TECHNO/CYBER/ XENO-FEMINISM

The Intimate and Possibly Subversive Relationship Between Women and Machines

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INTRODUCTION

This reader provides a brief look into the history of women in technology, with a focus on feminist theoretical and practical approaches to the changes that technology has brought into the lives of women.

The reader includes a collection of seven key texts from cyberfeminist discourse, as well as other material that give a historical context. It is built on the hypothesis that, as Sadie Plant describes it, 'there is an intimate and possibly subversive element between women and machines - especially the new intelligent machines - which are no longer simply working for man as are women no longer simply working for man'.

The first part of my research is looking at women's introduction into the workforce in the technology field. The focus is on the type of work women were doing as 'human computers', a job that was considered low-level, menial and was, therefore, overlooked when it came to praising the advances in technology. As an example, the selected text on this topic is 'When Computers Were Women' by Jennifer S. Light, in which she talks about women's work on the ENIAC computer after the second World War. Seen only as placeholders for the men gone to war, women were eventually removed from their positions and from historical memory.

An aspect that comes back often in the materials gathered in this reader is the connection between writing software and weaving. Working with textiles has always been interlaced with the lives of women. The first well-known programmable computer was build based on a punch card system used by the first electric loom. Apollo

computers had their memory weaved by hand. Sadie Plant's work, 'The Future Looms: Weaving Women and Cybernetics' is an excellent introduction on the natural progression from women weaving threads of textiles to women weaving data into software. Her focus on Ada Lovelace as the archetype of the woman working with computers is further developed in her book 'Zeros + Ones: Digital Women + the New Technoculture'. From the latter, the space restrictions and desire to keep my researched focused led to the selection of a couple of key essays that best represent the scope of the reader, and provide a passage to the rest of the texts.

The following 3 texts situate themselves in third wave feminism and its connections to computer technology. In the 90s, feminists produced work that looks at the relationship between women and technology, and supports the idea of embracing technology and making it work in their favour. At the same time, they envision a new type of future which moves beyond previous limitations on gender, feminism and politics. What follows is the piece entitled 'Where is the Feminism in Cyberfeminism', an article written by Faith Wilding in which she provides an overview of the development of cyberfeminism as a concept, movement and form of organization. One of the essential cyberfeminist artistic projects comes in the form of the '100 anti-theses' devised at the First Cyberfeminist International, a manifesto written in the form of a list of 100 anti-definitions of cyberfeminism, which consider labeling as a restriction, and thus describe cyberfeminism by what it is not, rather than what it is.

The final text reproduced in this reader comes as another manifesto, a more contemporary example of the direction of cyberfeminist discourse today. 'Xenofeminism: A Politics for Alienation', created by the feminist collective Laboria Cuboniks. The manifesto promotes the embracing of alienation, seeing it as freedom rather than restriction, and

as grounds for collective organization. It urges the need for the unification of the political left, as well the need to use existing technology to reshape our world.

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Last but not least, the abstracts hold a little secret. In pure oulipian style, the restriction they all adhere to is the number of words, always the same, 90.

WHEN COMPUTERS WERE WOMEN

JENNIFER S. LIGHT

Jennifer Light's essay 'When Computers Were Women' looks at women's early work in the technology field. In the 1940s, computation and programming were considered low-level jobs, and were mostly assigned to women. Back then, 'computer' was a job title, rather than an object. Even though their contribution was significant, women were overlooked when it came to praising the advances in technology, particularly regarding the ENIAC computer. Women's temporary positions in the technology field were eventually taken over by men returning from war, and their participation was pushed into historical invisibility.

J. Presper Eckert and John W. Mauchly, household names in the history of computing, developed America's first electronic computer, ENIAC, to automate ballistics computations during World War II. These two talented engineers dominate the story as it is usually told, but they hardly worked alone. Nearly two hundred young women, both civilian and military, worked on the project as human "computers," performing ballistics computations during the war. Six of them were selected to program a machine that, ironically, would take their name and replace them, a machine whose technical expertise would become vastly more celebrated than their own[1]

The omission of women from the history of computer science perpetuates misconceptions of women as uninterested or incapable in the field. This article retells the history of ENIAC's "invention" with special focus on the female technicians whom existing computer histories have rendered invisible. In particular, it examines how the job of programmer, perceived in recent years as masculine work,

originated as feminized clerical labor. The story presents an apparent paradox. It suggests that women were somehow hidden during this stage of computer history while the wartime popular press trumpeted just the opposite - that women were breaking into traditionally male occupations within science, technology, and engineering.

A closer look at this literature explicates the paradox by revealing wide spread ambivalence about women's work. While celebrating women's presence, wartime writing minimized the complexities of their actual work. While describing the difficulty of their tasks, it classified their occupations as subprofessional. While showcasing them in formerly male occupations, it celebrated their work for its femininity. Despite the complexities - and often path-breaking aspects - of the work women performed, they rarely received credit for innovation or invention.

The story of ENIAC's female computers supports Ruth Milkman's thesis of an "idiom of sex-typing" during World War II that the rationale explaining why women performed certain jobs contradicted the actual sexual division of labor.[2] Following her lead, I will compare the actual contributions of these women with their media image. Prewar labor patterns in scientific and clerical occupations significantly influenced the way women with mathematical training were assigned to jobs, what kinds of work they did, and how contemporary media regarded (or failed to regard) this work. This article suggests why previous accounts of computer history did not portray women as significant and argues for a reappraisal of their contributions.[3]

Women in Wartime

Wartime literature characterized World War II as a momentous event in the history of women's employment. In 1943 Wartime Opportunities for Women proclaimed, "It's a

Woman's World!"[4] Such accounts hailed unprecedented employment opportunities as men were recruited for combat positions. New military and civilian women's organizations such as the Army's Women's Auxiliary Army Corps (WAAC, converted to full military status in 1943 and renamed the Women's Army Corps [WAC]), the Navy's Women Accepted for Volunteer Emergency Service (WAVES), and the American Women's Voluntary Services (AWVS) channeled women into a variety of jobs. The press emphasized the role of machines in war and urged women with mechanical knowledge to "make use of it to the best possible purpose."[5] Wartime Opportunities for Women urged: "In this most technical of all wars, science in action is a prime necessity. Engineering is science in action. It takes what the creative mind behind pure science has to offer and builds toward a new engine, product or process.[6] According to the U.S. Department of Labor's Women's Bureau: "The need for women engineers and scientists is growing both in industry and government... Women are being offered scientific and engineering jobs where formerly men were preferred. Now is the time to consider your job in science and engineering. There are no limitations on your opportunities. ... In looking at the war job opportunities in science and engineering, you will find that the slogan there as elsewhere is 'WOMEN WANTED!'"[7]

A multiplicity of books and pamphlets published by the U.S. War Department and the Department of Labor, with such titles as Women in War, American Women in Uniform, Back of the Fighting Front, and Wartime Opportunities for Women, echoed this sentiment. Before World War II, women with college degrees in mathematics generally taught primary or secondary school. Occasionally they worked in clerical services as statistical clerks or human computers. The war changed job demands, and one women's college reported that every mathematics major had her choice of twenty-five jobs in industry or government.[8]

Yet, as Milkman suggests, more women in the labor market did not necessarily mean more equality with men. Sexual divisions of labor persisted during wartime. The geography of women's work settings changed, but the new technical positions did not extend up the job ladder. A widely held belief that female workers would be dismissed once male veterans returned from the war helps to explain the Women's Bureau acknowledgement that "except for Ph.D.'s, women trained in mathematics tend to be employed at the assistant level.[9] The War Department and the Department of Labor actively promoted women's breadth of opportunity yet in some areas explicitly defined which jobs were "open to women." Classified advertisements ran separate listings for "female help wanted" and "male help wanted."

Women's Ambiguous Entry into Computing

Women's role in the development of ENIAC offers an account of the feminization of one occupation, "ballistics computer," and both the creation of and gendering of another, "operator" (what we would now call programmer). Ballistics computation and programming lay at the intersection of scientific and clerical labor. Each required advanced mathematical training, yet each was categorized as clerical work. Such gendering of occupations had precedent. Since the late nineteenth century feminized jobs had developed in a number of sciences where women worked alongside men. Margaret Rossiter identifies several conditions that facilitated the growth of "women's work."[10] These include the rise of big science research projects, low budgets, an available pool of educated women, a lack of men, a woman who could act as an intermediary (such as a male scientist's wife), and a somewhat enlightened employer in a climate generally resistant to female employees entering traditionally male domains. Craving opportunities to use their skills, some women colluded with

this sexual division of labor. Many did not aspire to professional employment at higher levels.[11]

Occupational feminization in the sciences fostered long-term invisibility. For example, beginning in the 1940s, laboratories hired women to examine the nuclear and particle tracks on photographic emulsions.[12] Until the 1950s, published copies of photographs that each woman scanned bore her name. Yet eventually the status of these women's work eroded. Later publications were subsumed under the name of the lab leader, inevitably a man, and publicity photographs rarely, showcased women's contributions. Physicist Cecil Powell's request for "three more microscopes and three girls" suggests how invisibility and interchangeability went hand in hand.[13] In a number of laboratories, scientists described women not as individuals, but rather as a collective, defined by their lab leader ("Cecil's Beauty Chorus") or by their machines ("scanner girls"). Likewise in the ENIAC project, female operators are referred to as "[John] Holberton's group" or as "ENIAC girls." Technicians generally did not author papers or technical manuals. Nor did they acquire the coveted status symbols of scientists and engineers: publications, lectures, and membership in professional societies. Ultimately these women never got a public opportunity to display their technical knowledge, crucial for personal recognition and career advancement.

Wartime labor shortages stimulated women's entry into new occupations, and computing was no exception.[14] Ballistics computing, a man's job during World War I, was feminized by World War II. A memorandum from the Computing Group Organization and Practices at the National Advisory Committee for Aeronautics (NACA), dated 27 April 1942, explains how the NACA conceived the role of computers: "It is felt that enough greater return is obtained by freeing the engineers from calculating detail to over

come any increased expenses in the computers' salaries. The engineers admit themselves that the girl computers do the work more rapidly and accurately than they would. This is due in large measure to the feeling among the engineers that their college and industrial experience is being wasted and thwarted by mere repetitive calculation."[15]

Patterns of occupational segregation developed in selected industries and job categories newly opened to women.[16] Women hired as computers and clerks generally assisted men. Captain Herman Goldstine, an ENIAC project leader, served as liaison from the U.S. Army's Ballistic Research Laboratory (BRL) to the Moore School of Electrical Engineering at the University of Pennsylvania, which produced ENIAC, and director of computer training for BRL. He recalls that by World War II "there were a few men [computers] but only a few. Any able-bodied man was going to get taken up into the armed forces."[17] With feminization came a loss of technical status, since other men doing more "important" technical and classified work remained in noncombatant positions. Thus, the meaning of "wartime labor shortage" was circumscribed even as it came into being. While college educated engineers considered the task of computing too tedious for them selves, it was not too tedious for the college-educated women who made up the majority of computers.[18] These were not simply cases of women taking on men's tasks, but rather of the emergence of new job definitions in light of the female workforce.[19] Celebrations of women's wartime contributions thus rarely challenged gender roles. Rather, popular accounts portrayed civilian jobs for women as appropriately feminine, "domestic" work for the nation despite the fact they were formerly done by men[20].

