, 93–96.

17. Hicks, *Programmed Inequality*, 151.

18. Hicks, *Programmed Inequality*, 187.

19. Britain's first attempts to join the EEC (European Economic Community), for instance, were denied in part because its economy was perceived as not having adequately modernized. Hicks, *Programmed Inequality*, 190.

20. Note: Despite the UK's relatively small size, it took over ten times as many Jewish child refugees as the United States, which only accepted roughly 1,000 children.

21. Stephanie Shirley, *Let IT Go: The Memoirs of Dame Stephanie Shirley*, rev. ed. (Luton, UK: Andrews UK Limited, 2017), 6.

22. Shirley, *Let IT Go*, 58.

23. Job advertisement, "Freelance Programmers," *Times (London)* (June 26, 1964).

24. Hicks, *Programmed Inequality*, 178–179.

25. Hicks, *Programmed Inequality*, 116–122.

26. Hicks, *Programmed Inequality*, 118–121.

27. Hicks, *Programmed Inequality*, 120.

28. Hicks, *Programmed Inequality*, 204.

29. See, for example, Jennifer Light, "When Computers Were Women," *Technology and Culture* 40, no. 3 (1999): 455–483; Janet Abbate, *Recoding Gender: Women's Changing Participation in Computing* (Cambridge, MA: MIT Press, 2012); and Margot Lee Shetterly, *Hidden Figures: The American Dream and the Untold Story of the Black Women Mathematicians Who Helped Win the Space Race* (New York: William Morrow, 2016).

30. Shetterly, *Hidden Figures*.

31. See, for example, Ford, *Think Black*.

32. The UK's failed modernization plans hurt its integration into the EEC and diminished its economic and political capacities on the world stage. For more, see Hicks, *Programmed Inequality*, chapters 3, 4, and 5.

33. See, for example, Slaton, *Race, Rigor and Selectivity in U.S. Engineering*; Abbate, *Recoding Gender*; Light, "When Computers Where Women"; Hicks, *Programmed Inequality*.

34. In Meredith Broussard's *Artificial Unintelligence: How Computers Misunderstand the World* (Cambridge, MA: MIT Press, 2018), Broussard discusses how the history of computing often mirrors the technological success stories that computer scientists tell about their own work.

35. See, for example, the popular biographies of software industry personalities like Steve Jobs that fall into the "great man" history trope. Biographies of notable women in computing, like Grace Hopper, sometimes borrow from this style as well, switching great man narratives of success for "great woman" narratives. The ubiquity and popularity of such accounts gives the impression that individual actors are responsible for historical change, rather than foregrounding the complex actions of large masses of people. In general, they focus only on historical success stories as instructive. Walter Isaacson, *Steve Jobs* (New York: Simon & Schuster, 2011); Kurt Beyer, *Grace Hopper and the Invention of the Information Age* (Cambridge, MA: MIT Press, 2009).

36. Lisa Nakamura, "Indigenous Circuits: Navajo Women and the Racialization of Early Electronics Manufacture," *American Quarterly* 64, no. 4 (December 2013): 919–941; Shetterly, *Hidden Figures*; Slaton, *Race, Rigor and Selectivity in U.S. Engineering*.

37. For a fuller discussion of these issues, see David Golumbia, "Do You Oppose Bad Technology, or Democracy?," *Medium* (April 24, 2019), https://medium.com/@davidgolumbia/do-you-oppose-bad-technology-or-democracy-c8bab5e53b32, and Fred Turner, "How Digital Technology Found Utopian Ideology: Lessons from the First Hackers' Conference," in *Critical Cyberculture Studies: Current Terrains, Future Directions*, ed. David Silver and Adrienne Massanari (New York: NYU Press, forthcoming), https://fredturner.stanford.edu/wp-content/uploads/turner-ccs-hackers-conference.pdf.