The introduction of technology also facilitated women's entry into paid labor. Machines stimulated the reorganization of work processes, often leading to the

creation of new occupations and the culling of older ones. In both clerical and factory work, introducing technology changed some jobs so that women performed slightly different tasks rather than substituting directly for men. Women's entry into the workforce was greatest in new occupations where they did not displace men.[21] Once a particular job was feminized this classification gathered momentum, often broadening to include other occupations. [22] By World War II, computing was feminized across a variety of fields, including engineering, architecture, ballistics, and the aircraft industry. The new machines, capable of replacing hundreds of human computers, required human intervention to set up mathematical problems. Without a gendered precedent, the job of computer operator, like the newly created jobs of "stenographer typist" and "scanning girl," became women's work. There is, of course, a fundamental difference between the human computer and the programmer who transfers this skill to an auto mated process. In the 1940s, the skill of transferring this information - what we now call programming - fit easily with notions about women's work. As an extension of the job of a human computer, this clerical task offered slightly higher status and higher pay than other kinds of clerical labor.[23]

Female Computers and ENIAC Girls

Like much of scientific research and development during World War II, the ENIAC was the offspring of a wartime alliance between a university (the University of Pennsylvania, specifically the Moore School of Electrical Engineering) and the U.S. armed forces, in this case the Army Proving Ground (APG) in Aberdeen, Maryland. The APG housed the army's Ballistic Research Laboratory (BRL), which produced range tables for gunners. During the war, BRL recruited approximately two hundred women to work as computers, hand-calculating firing tables for rockets and

artillery shells. In 1940, when President Franklin D. Roosevelt declared a national emergency, BRL commandeered the Moore School's differential analyzer and began to move some of its work to the university.[24]

One of the first women the army hired to work at the Moore School was twenty-two-year-old Kathleen McNulty. She had graduated in 1942 from Chestnut Hill College, in Philadephia, with one of the three math degrees awarded in her class. McNulty and her friend Frances Bilas answered an advertisement in a local paper that said Aberdeen was hiring mathematicians:

I never heard of numerical integration. We had never done anything like that. Numerical integration is where you take, in this particular case ... [the] path of a bullet from the time it leaves the muzzle of the gun until it reaches the ground. It is a very complex equation; it has about fifteen multiplications and a square root and I don't know what else. You have to find out where the bullet is every tenth of a second from the time it leaves the muzzle of the gun, and you have to take into account all the things that are going to affect the path of the bullet. The very first things that affect the path of the bullet [are] the speed at which it shoots out of the gun [the muzzle velocity], the angle at which it is shot out of the gun, and the size. That's all incorporated in a function which they give you a [ballistic] coefficient. As the bullet travels through the air, before it reaches its highest point, it is constantly being pressed down by gravity. It is also being acted upon by air pressure, even by the temperature. As the bullet reached a certain muzzle velocity - usually a declining muzzle velocity, because a typical muzzle velocity would be 2,800 feet per second [fps] - when it got down to the point of 1,110 fps, the speed of sound, then it wobbled terribly... So instead of computing now at a tenth of a second, you might have broken this down to one one hundredth of a second to very carefully calculate this path as it went through there. Then what you had to do, when you finished the whole

calculation, you interpolated the values to find out what was the very highest point and where it hit the ground.[25]

The work required a high level of mathematical skill, which included solving nonlinear differential equations in several variables: "Every four lines we had to check our computations by something called Simpson's rule to prove that we were performing the functions correctly. All of it was done using numbers so that you kept constantly finding differences and correcting back."[26] Depending upon their method, the computers could calculate a trajectory in somewhere between twenty minutes and several days, using the differential analyzer, slide rules, and desktop commercial calculators.[27] Despite the complexities of preparing firing tables, in this feminized job category McNulty's appointment was rated at a subprofessional grade. The BRL also categorized women like Lila Todd, a computer supervisor when McNulty started work at the Moore School, as subprofessional.[28]

Herman Goldstine recalls that BRL hired female computers almost exclusively. At first, most women were recent college graduates in the Baltimore and Philadelphia area. Adele Goldstine, his wife and a senior computer, expanded recruiting to include colleges across the Northeast, but the project still needed more personnel.[29] In a short time, recalls Goldstine, "We used up all of the civil service women we could get our hands on."[30] A memo to University of Pennsylvania provost George McClelland from Harold Pender, dean of the Moore School, explained how BRL sought to remedy the situation: "Colonel Simon, Chief of the Ballistic Research Laboratory, has had a specially selected group of WACs assigned to the Laboratory. Although these women have been individually picked they are for the most part ready for training and are not trained persons who can enter fully into the Laboratory's work. ... By consulting appropriate per sons on the campus it appears

that this can be carried out without interfering with any of the University's regular work. . . . Under the above circumstances it appears that the University's regular work will not be disturbed and at the same time we will have the opportunity to do a rather important service."[31] Pender's memo embodies a more widespread ambivalence about women's wartime contributions, particularly as members of the military. While "specially selected" for a "rather important" task these women were simultaneously "not trained persons" and could not enter "fully" into the BRL's work.

Colonel Simon assigned two groups of WACs to work as computers. One used desk calculators and the differential analyzer for practical work at the BRL, while the other studied mathematics for ballistics computations at the University of Pennsylvania. These two groups alternated monthly for eight months. The first WAC course started on 9 August 1943. According to reports in the Daily Pennsylvanian, the university's student newspaper, these women assimilated smoothly into campus life:

The WACs at present stationed on the University campus are members of two groups alternating in a special course at the Moore School of Electrical Engineering, and were detached from the unit at Aberdeen Proving Ground, Maryland. At Aberdeen most of them were assigned as computers. The two sections, each of which numbers approximately thirty women, are commanded by second lieutenants and corporals. They are taking courses that are equivalent to the work of a college mathematics major. The results of these studies will later be used in ballistic work at the Ballistic Research Laboratory of the Army Ordnance Department. They are stationed at the Moore School of Electrical Engineering rather than at any other University school because of the large amount of work that the Moore School has done in collaboration with the Ballistic Research Laboratory. They are quartered in the fraternity house [Phi Kappa Sigma], messed in Sergeant Hall, and receive

physical training at Bennett Hall. They are required to police their own rooms and be in bed at eleven forty-five p.m., with the exception of weekends. Reveille must be answered at 7:10 a.m.[32]

In this straightforward report, the student reporter neglects to mention the concurrent and widespread tensions surrounding WACs. Only a month earlier, on 1 July 1943, President Roosevelt had signed legislation converting the Women's Auxiliary Army Corps to full military status as the WAC. The conversion was scheduled for implementation by 1 October. According to WAC historian Mattie Treadwell, "The following ninety days of the summer of 1943, initially called The Conversion, were perhaps the busiest in the history of the Corps."[33]

While the article quoted several WACs commenting about their campus lives in a quite positive tone, Adele Goldstine, in an undated letter to a correspondent, reported, "Rumor hath it that the WACs (Sec. I) have been told that they're unloved by everybody including the ES & MWTesses. If it's true, I'm sorry to hear it because I'm afraid it will make our uphill fight steeper."[34] Her letter suggests that the women's presence on campus had become the "interference" and "disturbance" intimated by Simon's memo. Indeed, ambivalence about The Conversion had triggered slander campaigns against WACs from 1943. The cold reception of WAC volunteers was a product not only of news media but also of local gossip: "Resentment was expressed in towns where WACs were quartered, to the effect that they were spoiling the character of the town."[35] The WACs in Philadelphia may have experienced some of the more widespread hostility towards enlisted women.

Separated by skill level into two groups, the WACs at the Moore school had forty hours of classroom instruction per week. According to the syllabus, the course was designed to treat "in succinct form the mathematics which a

person should have to work on physical problems such as those likely to be met in the Ballistic Research Laboratory."[36] The mathematics ranged from elementary algebra to simple differential equations. In addition, a unit on the use of calculating machines covered computation - and calculation - machine techniques, handling numerical data, organizing work for machine calculation, and using slide rules.

The instructors included three men (a Dr. Sohon, a Mr. Charp, and a Mr. Fliess) and nine women (Adele Goldstine, Mary Mauchly, Mildred Kramer, Alice Burks, a Mrs. Harris, a Miss Mott, a Miss Greene, a Mrs. Seeley, and a Mrs. Pritkin). Accounts of ENIAC that discuss the WAC course, such as Goldstine's book and the civilian women's own reflections, mention as instructors only three married women: Adele Goldstine, Mary Mauchly, wife of John Mauchly of the Moore School, and Mildred Kramer, wife of Samuel Noah Kramer, a professor of Assyriology at the University of Pennsylvania. Yet archival records show that this is not the full story[37]. Perhaps this oversight is consistent with a different trend Rossiter discusses that more prominent women in science were often married to notable men, also often scientists. It is unclear whether Goldstine, Mauchly, and Kramer became "visible" because their husbands' visibility accorded them extra attention, because these men somehow facilitated their wives' careers, or because the women themselves campaigned for recognition.

"Thanks for the Memory," a song presumably written by several WACs, offers a playful account of their time at the Moore School:

Of days way back when school
Was just the daily rule
When we just studied theories
For fun and not as tools - thank you so much.

Of lectures running late
Of Math that's mixed with paint
Of dainty slips that ride up hips
And hair-do-ups that ain't - thank you so much.
Many's the time that we fretted
And many's the time that we sweated
Over problems of Simpson and Weddle
But we didn't care for c'est la guerre!
That Saturday always came
And teach ran for her train
If she didn't lam - like Mary's lamb
Her pets to Moore School came - thank you so much.
Machines that dance and dive
Of numbers that can jive
Of series that do leaps and bounds
Until you lose the five - thank you so much.
Of half-hour luncheon treks
How we waited for our checks!
Of assets, liabilities?
Till all of us were wrecks - thank you too much.
We squared and we cubed and we plotted
And many lines drew and some dotted
We've all developed a complex
Over wine, sex, and/(x)
Of private tete-a-tetes
And talk about our dates
And how we wish that teacher would oblige
By coming late - thank you so much.
And so on through the night.[38]

Even as the WAC courses went on, Moore School engineers were designing a machine to automate the production of the same firing and bombing tables calculated by the human computers: the ENIAC. Engineers wanted answers faster than women could supply them using available technologies. Yet ENIAC couldn't do everything itself. Programming equations into the machine

required human labor.[39] The eventual transfer of computing from human to machine led to shifting job definitions. A "computer" was a human being until approximately 1945. After that date the term referred to a machine, and the former human computers became "operators."[40]

Herman Goldstine recounts selecting the operators. At BRL, one group of women used desk calculators and another the differential analyzer. Selecting a subgroup from each, Goldstine "assigned six of the best computers to learn how to program the ENIAC and report to [John] Holberton," employed by the Army Ordnance Department to supervise civilians.[41] With no precedents from either sex, the creation and gendering of "computer operator" offers insight into how sexual divisions of labor gather momentum. Computing was a female job, and other female clerical workers operated business machines. So it was not unusual that in July 1945, women would migrate to a similar but new occupation. The six women - Kathleen McNulty, Frances Bilas, Betty Jean Jennings, Ruth Lichterman, Elizabeth Snyder, and Marlyn Wescoff - reported to the Moore School to learn to program the ENIAC.

The ENIAC project made a fundamental distinction between hardware and software: designing hardware was a man's job; programming was a woman's job. Each of these gendered parts of the project had its own clear status classification. Software, a secondary, clerical task, did not match the importance of constructing the ENIAC and getting it to work.[42] The female programmers carried out orders from male engineers and army officers. It was these engineers and officers, the theoreticians and managers, who received credit for invention. The U.S. Army's social caste system is historically based on European gentlemen's social codes.[43] As civil servants, the six women computers chosen to operate the ENIAC stood outside this system.

Yet if engineers originally conceived of the task of programming as merely clerical, it proved more complex. Under the direction of Herman and Adele Goldstine, the ENIAC operators studied the machine's circuitry, logic, physical structure, and operation. Kathleen McNulty described how their work overlapped with the construction of the ENIAC: "Somebody gave us a whole stack of blueprints, and these were the wiring diagrams for all the panels, and they said 'Here, figure out how the machine works and then figure out how to program it.' This was a little bit hard to do. So Dr. Burks at that time was one of the people assigned to explain to us how the various parts of the computer worked, how an accumulator worked. Well once you knew how an accumulator worked, you could pretty well be able to trace the other circuits for yourself and figure this thing out."[44]

Understanding the hardware was a process of learning by doing. By crawling around inside the massive frame, the women located burnt-out vacuum tubes, shorted connections, and other nonclerical bugs.[45] Betty Jean Jennings's description confirms the ingenuity required to program at the machine level and the kinds of tacit knowledge involved:

We spent much of our time at APG learning how to wire the control board for the various punch card machines: tabulator, sorter, reader, reproducer, and punch. As part of our training, we took apart and attempted to fully understand a fourth-order difference board that the APG people had developed for the tabulator.... Occasionally, the six of us programmers all got together to discuss how we thought the machine worked. If this sounds haphazard, it was. The biggest advantage of learning the ENIAC from the diagrams was that we began to understand what it could and what it could not do. As a result we could diagnose troubles almost down to the individual vacuum tube. Since we

knew both the application and the machine, we learned to diagnose troubles as well as, if not better than, the engineer.[46]

Framing the ENIAC story as a case study of the mechanization of female labor, it would be hard to argue that de-skilling accompanied mechanization.[47] The idiom of sex-typing, which justified assigning women to software, contradicted the actual job, which required sophisticated familiarity with hardware. The six ENIAC operators understood not only the mathematics of computing but the machine itself. That project leaders and historians did not value their technical knowledge fits the scholarly perception of a contradiction between the work actually performed by women and the way others evaluate that work. In the words of Nina Lerman, "Gender plays a role in defining which activities can readily be labeled 'technological.'"[48]

Meanwhile, at the Los Alamos Scientific Laboratory in New Mexico, scientists were preparing a new thermonuclear weapon, the Super. Stanley Frankel and Nicholas Metropolis, two Los Alamos physicists, were working on a mathematical model that might help to determine the possibility of a thermonuclear explosion. John Von Neumann, a technical consultant, suggested that Los Alamos use ENIAC to calculate the Super's feasibility. Once Von Neumann told Herman Goldstine about this possible use, Herman and Adele invited Frankel and Metropolis to Philadelphia and offered them training on the ENIAC. When the two physicists arrived in Philadelphia in the summer of 1945, Adele Goldstine and the women operators explained how to use the machine. McNulty recalled that "We had barely begun to think that we had enough knowledge of the machine to program a trajectory, when we were told that two people were coming from Los Alamos to put a problem on the machine."[49] Despite such self-effacing comments, the operators demonstrated impressive mastery of the ENIAC during the collaboration with the Los Alamos physicists. By

October, the two theoretical physicists had programmed their elaborate problem on huge sheets of paper. Then, the women programmed it into the machine, which no one had formally tested. As McNulty explained, "No one knew how many bad joints there were, and how many bad tubes there were, and so on."[50] The cooperative endeavor furthered the operators' intimate understanding of ENIAC as they pushed it to a new level of performance. Programming for Frankel and Metropolis took one million IBM punch cards, and the machine's limited memory forced the women to print out intermediate results before repunching new cards and submitting them to the machine. Within a month, the Los Alamos scientists had their answer that there were several design flaws.[51]

The "ENIAC girls" turned their attention back to shell trajectory calculations and were still engaged on that project when the war ended. The ENIAC, designed and constructed in military secrecy, was prepared for public unveiling in early 1946. A press conference on 1 February and a formal dedication on 15 February each featured demonstrations of the machine's capabilities. According to Herman Goldstine, "The actual preparation of the problems put on at the demonstration was done by Adele Goldstine and me with some help on the simpler problems from John Holberton and his girls."[52] Indeed, Elizabeth Snyder and Betty Jean Jennings developed the demonstration trajectory program.[53] Although women played a key role in preparing the demonstrations, both for the press and for visitors to the laboratory, this information does not appear in official accounts of what took place.

Contemporary Accounts of ENIAC

Social constructionist historians and sociologists of science take the position that scientists describing their experimental work do not characterize events as they

actually happened.[54] Publicity for technical demonstrations is not so different. In presenting ENIAC to the public, engineers staged a well-rehearsed event. They cooperated with the War Department, which controlled representations of the project through frequent press releases to radio and newspapers.

It is a curious paradox that while the War Department urged women into military and civil service and fed the media uplifting stories about women's achievements during the war, its press releases about a critical project like the ENIAC do not mention the women who helped to make the machine run. War Department press releases characterize ENIAC as "designed and constructed for the Ordnance Department at the Moore School of Electrical Engineering of the University of Pennsylvania by a pioneering group of Moore School experts."[55] They list three individuals as "primarily responsible for the extremely difficult technical phases of work... Eckert - engineering and design; Mauchly - fundamental ideas, physics; Goldstine - mathematics, technical liaison."[56] The War Department's selective press releases highlighted certain individuals involved in the ENIAC project while omitting others, specifically the women operators. Because of these omissions the operators were neither interviewed nor offered the opportunity to participate in telling the ENIAC story. Newspaper accounts characterize ENIAC's ability to perform tasks as "intelligent" but the women doing the same computing tasks did not receive similar acclaim.[57] While the media publicly hailed hardware designers as having "fathered" the machine, they did not mention women's contributions. The difference in status between hardware and software illustrates another chapter in the story of women in the history of science and technology. The unmentioned computer technicians are reminiscent of Robert Boyle's "host of 'laborants,' 'operators,' 'assistants' and 'chemical servants'" whom Steven Shapin described as "invisible actors." Working three

centuries earlier, their fate was the same: they "made the machines work, but they could not make knowledge."[58]

The New York Times of 15 February 1946 described Arthur Burks's public demonstration: "The ENIAC was then told to solve a difficult problem that would have required several weeks' work by a trained man. The ENIAC did it in exactly 15 seconds."[59] The "15 seconds" claim ignores the time women spent setting up each problem on the machine. Accompanying photographs of Eckert and Mauchly, the article reported that "the Eniac was invented and perfected by two young scientists of the [Moore] school, Dr. John William Mauchly, 38, a physicist and amateur meteorologist, and his associate, J. Presper Eckert Jr., 26, chief engineer on the project. Assistance was also given by many others at the school [The machine is] doing easily what had been done laboriously by many trained men... Had it not been available the job would have kept busy 100 trained men for a whole year."[60] While this account alludes to the participation of many individuals other than Eckert and Mauchly, the hypothetical hundred are described as men. Why didn't the article report that the machine easily did calculations that would have kept one hundred trained women busy, since BRL and the Moore School hired women almost exclusively as computers. Even in an era when language defaulted to "he" in general descriptions, this omission is surprising, since the job of computer was widely regarded as women's work.[61] Women seem to have vanished from the ENIAC story, both in text and in photographs. One photograph accompanying the New York Times story foregrounds a man in uniform plugging wires into a machine. While the caption describes the "attendants preparing the machine to solve a hydrodynamical problem," the figures of two women in the background can be seen only by close scrutiny. Thus, the press conference and follow up coverage rendered invisible both the skilled labor required to set up the demonstration and the gender of the skilled workers who did it.

The role of the War Department and media in shaping public discourse about the machine and its meaning is significant. Several potential opportunities for the women operators to get some public attention and credit for their work never materialized. For example, the publicity photograph of the ENIAC printed in the New York Times was among the most widely disseminated images of the machine. When it was published as an army recruitment advertisement, the women were cropped out.[62] This action is understandable, at one level, since the operators were all civilians. Yet given the important participation of WACs in closely related wartime work, it constituted another missed opportunity to give the women their due.

Archival records show that photographers came in to record the ENIAC and its engineers and operators at least twice. Neither visit resulted in any publicity for the women. On the first occasion, an anonymous photographer's pictures of the ENIAC group turned out poorly. Herman Goldstine wrote apologetically to Captain J. J. Power, Office of the Chief of Ordnance: "Dear John, I am returning herewith the photographs with sheets of suggested captions. As you can see from looking at these photo graphs, many of them are exceedingly poor, and, I think, unsuitable for publication."[63] Nonetheless, the captions for these unsuitable photographs are instructive:

VIEW OF ONE SIDE OF THE ENIAC: Miss Frances Bilas (Philadelphia, Pa.) and Pfc. Homer W. Spence (Grand Rapids, Mich.) are setting program switches. Miss Bilas is an ENIAC operator in the employ of the Ballistic Research Laboratory, Aberdeen Proving Ground, Md., and Pfc. Spence is a maintenance engineer...

SETTING UP A PROBLEM ON THE ENIAC: Reading from left to right, Miss Akrevoe Kondopria (Philadelphia, Pa.) at an accumulator, Miss Betty Jennings (Stanbury, Mo.), Cpl. Irwin

Goldstein (Brooklyn, NY) and Miss Ruth Lichterman (Rockaway, NY) standing at function tables. Miss Kondopria is a Moore School employee on the ENIAC project; Miss Jennings and Miss Lichterman are ENIAC operators employed by the Ballistic Research Laboratory, Aberdeen Proving Ground, Md., and Cpl. Goldstein is a maintenance engineer...

SETTING UP A PROBLEM ON THE ENIAC: Reading from left to right, Miss Betty Snyder (Narberth, Pa.), Miss Betty Jennings (Stanbury, Mo.), Miss Marlyn Wescoff (Philadelphia, Pa.) and Miss Ruth Lichterman (Rockaway, NY). Miss Snyder is setting program switches on an accumulator; Miss Jennings is setting up numbers to be remembered in the function table ... Miss Wescoff and Miss Lichterman are working at the printer_The function table which stores numerical data set up on its switches is seen at the right and its two control panels are behind Miss Frances Bilas (Philadelphia, Pa.) who is plugging a program cable in the master programmer. Miss Bilas is an ENIAC operator in the employ of the Ballistic Research Laboratory, Aberdeen Proving Ground, Maryland.[64]

"Setting switches," "plugging cables," and "standing at function tables" - such captions understate the complexities of women's work. While two men appear alongside the operators, they are "maintenance engineers," occupational titles suggesting technical expertise.

The second photographer was Horace K. Woodward Jr., who wrote an article about ENIAC for Science. He wrote to Adele Goldstine: "Dear Mrs. Goldstine and other mENIACS, You will be perturbed to hear that the color flesh shots (oops, flash shots) that I was taking 1 feb 46 turned out nicely. I hadn't intended them for publication but thought you folks might like them."[65] His article in Science carried no

photographs of the women and made no reference to their existence.

More surprising still, the media reports did not highlight Adele Goldstine, despite her leadership position and her expertise in a technical realm that had not earlier existed for either sex.[66] An affidavit Adele Goldstine submitted as testimony in Sperry Rand v. Bell Labs explains how she saw her own role: "I did much of the programming and the setting up of the ENIAC for the various problems performed on it while I was at the Moore School. I also assisted my husband in training Mr. Holberton and a group of girls to set up problems on the ENIAC. ...I worked with Mr. Holberton and his group to program each problem which they put on the ENIAC up to and including the demonstration problems for the ENIAC dedication exercises."[67] Adele Goldstine and Moore School professor Harry Huskey were charged with producing an ENIAC operating manual, a complete technical report, and a maintenance manual.[68] Herman Goldstine explains: "The only persons who really had a completely detailed knowledge of how to program the ENIAC were my wife and me. Indeed, Adele Goldstine wrote the only manual on the operation of the machine. This book was the only thing available which contained all the material necessary to know how to program the ENIAC and indeed was its purpose."[69] In addition, he reports that his wife contributed heavily to a 1947 paper he coauthored with John Von Neumann, Planning and Coding Problems for an Electronic Computing Instrument.[70]

It is an overstatement to say that female computers and operators were never covered in any media. A few articles mention them, as in this example:

An initial group, consisting primarily of women college graduates, especially trained for work by the Moore School, began the work in ground gunfire, bombing and related ballistics studies

immediately after Pearl Harbor, when the Aberdeen Proving Ground's Ballistic Research Laboratory broadened its program at the University. Forerunners of a group eventually numbering more than 100, they made use of the Moore School's differential analyzer, which is equally useful in the realm of ballistics and the solution of peacetime mathematical problems. Two other groups were organized later, under separate contracts, one of which was devoted to analysis of experimental rocket firing at Aberdeen, while the other assisted in the proving ground development of new shells and bombs.[71]

This recognition is quite different from the publicity accorded to male officers and engineers associated with the project.[72] The article cited here portrays the women as interchangeable. Even if it were too space-consuming to name each human computer, it is still notable that the article describes the women as being trained for work "by the Moore School" as opposed to "by Adele Goldstine" or by her many female colleagues.[73] That ENIAC's 1946 demonstration doubled as a vanishing act for its female participants fits neatly with postwar propaganda that as early as 1944 began redirecting women into more traditional female occupations or out of the paid labor force entirely.[74] And what of the several years after World War II. While the Department of Labor acknowledged women's desire to stay on in paid employment, its publications were not so optimistic.[75] An avalanche of materials urged women to leave work. A 1948 Women s Bureau Bulletin reported on the situation for women with mathematics education who sought paid work:

Although, during the war, production firms and Government projects were important outlets for women trained in mathematics, the emphasis, following the end of hostilities, shifted back to the more usual channels. Teaching and employment with insurance and other business firms became the principal outlets for women college graduates with mathematical training_Most of

the wartime research projects sponsored by the Government were dropped after V-J day. In the few that continued, the small number of mathematical jobs were filled by the staffs of the institutions at which the research was being done and by men with mathematical skills who were being released from military service. The women's military services, which utilized women with mathematical training during the war, were reduced to very small staffs... As women leave, men will be hired to replace them - Although many women are continuing on their wartime mathematical jobs, it is difficult to say how much of the gain will be in terms of permanent opportunities for women.[76]

The Federal Bureau of Investigation dropped many of the women it had hired as cryptographers during the war. By 1946, the National Bureau of Standards had filled most of the vacancies on its computing staff with male veterans.[77] At the Ballistics Research Laboratory, an army memorandum detailed criteria for how individuals would be let go, with separate instructions for male officers and for WAC officers.[78] With this in mind, the absence of women from an October 1946 army recruitment ad makes sense. The "propaganda machine," as Herzenberg and Howes call it, that during the war had so successfully called women out of their homes, made a 180-degree turn, pushing many women back towards full-time domesticity.[79]

In the 1950s, new opportunities developed alongside continuing ambivalences about women's occupational roles. A 1956 U.S. Department of Labor report on employment opportunities for women mathematicians and statisticians is replete with examples of women's mathematical work - and the future need for women mathematicians - in a variety of fields including programming. Four "findings" appear as an executive summary:

1. More women mathematicians and statisticians are currently needed, and interesting jobs await those trained at the bachelor's

degree as well as graduate levels.
2. Young women in high school should be encouraged to try mathematics and if they have the qualifications for success in mathematics and statistics should be encouraged to prepare for those fields; anticipated shortages make the long-run outlook exceptionally favorable.
3. Young women who combine the qualifications for teaching with ability in mathematics should be encouraged to teach, at least part time, since in teaching they can magnify their contribution to the Nation's progress.
4. Mature college women who have majored in mathematics, possess the personal qualifications for teaching, and have time available to work, should prepare themselves through refresher courses in mathematics and education for teaching positions, if they live in one of the many communities experiencing or anticipating a shortage of mathematics teachers.[80]

The report explores a wide range of career options, including programming and actuarial work. Yet as the patriotic rhetoric of service "to the Nation's progress" makes clear, the Department of Labor prioritized teaching as a career choice. Science and engineering had won the war, and now the developing baby boom predicted a growing demand for math teachers.

Despite such exhortations, some women never left computer programming. Fran Bilas, Kay McNulty, and Betty Snyder continued briefly with ENIAC when it moved to BRL in 1947; Ruth Lichterman stayed on for two years.[81] Other women joined the ENIAC at BRL following the war. Betty Snyder Holberton went on to program UNIVAC and to write the first major software routine ever developed for automatic programming. She also collaborated on writing COBOL and FORTRAN with Grace Hopper, a key programmer of the Mark I. Hopper left active duty with the U.S. Navy as a lieutenant in 1946 but remained with the Navy reserves until 1966. From 1946 until it started running

programs around 1951, the Electronic Computer Project at Princeton's Institute for Advanced Study employed mostly female programmers, who included Thelma Estrin, Hedi Selberg, Sonia Bargmann, and Margaret Lamb. Their accomplishments are future chapters for a history of computer programming.

Conclusion

The ENIAC story highlights several issues in the history and historiography of gender, technology, and labor. Major wars have unmistakable influences on gender relations and work, and those effects can be elusive and complex. Conflicts among representations of women's work in computing ensure work for the historian in distinguishing seeming gender changes from real ones. These conflicts and sometime contradictions lie at the heart of women's historical invisibility.

First, the variance between effusive wartime recruiting literature and historians' evaluations of women's actual opportunities is striking. Disputing the claims of propaganda, historians generally agree that during wartime women may have made some progress in expanding the varieties of work they could do. Yet rather than move up the ladder of success women's work appears to have added more rungs at the bottom. The narrative histories of the ENIAC since 1946 echo this finding. With few exceptions, they make the implicit or explicit assumption that, while women were involved, their participation was not sufficiently important to merit explication. Thus, this episode in the history and historiography of computing confirms Rossiter's "Matilda effect": individuals at the top of professional hierarchies receive repeated publicity and become part of historical records, while subordinates do not, and quickly drop from historical memory.[82]

A second conflicting representation concerns the actual work per formed by women contrasted with how employers categorized this work. As this article shows, the evidence of ENIAC challenges the implicit assumption of computing historians that the low-status occupations of women meant that their work could not be innovative. Wartime propaganda proclaimed "no limitations on your opportunities," yet only certain jobs were open to women. However, it was within the confines of precisely such low-status occupational classifications that women engaged in unprecedented work. Looking behind media accounts and later narratives of the development of ENIAC to consider primary source accounts of the work women actually performed reveals how its low-status categorization clashed with the kinds of knowledge required. Finding this mismatch offers the possibility that, in their work as operators, women moving into stereotypical male domains played a subversive role, challenging the gender status quo before the war. According to this view, women's invisibility reflects deep-rooted ambivalences about the roles women professionals began to occupy in the labor force. These ambivalences permeated both power relationships in the workplace and media portrayals of women's contributions.

Third, portrayals of women's postwar fate continue the ambivalence that characterized their wartime work. Women were seen as meeting a crisis - but only a temporary one. One 1943 guide to managers explained: "Women can be trained to do any job you've got - but remember 'a woman is not a man;' A woman is a substitute - like plastic instead of metal."[83] Both postwar propaganda and historians characterize women as retreating to teaching and homemaking after the war, abandoning their gains. Yet a fair number did not leave the workforce, a fact that the Department of Labor acknowledged even as it urged women toward teaching.[84]

The revised history of ENIAC presented here reveals that many of historians' questions about the history of computing reflect the unintentionally "male-centered terms" of history.[85] The result is a distorted history of technological development that has rendered women's contributions invisible and promoted a diminished view of women's capabilities in this field. These incomplete stories emphasize the notion that programming and coding are, and were, masculine activities. As computers saturate daily life, it becomes critical to write women back into the history they were always a part of, in action if not in memory.

References and Notes

1. History has valued hardware over programming to such an extent that even the IEEE Annals of the History of Computing issue devoted to ENIAC's fiftieth anniversary barely mentioned these women's roles. See IEEE Annals of the History of Computing 18, no. 1 (1996). Instead, they were featured two issues later in a special issue on women in computing.

2. Ruth Milkman, Gender at Work: The Dynamics of Job Segregation by Sex During World War II (Chicago, 1987).

3. Two books currently offer some information on the participation of women in computer history: see Autumn Stanley, Mothers and Daughters of Invention: Notes for a Revised History of Technology (Metuchen, N.J., 1993), and Herman Goldstine, The Computer from Pascal to Von Neumann (Princeton, 1972). For recollections from women who worked on the ENIAC, see W. Barkley Fritz, "The Women of ENIAC," IEEE Annals of the History of Computing 18, no. 3 (1996): 13-28. Other histories tend to make passing references to the women and to show photographs of them without identifying them by name.

4. Evelyn Steele, Wartime Opportunities for Women (New York, 1943), preface. For an analysis of American mobilization propaganda directed at women, see Leila Rupp, Mobilizing Women for War: German and American Propaganda, 1939-1945 (Princeton, 1978).

5. Keith Ayling, Calling All Women (New York, 1942), 129. 6. Steele, 101. 7. Ibid., 99-100. 8. According to a Women's Bureau Bulletin, "A coeducational university, which before the war had few outlets for mathematics majors except in routine calculating jobs, found many attractive jobs available to mathematics majors during the war, mostly in Government-sponsored research... There was a definite shift from the

usual type of employment for mathematics majors in teaching and in clerical jobs in business firms to computing work in industry and on Government war projects." See United States Department of Labor, "The Outlook for Women in Mathematics and Statistics," Women s Bureau Bulletin 223-24 (1948): 3. According to this report, women comprised the majority of high-school mathematics teachers.

9. Ibid., 8. Margaret Rossiter, Women Scientists in America: Before Affirmative Action, 1940-1972 (Baltimore, 1995), 13, confirms this practice more widely in the sciences. The few women who worked in supervisory roles generally supervised other women, a much less prestigious managerial role than supervising men. However, at the Work Project Administration's Mathematical Tables Project, women supervised male computers. See Denise W. Giirer, "Women's Contributions to Early Computing at the National Bureau of Standards," IEEE Annals of the History of Computing 18, no. 3 (1996): 29-35. The War Department in 1942 classified all military occupational specialties as either suitable or unsuitable for women; all jobs involving supervision over men were automatically declared unsuitable. Public Law 110 also made explicit that women could not command men without intervention from the secretary of war; see Bettie Morden, The Women s Army Corps, 1945-1978 (Washington, D.C, 1990), 14.

10. See Margaret Rossiter, Women Scientists in America: Struggles and Strategies to 1940 (Baltimore, 1982), also Women Scientists in America: Before Affirmative Action, 1940-1972. In the 1982 volume, p. 55, Rossiter describes the late-nineteenth-century star counters in astronomical laboratories who performed computer work for male astronomers. The famed astronomer Maria Mitchell was employed as a computer for the U.S. Coast and Geodetic Survey in the late 1860s. The term computer, meaning "one who computes," originally referred to the human who was assigned various mathematical calculations. Ute Hoffman dates the use of computer to the seventeenth century, when it was used in reference to men who tracked the course of time in their calendars. For decades the terms computer and calculator were interchangeable. In fact, early computers such as the ENIAC and Mark I were called electronic calculators. See Ute Hoffmann, "Opfer und Taterinnen: Frauen in der Computergeschichte," in Micro Sisters: Digitalisierung des Alltags, Frauen und Computer, ed. Ingrid Scholl and Ina Kiiller (Berlin, 1988).
A number of other historians have documented women's work in other sciences. For example, Peter Galison, Image and Logic: A Material Culture of Microphysics (Chicago, 1997), discusses the work of women in high-energy physics laboratories, both those who counted flashes on the scintillator in Rutherford's laboratory and those who scanned the photographs from bubble-chamber experiments. Caroline Herzenberg and Ruth Howes, "Women of the Manhattan Project," Technology Review 8 (1993): 37, describe the work of women at Los Alamos, "some with

degrees in mathematics and others with little technical back ground," who performed mathematical calculations for the design of the bomb. Amy Sue Bix, "Experiences and Voices of Eugenics Field-Workers: 'Women's Work' in Biology," Social Studies of Science 27 (1997): 625-68, reports the work of female field workers at the Eugenics Record Office, who gathered data on individuals and families. In every case the work was subordinate to men's. See also Jane S. Wilson and Charlotte Serber, eds., Standing By and Making Do: Women of Wartime Los Alamos (Los Alamos, N.M., 1988).

11. See Rossiter, Women Scientists in America (both volumes). According to Herman Goldstine, it was the fact that women were not seeking career advancement that made them ideal workers: "In general women didn't get Ph.D.'s. You got awfully good women because they weren't breaking their backs to be smarter than the next guy." Herman Goldstine, interview by author, Philadelphia, 16 November 1994. Goldstine also noted that the few men he encountered working on programming rarely conceived of their jobs as permanent. Rather, they were steps on the way to something better. These jobs were "never careers for them, but a way of making money for a short time." Consequently, Goldstine observes, "Men in general were lousy - the brighter the man the less likely he was to be a good programmer.... The men we employed were almost all men who wanted Ph.D.'s in math or physics. This [hands-on work] was a bit distasteful. I think they viewed what they were doing as something they were not going to be doing for a career. If you take a woman like Hedi Selberg [a programmer at the Institute for Advanced Study Electronic Computer Project] she probably didn't want to sit around with the baby all the time."

12. Galison cites the invention and popularization of the term "scanner girl."

13. Ibid., 176.

14. For further discussion of prewar trends in hiring practices, see Lisa Fine, The Souls of the Skyscraper: Female Clerical Workers in Chicago, 1870-1930 (Philadelphia, 1990), and Margery Davies, Women's Place is at the Typewriter: Office Work and Office Workers, 1870-1930 (Philadelphia, 1982). See also Milkman (n. 2 above), chaps. 1-3.

15. Paul Ceruzzi, "When Computers Were Human," Annals of the History of Computing 13 (1991): 242.

16. Cf. Milkman, 49: "The boundaries between 'women's' and 'men's' work changed location, rather than being eliminated. . . . Rather than hiring women workers to fill openings as vacancies occurred, managers explicitly defined some war jobs as 'suitable' for women, and others as 'unsuitable,' guided by a hastily revised idiom of sex-typing that adapted

prewar traditions to the special demands of the war emergency." Both Milkman and Fine discuss how gender-specific advertisements reflect the feminization of specific occupations. Fine offers an analysis of the shifting gender imagery of some clerical occupations. On this point, however, note that focusing on the industry's language about women (in this case, the stories about the biological capacities and natural implications of womanhood - or, by extension, on the advertising techniques used to create a gendered labor force) can confuse industry ideals with women's actual practice. As Milkman's notion of the idiom of sex-typing suggests, there is indeed a disjuncture between women's prescribed place and what women actually did. This disjuncture is central to women's invisibility in technological history.

17. Goldstine interview (n. 11 above). The domain's masculinity appears in the preface of a textbook on exterior ballistics: Office of the Chief of Ordnance, The Method of Numerical Integration in Exterior Ballistics: Ordnance Textbook (Washington, D.C, 1921). "The names of the men who have contributed most to its [the text's] development, particularly Major Moulton and Professor Bliss, are mentioned in various places in the text, and to whom the writer might appropriately make personal acknowledgement, would amount practically to an enumeration of all the officers, civilian investigators, and computers who have been connected with the work in ballistics in Washington and at the Aberdeen Proving Ground."

18. The heads of the computing groups were all college graduates, as were the majority of computers.

19. "The title 'engineering computer' was created for these women, since such work before the war was done by young, junior engineers as part of their induction training following graduation from an engineering college." U.S. Department of Labor, "Women in Architecture and Engineering" Women's Bureau Bulletin 223-25 (1948): 56. See Sharon Hartmann Strom, Beyond the Typewriter: Gender, Class, and the Origins of Modern American Office Work, 1900-1930 (Urbana, 111., 1992), for a discussion of similar circumstances within American businesses. To call a particular job "feminized" does not restrict it to women. Certainly there were some male computers and programmers. For a review of literature on gender and technology, see Nina Lerman, Arwen Palmer Mohun, and Ruth Oldenziel, "Versatile Tools: Gender Analysis and the History of Technology," Technology and Culture 38 (1997): 1-30.

20. The idiom of sex-typing made the sexual division of labor seem natural; differences in work capacity were considered biologically based. Evelyn Steele, editorial director of Vocational Guidance Research, writes, "It is generally agreed that women do well at painstaking, tedious work requiring patience and dexterity of the hands. The actual fact that women's fingers are more slender than men's makes a difference. Also,

women adapt themselves to repetitive jobs requiring constant alertness, nimble fingers and tireless wrists. They have the ability to work to precise tolerances, can detect variations of ten thousandths of an inch, [and] can make careful adjustments at high speed with great accuracy"; Steele (n. 4 above), 46. Women's strengths thus lay in performing repetitive, detailed, unskilled tasks. Such statements were not new. Arguments made in favor of women working as telephone operators were similar: "The work of successful telephone operating demanded just that particular dexterity, patience and forbearance possessed by the average woman in a degree superior to that of the opposite sex." Brenda Maddox, "Women and the Switchboard," in The Social Impact of the Telephone, ed. Ithiel de Sola Pool (Cambridge, Mass., 1977), 266. See also Fine (n. 14 above), chap. 4, "The Discourse on Fitness: Science and Symbols." For a discussion of women's wartime labor as portrayed in literature and advertising, see Charles Hannon, "'The Ballad of the Sad Cafe' and Other Stories of Women's Wartime Labor" Genders 23 (1996): 97-119.

21. For a further discussion of the prewar situation and the complex interaction between new technologies and the sexual division of labor, see Fine, also Davies (n. 14 above). Jobs with a more established tradition of male employment were less likely to become feminized before World War II. For example, while "clerk" and "bookkeeper" stayed largely male, feminization was more widespread in stenography because it had not been defined as male. See Milkman (n. 2 above), chap. 4. For further discussion of how new jobs were gendered, see Heidi Hartmann, Robert Kraut, and Louise Tilly, eds., Computer Chips and Paper Clips: Technology and Women's Employment, 2 vols. (Washington, D.C, 1986), vol. 1, chap. 2.

22. See Rossiter, Women Scientists in America: Struggles and Strategies to 1940 (n. 10 above), and Milkman.

23. At the time, women were concentrated in clerical roles more than in any other occupation; they comprised 54 percent of all clerical workers in 1940 and 62 percent in 1950. U.S. Department of Labor, "Changes in Women's Occupations 1940-1950," Women's Bureau Bulletin 253 (1954): 37. Clerical work encompasses a broad range of jobs, including office machine operators. The Employment and Training Administration and U.S. Employment Service's Dictionary of Occupational Titles (Washington, D.C, 1939^11) classified computing-machine operator and calculating-machine operator as entry-level clerical occupations. For further discussion of the wide range of clerical jobs, see Strom (n. 19 above) and Fine. See also David Alan Grier, "The ENIAC, the Verb 'to program' and the Emergence of Digital Computers," IEEE Annals of the History of Computing 18, no. 1 (1996): 51-55.

24. It was part of a prior agreement with the Moore School that in times of national emergency the Aberdeen Proving Ground could commandeer the school's differential analyzer. Lydia Messer, oral history,

interview by Cornelius Weygandt, 22 March 1988, University of Pennsylvania Archives, Philadelphia. Joel Shurkin, Engines of the Mind (New York, 1984), 119. BRL had apparently organized previous cooperative projects during World War I with the University of Pennsylvania. The U.S. Army Ordnance Department's Course in Exterior Ballistics: Ordnance Textbook (Washington, D.C, 1921) credits H. H. Mitchell of the University of Pennsylvania as "Master Computer, who organized the range table computation work at Aberdeen." Before 1941, the Moore School also provided computers for BRL. Nancy Stern, From ENIAC to UNIVAC: An Appraisal of the Eckert-Mauchly Computers (Bedford, Mass., 1981), 10.

25. Shurkin, 128.

26. Shurkin, 127-28.

27. Stern, 13-14.

28. Not all women's jobs ranked lower or earned less than men's, but the history of female employment shows a persistent pattern into which the BRL's policies fit. For example, see Sharon Hartmann Strom, "'Machines Instead of Clerks': Technology and the Feminization of Bookkeeping, 1910-1950," in Hartmann, Kraut, and Tilly (n. 21 above), 2:63-97. See Fritz (n. 3 above) for women's accounts of the work they performed and H. Polachek, "Before the ENIAC," IEEE Annals of the History of Computing 19, no. 2 (1997): 25-30, for the complexities of computations for preparing firing tables.

29. Adele Goldstine received her bachelor's degree from Hunter College in 1941, then a master's from the University of Michigan in 1942. In 1942 she taught mathematics in the public school system in Philadelphia. From late 1943 to March 1946 she worked for the ENIAC project at the Moore School and spent part of 1944 at the Aberdeen Proving Ground. In 1948, she resumed graduate study at New York University. She became a consultant to the Atomic Energy Commission project effective 7 June 1947, working on making the ENIAC into a stored-program computer. Herman Goldstine recalls that "Los Alamos was the major user of the ENIAC so it was [John] Von Neumann [who was using it]. Adele was his assistant. I was also a consultant but she was doing the major part." Goldstine interview (n. 11 above).

30. Ibid.

31. Harold Pender to George McCelland, 23 July 1943, Information Files: World War II: WAC Training: Miscellaneous, University of Pennsylvania Archives.

32. Daily Pennsylvanian, 29 September 1943, untitled clipping in Information Files: World War II: WAC Training: Miscellaneous, University of

Pennsylvania Archives. While women received instructions from civilians (not an unusual practice in the armed services), they were commanded by military second lieutenants and corporals. The WAC officer in charge of the detachment on campus was Lt. Mildred Fleming.

33. Mattie Treadwell, United States Army in World War Two Special Series: The Women's Army Corps (Washington, D.C, 1954), 221.

34. Adele Goldstine to J. G. Brainerd, n.d., "Monday Night," Information Files: World War II: WAC Training: Miscellaneous, University of Pennsylvania Archives. The ESMWTesses were the women involved in the Engineering, Science, and Management War Training courses. J. G. Brainerd was a professor at the Moore School and liaison with U.S. Army Ordnance.

35. Helen Rogan, Mixed Company: Women in the Modern Army (New York, 1981), 41; Treadwell, chap. 4. Building on the work of historians such as Milkman (n. 2 above) and Fine (n. 14 above), who have analyzed the need for women in men's jobs to maintain femininity, Leisa Meyer has described the sexual politics of women's entrance into military service; see "Creating G.I. Jane: The Regulation of Sexuality and Sexual Behavior in the Women's Army Corps During World War Two," Feminist Studies 18 (1992) 581-601, and Creating G.I. Jane: Sexuality and Power in the Women's Army Corps during World War Two (New York, 1996).

36. "Topics Included in the Engineering, Science, and Management War Training Courses for Members of the W.A.C. from Aberdeen Proving Ground," Information Files: World War II: WAC Training: Miscellaneous, University of Pennsylvania Archives. There was a second training course in 1945; Herman Goldstine Papers, American Philosophical Society Library, Philadelphia (hereinafter Goldstine Papers).

37. Goldstine, The Computer from Pascal to Von Neumann (n. 3 above), 134; Fritz (n. 2 above). The histories of other sciences, in both Britain and the United States, show scentists' wives filling a number of the more senior women's positions in science. For example, Cecil Powell's wife Isobel led the scanning girls in Powell's laboratory, and Janet Landis Alvarez, wife of Luis Alvarez, trained the women bubble-chamber scanners at Berkeley. Among the computers at NACA were a number of engineers' wives. At the Los Alamos Scientific Laboratory, John Von Neumann's second wife, Klara Dan Von Neumann, became a programmer and helped to program and code some of the largest programs of the 1950s. Also at Los Alamos were Kay Manley, wife of John Manley, and Mici Teller, wife of Edward Teller, who performed mathematical calculations for the design of the bomb. For further discussion of couples in the sciences, see Helena M. Pycior, Nancy G. Slack, and Pnina G. Abir-Am, eds., Creative Couples in the Sciences (New Brunswick, N.J., 1996). According to Fritz, at least four computers married engineers at the Moore School after

1946. Frances Bilas married Homer Spence, Kathleen McNulty became Mauchly's second wife, and Elizabeth Snyder married John W. Holberton. According to Goldstine, Betty Jean Jennings (Bartik) married a Moore School engineer. Also at the Moore School were Eckert's first wife, a draftsman for the ENIAC project; Alice Burks, whose husband Arthur worked with Eckert and Mauchly on the ENIAC design; and Emma Lehmer, wife of Derrick Henry Lehmer, a computer and table compiler.

38. "Thanks for the Memory," presumably written by WACs at the Moore School, ca. 1943^14, Goldstine Papers.

39. In a retrospective analysis, Goldstine framed the computers' job as a prime candidate for mechanization due to its low skill: "Computing is thus subhuman in that it calls on very few of man's manifold abilities and yet is fundamental to many of his other activities, as Leibnitz so clearly perceived. This then is basically why computing was chosen as a human task to be mechanized"; Goldstine, The Computer from Pascal to Von Neumann, 343.

40. It is unclear exactly when this shift occurred. It was at least as early as February 1945, when George Stibbitz wrote in a report on relay computers for the National Defense Research Committee: "Human agents will be referred to as 'operators' to distinguish them from 'computers' (machines)." Ceruzzi (n. 15 above), 240.

41. Goldstine interview (n. 11 above). Interestingly, Milkman (n. 2 above) has discussed how jobs perceived as feminine in some places were quintessentially masculine in others - often within the same industry. The idiom of sex-typing, while consistent in individual factories, often differed among factories manufacturing the same product. On the Mark II computer at the Navy's Dahlgren Proving Ground, for instance, operators were male. This area deserves further study.

42. The terms hard and soft, as used to describe gendered tasks, are significant. For the hard and soft sciences, hard mastery and soft mastery are binary distinctions in science and technology implying that the "hard" ways of knowing are men's domain; "soft" ways of knowing are more feminine. Goldstine, when interviewed, reported that he had resisted "there being a distinction" between hardware and software. He observed: "At the beginning, the hardware was the important thing, but as soon as you get beyond the bottleneck of making the computer," programming software became a new bottleneck. "They've automated the bejeezus out of making chips but not software." Ironically, by the time the process of making hardware was automated programming software had become a man's job and acquired higher status than it had had in the 1940s. See, for example, Phillip Kraft, "The Routinization of Computer Programming," Sociology of Work and Occupations 6 (1977): 139-55.

43. Jeanne Holm, Women in the Military: An Unfinished Revolution, rev. ed. (Novato, Calif., 1992), 73. Social mores, as well as a variety of rules and regulations, meant that women's qualifications had to surpass men's before they could compete for higher-level jobs within academia (including government-sponsored research) and industry. The army had higher selection criteria for female officers and enlisted personnel "than those for men in the same service" (p. 50). P.L. 110, the legislation converting the WAC to full military status, specified that "its commanding officer could never be promoted above the rank of colonel and its other officers above the rank of lieutenant colonel; its officers could never command men unless specifically ordered to do so by Army superiors" (Treadwell [n. 33 above], 220). Additionally, the War Department in 1943 set the ratio of female officers to enlisted women at one to twenty. Comparable figures for men were one to ten. Using the excuse of a surplus of male officers, it capped WAC officers by limiting entrants to the WAC Officer Candidate School but did not impose a similar limitation on male officers. None of the six women ENIAC operators held high status in academia or the military. Men at the Moore School who were not affiliated with the army, such as Harry Huskey or Arthur Burks, had visible academic appointments. See Rossiter, Women Scientists in America: Before Affirmative Action, 1940-1972 (n. 9 above), for more on hierarchies, promotions, and payment in science.

44. Shurkin (n. 24 above), 188.

45. Kraft (n. 42 above), 141.

46. Fritz (n. 2 above), 19-20.

47. A number of historians have disputed de-skilling assumptions. For example, Sharon Hartmann Strom, "'Machines Instead of Clerks'" (n. 28 above), 64, describes in the case of bookkeeping machine operators how "workers continued to apply hidden skills of judgement and to integrate a number of tasks, particularly to jobs in the middle levels of bookeeping, even though these jobs required the use of machines." Fine (n. 14 above), 84, claims that the stenographer-typist's job was more challenging than the copyist's whom she replaced. For a review of literature on gender, mechanization, and deskilling, see Nina Lerman, Arwen Palmer Mohum, and Ruth Oldenziel, "The Shoulders We Stand On and the View from Here: Historiography and Directions for Research," Technology and Culture 38 (1997): 9-30. See also Kenneth Lipartito, "When Women Were Switches: Technology, Work, and Gender in the Telephone Industry, 1890-1920," American Historical Review 99 (1994): 1075-111.

48. Nina Lerman, "'Preparing for the Duties and Practical Business of Life': Technological Knowledge and Social Structure in Mid-19th-century Philadelphia," Technology and Culture 38 (1997): 36. Judy Wajcman,

Feminism Confronts Technology (University Park, Penn., 1991), 37, observes: "Definitions of skill can have more to do with ideological and social constructions than with technical competencies which are possessed by men and not by women."

49. Shurkin, 188.

50. Ibid., 189.

51. C. Dianne Martin, "ENIAC: Press Conference That Shook the World," IEEE Technology and Society Magazine 14, no. 4 (1995): 3-10. Because the problem was classified, the equations remained concealed.

52. Goldstine, The Computer from Pascal to Von Neumann (n. 3 above), 229. For details of the kinds of calculations performed using ENIAC, see Arthur W. Burks and Alice R. Burks, "The ENIAC: First General-Purpose Electronic Computer," Annals of the History of Computing 3 (1981): 310-89. The Burks were another significant husband and wife team, publishing their story together; Alice R. Burks and Arthur W. Burks, The First Electronic Computer: The Atanasoff Story (Ann Arbor, Mich., 1988).

53. Fritz (n. 2 above), 20-21. Goldstine recalled bringing Douglas Hartree, a physicist who had built a differential analyzer in Britain, to the United States for a visit. "I got Kay McNulty to be his programmer and she was good and intelligent. The girls soon branched off independently and it was during that period that my wife was making ENIAC into a stored program computer"; Goldstine interview (n. 11 above).

54. See, for example, Bruno Latour, Science in Action (Cambridge, 1987).

55. U.S. War Department, Bureau of Public Relations, "Ordnance Department Develops All-Electronic Calculating Machines," press release, February 1946, Goldstine Papers.

56. U.S. War Department, Bureau of Public Relations, "History of Development of Computing Devices," press release, 15-16 February 1946, Goldstine Papers.

57. For media characterizations of ENIAC, see C. Dianne Martin, "The Myth of the Awesome Thinking Machine," Communications of the ACM 36, no. 4 (1993): 125,127; see also Martin, "ENIAC" (n. 51 above), 3-10. Like the laundry industry that made its employees invisible by publicizing the tireless machines, the ENIAC was portrayed as doing almost all of the work; Arwen Mohun, "Laundrymen Construct their World: Gender and the Transformation of a Domestic Task to an Industrial Process," Technology and Culture 38 (1997): 97-120.

58. Steven Shapin, "The House of Experiment in Seventeenth-Century England," Isis 79 (1988): 395.

59. T. R. Kennedy, "Electronic Computer Flashes Answers, May Speed Engineering," New York Times, 15 February 1946.

60. Ibid.

61. The NACA memorandum (n. 15 above) specifically used she to describe the computers in its service. Women played salient roles in the demonstration of many domestic and business technologies, from sewing machines to typewriters to IBM office products, making their omission here all the more pointed.

62. See, for example, Popular Science Monthly, October 1946,212.

63. Herman Goldstine to Captain J. J. Power, Office of the Chief of Ordnance, 17 January 1946, Goldstine Papers.

64. ENIAC file appended to Goldstine to Power, 17 January 1946.

65. Horace K. Woodward Jr. to Adele Goldstine, 23 February 1946, Goldstine Papers.

66. While Adele Goldstine did not receive media acknowledgement, she clearly had some status among her colleagues at the Moore School as the only woman working on the machine's hardware. Initially, she oversaw Holberton. As head of the WAC course, despite her civilian status, she had frequent contact with top administrators at both the Moore School and the Aberdeen Proving Ground. In a publicity folder, biographical pro files on approximately a dozen staff members at the Moore School connected with the ENIAC include J. Presper Eckert, John W. Mauchly, Herman H. Goldstine, John G. Brainerd, Arthur Burks, Harry Huskey, Cpl. Irwin Goldstein, and Pfc. Spence. Adele Goldstine is the only woman included.

67. The affidavit is included in a letter from Harry Pugh, at Fish, Richardson, and Neave, to Herman Goldstine, 12 December 1961, Goldstine Papers.

68. Goldstine, The Computer from Pascal to Von Neumann (n. 3 above), 200.

69. Ibid., 330.

70. Ibid., 255 n. 4.

71. "Studies at Penn Aided Artillery," undated clipping from unidentified newspaper, ENIAC Publicity Folder, Goldstine Papers.

72. See, for example, Allen Rose, "Lightning Strikes Mathematics," Popular Science Monthly, April 1946, 85, photo caption: "T. K. Sharpless, of the Moore School of Engineering, sets a dial on the Eniac's initiating unit, which contains some of the master controls of the huge, complex mechanics_Mr. Sharpless designed some Eniac equip ment."

73. Bruno Latour and Steve Woolgar, in Laboratory Life (Beverley Hills, Calif., 1979), 219, point out that "a key feature of the hierarchy is the extent to which some people are regarded as replaceable."

74. Rupp (n. 4 above), 161.

75. Ibid., 161-62.

76. U.S. Department of Labor, "The Outlook for Women in Mathematics and Statistics" (n. 8 above), 9-11. See also U.S. Department of Labor, "A Preview as to Women Workers in Transition from War to Peace," Women's Bureau Special Bulletin, 1944; Rossiter, Women Scientists in America: Before Affirmative Action, 1940-1972 (n. 9 above), chap. 2.

77. U.S. Department of Labor, "The Outlook for Women," 11.

78. Army Service Forces Office of the Chief of Ordnance, Washington, D.C, to personnel at BRL, 29 January 1946, Goldstine Papers.

79. Herzenberg and Howes (n. 10 above).

80. U.S. Department of Labor, "Employment Opportunities for Women Mathematicians and Statisticians," Women's Bureau Bulletin 262 (1956): vi.

81. For these women's later employment histories, see Fritz (n. 2 above), 17.

82. Margaret Rossiter, "The Matilda Effect in Science," Social Studies of Science 23 (1993): 325-41.

83. U.S. War Department, You re Going to Hire Women, booklet produced to persuade managers and supervisors to hire women, cited in Chester Gregory, Women in Defense Work During World War II: An Analysis of the Labor Problem and Women's Rights (New York, 1974), 12.

84. For example, the Women's Bureau Bulletin 262 (1956) features several pictures of women working with computers and mentions women coding and programming.

85. Gerda Lerner, "The Necessity of History," in Why History Matters: Life and Thought (NewYork, 1997), 119.

THE FUTURE LOOMS: WEAVING WOMEN AND CYBERNETICS

SADIE PLANT

'The Future Looms: Weaving Women and Cybernetics' an essay by Sadie Plant, draws a fascinating connection between weaving strings into textiles and data into software. Plant looks at the history of the first computer, based on the electric loom, and how the practices of working with them are more alike than it seems. Her fascination with Ada Lovelace, the first woman associated with the development of computing, is also transparent. If women's history is so interlaced with that of weaving, does that mean that women were born to be programmers?

Beginning with a passage from a novel:

The woman brushed aside her veil, with a swift gesture of habit, and Mallory caught his first proper glimpse of her face. She was Ada Byron, the daughter of the Prime Minister. Lady Byron, the Queen of Engines. (Gibson and Sterling, 1990: 89)

Ada was not really Ada Byron, but Ada Lovelace, and her father was never Prime Minister: these are the fictions of William Gibson and Bruce Sterling, whose book The Difference Engine sets its tale in a Victorian England in which the software she designed was already running; a country in which the Luddites were defeated, a poet was Prime Minister, and Ada Lovelace still bore her maiden name. And one still grander: Queen of Engines. Moreover she was still alive. Set in the mid-1850s, the novel takes her into a middle-age she never saw: the real Ada died in 1852 while she was still in her thirties. Ill for much of her life with unspecified disorders, she was eventually diagnosed as

suffering from cancer of the womb, and she died after months of extraordinary pain.

Ada Lovelace, with whom the histories of computing and women's liberation are first directly woven together, is central to this paper. Not until a century after her death, however, did women and software make their respective and irrevocable entries on to the scene. After the military imperatives of the 1940s, neither would ever return to the simple service of man, beginning instead to organize, design and arouse themselves, and so acquiring unprecedented levels of autonomy. In later decades, both women and computers begin to escape the isolation they share in the home and office with the establishment of their own networks. These, in turn, begin to get in touch with each other in the 1990s. This convergence of woman and machine is one of the preoccupations of the cybernetic feminism endorsed here, a perspective which owes a good deal to the work of Luce Irigaray, who is also important to this discussion.

The computer emerges out of the history of weaving, the process so often said to be the quintessence of women's work. The loom is the vanguard site of software development. Indeed, it is from the loom, or rather the process of weaving, that this paper takes another cue. Perhaps it is an instance of this process as well, for tales and texts are woven as surely as threads and fabrics. This paper is a yarn in both senses. It is about weaving women and cybernetics, and is also weaving women and cybernetics together. It concerns the looms of the past, and also the future which looms over the patriarchal present and threatens the end of human history.

Ada Lovelace may have been the first encounter between woman and computer, but the association between women and software throws back into the mythical origins

of history. For Freud, weaving imitates the concealment of the womb: the Greek hystera; the Latin matrix. Weaving is woman's compensation for the absence of the penis, the void, the woman of whom, as he famously insists, there is 'nothing to be seen'. Woman is veiled, as Ada was in the passage above; she weaves, as Irigaray comments, 'to sustain the disavowal of her sex'. Yet the development of the computer and the cybernetic machine as which it operates might even be described in terms of the introduction of increasing speed, miniaturization and complexity to the process of weaving. These are the tendencies which converge in the global webs of data and the nets of communication by which cyberspace, or the matrix, are understood.

Today, both woman and the computer screen the matrix, which also makes its appearance as the veils and screens on which its operations are displayed. This is the virtual reality which is also the absence of the penis and its power, but already more than the void. The matrix emerges as the processes of an abstract weaving which produces, or fabricates, what man knows as 'nature': his materials, the fabrics, the screens on which he projects his own identity.

* * *

As well as his screens, and as his screens, the computer also becomes the medium of man's communication. Ada Lovelace was herself a great communicator: often she wrote two letters a day, and was delighted by the prospect of the telegraph. She is, moreover, often remembered as Charles Babbage's voice, expressing his ideas with levels of clarity, efficiency and accuracy he could never have mustered himself.

When Babbage displayed his Difference Engine to the public in 1833, Ada was a debutante, invited to see the

machine with her mother, Lady Byron, who had herself been known as the Princess of Parallelograms for her mathematical prowess. Lady Byron was full of admiration for the machine, and it is clear that she had a remarkable appreciation of the subtle enormities of Babbage's invention. 'We both went to see the thinking machine (for such it seems) last Monday', she wrote. 'It raised several Nos. to the 2nd & 3rd powers, and extracted the root of a quadratic Equation' (Moore, 1977: 44).

Ada's own response was recorded by another woman, who wrote:

While other visitors gazed at the working of the beautiful instrument with a sort of expression, and dare I say the same sort of feeling, that some savages are said to have shown on first seeing a looking glass or hearing a gun... Miss Byron, young as she was, understood its working, and saw the great beauty of the invention. (Moore, 1977: 44)

Ada had a passion for mathematics at an early age. She was admired and was greatly encouraged by Mary Somerville, herself a prominent figure in the scientific community and author of several scientific texts including the widely praised Connection of the Physical Sciences. Ada and Mary Somerville corresponded, talked together, and attended a series of lectures on Babbage's work at the Mechanics' Institute in 1835. Ada was fascinated by the engine, and wrote many letters to Babbage imploring him to take advantage of her brilliant mind. Eventually, and quite unsolicited, she translated a paper by Menabrea on Babbage's Analytic Engine, later adding her own notes at Babbage's suggestion. Babbage was enormously impressed with the translation, and Ada began to work with him on the development of the Analytical Engine.

Babbage had a tendency to flit between obsessions; a remarkably prolific explorer of the most fascinating questions of science and technology, he neverthe less rarely managed to complete his studies; neither the Difference Engine nor the Analytical Engine were developed to his satisfaction. Ada, on the other hand, was determined to see things through; perhaps her commitment to Babbage's machines was greater than his own. Knowing that the Difference Engine had suffered for lack of funding, publicity and organization, she was convinced that the Analytical Engine would be better served by her own attentions. She was often annoyed by what she perceived as Babbage's sloppiness, and after an argument in 1843, she laid down several severe conditions for the continuation of their collaboration: 'can you', she asked, with undisguised impatience,

undertake to give your mind wholly and undividedly, as a primary object that no engagement is to interfere with, to the consideration of all those matters in which I shall at times require your intellectual assistance & supervision; & can you promise not to slur & hurry things over; or to mislay & allow confusion & mistakes to enter into documents? (Moore, 1977: 171) Babbage signed this agreement, but in spite of Ada's conditions, ill health and financial crises conspired to prevent the completion of the machine.

Ada Lovelace herself worked with a mixture of coyness and confidence; attributes which often extended to terrible losses of self-esteem and megalomaniac delight in her own brilliance. Sometimes she was convinced of her own immortal genius as a mathematician; 'I hope to bequeath to future generations a Calculus of the Nervous System', she wrote in 1844. 'I am proceeding in a track quite peculiar & my own, I believe' (Moore, 1977: 216). At other times, she lost all confidence, and often wondered whether she should not have pursued her musical abilities, which were also fine.

Ada was always trapped by the duty to be dutiful; caught in a cleft stick of duties, moral obligations she did not understand.

Ada's letters - and indeed her scientific writings - are full of suspicions of her own strange relation to humanity. Babbage called her his fairy, because of her dextrous mind and light presence, and this appealed to Ada's inherited romanticism. 'I deny the Fairyism to be entirely imaginary', she wrote: 'That Brain of mine is something more than merely mortal; as time will show; (if only my breathing & some other etceteras do not make too rapid a progress towards instead of from mortality)' (Moore, 1977: 98). When one of her thwarted admirers wrote to her: 'That you're a peculiar - very peculiar - specimen of the feminine race, you are yourself aware' (Moore, 1977: 202), he could only have been confirming an opinion she already - and rather admiringly - had of herself. Even of her own writing, she wrote: 'I am quite thunderstruck by the power of the writing. It is especially unlike a woman's style but neither can I compare it with any man's exactly' (Moore, 1977: 157). The words of neither a man nor a woman: who was Ada Lovelace? 'Before ten years are over', she wrote, 'the Devil's in it if I haven't sucked out some of the life blood from the mysteries of this universe, in a way that no purely mortal lips or brains could do'(Moore, 1977: 153).

Ada may have been Babbage's fairy, but she was not allowed to forget that she was also a wife, mother and victim of countless 'female disorders'. She had three children by the age of 24 of whom she later wrote: 'They are to me irksome duties & nothing more' (Moore, 1977: 229). Not until the 1840s did her own ill health lead her husband and mother to engage a tutor for the children, to whom she confided 'not only her present distaste for the company of her children but also her growing indifference to her husband, indeed to men in general' (Moore, 1977: 198). One

admirer called her 'wayward, wandering . . . deluded', and as a teenager she was considered hysterical, hypochondriac and rather lacking in moral fibre. She certainly suffered extraordinary symptoms, walking with crutches until the age of 17, and often unable to move. Her illnesses gave her some room for manoeuvre in the oppressive atmosphere of her maternal home. Perhaps Ada even cherished the solitude and peculiarity of her diseases; she certainly found them of philosophical interest, once writing: 'Do you know it is to me quite delightful to have a frame so susceptible That it is an experimental laboratory always about me, & inseparable from me. I walk about, not in a Snail-Shell, but in a Molecular Laboratory' (Moore, 1977: 218).

Not until the 1850s was cancer diagnosed: Lady Byron had refused to accept such news, still preferring to believe in her daughter's hysteria. Even Ada tended to the fashionable belief that over-exertion of the intellect had led to her bodily disorders; in 1844, while she was nevertheless continuing chemical and electrical experiments, she wrote: 'Many causes have contributed to produce the past derangements; & I shall in future avoid them. One ingredient, (but only one among many) has been too much Mathematics' (Moore, 1977: 153-4). She died in November 1852 after a year of agonized decline.

Ada Lovelace often described her strange intimacy with death; it was rather the constraints of life with which she had to struggle. 'I mean to do what I mean to do', she once wrote, but there is no doubt that Ada was horribly confined by the familiar - her marriage, her children and her indomitable mother conspired against her independence, and it was no wonder that she was so attracted to the unfamiliar expanses of mathematical worlds. Ada's marriage prompted the following words from her mother: 'Bid adieu to your old companion Ada Byron with all her peculiarities, caprices, and self-seeking; determined that as A.K. you will

live for others' (Moore, 1977: 69). But she never did. Scorning public opinion, she gambled, took drugs and flirted to excess. But what she did best was computer programming.

Ada Lovelace immediately saw the profound significance of the Analytical Engine, and she went to great lengths to convey the remarkable extent of its capacities in her writing. Although the Analytical Engine had its own limits, it was nevertheless a machine vastly different from the Difference Engine. As Ada Lovelace observed:

The Difference Engine can in reality . . . do nothing but add; and any other processes, not excepting those of simple subtraction, multiplication and division, can be performed by it only just to that extent in which it is possible, by judicious mathematical arrangement and artifices, to reduce them to a series of additions. (Morrison and Morrison, 1961: 25 0)

With the Analytical Engine, Babbage set out to develop a machine capable not merely of adding, but performing the 'whole of arithmetic'. Such an undertaking required the mechanization not merely of each mathematical operation, but the systematic bases of their functioning, and it was this imperative to transcribe the rules of the game itself which made the Analytical Engine a universal machine. Babbage was a little more modest, describing the Engine as 'a machine of the most general nature' (Babbage, 1961: 56), but the underlying point remains: the Analytical Engine would not merely synthesize the data provided by its operator, as the Difference Engine had done, but would incarnate what Ada Lovelace described as the very 'science of operations'. The Difference Engine, Ada Lovelace wrote, 'is the embodying of one particular and very limited set of operations, which... may be expressed thus (+, +, +, +, +, +), or thus 6(+) . Six repetitions of the one operation, +, is, in fact, the whole sum and object of that engine' (Morrison and

Morrison, 1961: 249). What impressed Ada Lovelace about the Analytical Engine was that, unlike the Difference Engine or any other machine, it was not merely able to perform certain functions, but was 'an embodying of the science of operations, constructed with peculiar reference to abstract number as the subject of those operations'. The Difference Engine could simply add up, whereas the Analytical Engine not only performed synthetic operations, but also embodied the analytic capacity on which these syntheses are based. 'If we compare together the powers and the principles of construction of the Difference and of the Analytic Engines', wrote Ada, 'we shall perceive that the capabilities of the latter are immeasurably more extensive than those of the former, and that they in fact hold to each other the same relationship as that of analysis to arithmetic' (Morrison and Morrison, 1961: 250). In her notes on Menabrea's paper, this is the point she stresses most: the Engine, she argues, is the very machinery of analysis, so that

> *there is no finite line of demarcation which limits the powers of the Analytical Engine. These powers are co-extensive with our knowledge of the laws of analysis itself, and need be bounded only by our acquaintance with the latter. Indeed we may consider the engine as the material and mechanical representative of analysis. (Morrison and Morrison, 1961: 252)*

The Difference Engine was 'founded on the principle of successive orders of differences', while the

> *distinctive characteristic of the Analytical Engine, and that which has rendered it possible to endow mechanism with such extensive faculties as bid fair to make this engine the executive right-hand of abstract algebra, is the introduction of the principle which Jacquard devised for regulating, by means for punched cards, the most complicated patterns in the fabrication of brocaded stuffs. (Morrison and Morrison, 1961: 252)*

Indeed, Ada considered Jacquard's cards to be the crucial difference between the Difference Engine and the Analytical Engine. 'We may say most aptly', she continued, 'that the Analytical Engine weaves Algebraical patterns, just as the Jacquard loom weaves flowers and leaves. Here, it seems to us, resides much more of originality than the Difference Engine can be fairly entitled to claim' (Morrison and Morrison, 1961: 252). Ada's reference to the Jacquard loom is more than a metaphor: the Analytical Engine did indeed weave 'just as' the loom, operating, in a sense, as the abstracted process of weaving.

Weaving has always been a vanguard of machinic development, perhaps because, even in its most basic form, the process is one of complexity, always involving the weaving together of several threads into an integrated cloth. Even the drawloom, which is often dated back to the China of 1000 BC, involves sophisticated orderings of warp and weft if it is to produce the complex designs common in the silks of this period. This means that 'information is needed in large amounts for the weaving of a complex ornamental pattern. Even the most ancient Chinese examples required that about 1500 different warp threads be lifted in various combinations as the weaving proceeded' (Morrison and Morrison, 1961: xxxiv). With pedals and shuttles, the loom becomes what one historian refers to as the 'most complex human engine of them all', a machine which 'reduced everything to simple actions: the alternate movement of the feet worked the pedals, raising half the threads of the warp and then the other, while the hands threw the shuttle carrying the thread of the woof' (Braudel, 1973: 24 7). The weaver was integrated into the machinery, bound up with its operations, linked limb by limb to the processes. In the Middle Ages, and before the artificial memories of the printed page, squared paper charts were used to store the information necessary to the accurate development of the design. In early 18th-century Lyons,

Basyle Bouchon developed a mechanism for the automatic selection of threads, using an early example of the punched paper rolls which were much later to allow pianos to play and type to be cast. This design was developed by Falcon a couple of years later, who introduced greater complexity with the use of punched cards rather than the roll. And it was this principle on which Jacquard based his own designs for the automated loom which revolutionized the weaving industry when it was introduced in the 1800s and continues to guide its contemporary development. Jacquard's machine strung the punch cards together, finally automating the operations of the machine and requiring only a single human hand. Jacquard's system of punch card programs brought the information age to the beginning of the 19th century. His automated loom was the first to store its own information, functioning with its own software, an early migration of control from weaver to machinery.

Babbage owned what Ada described as 'a beautiful woven portrait of Jacquard, in the fabrication of which 24,000 cards were required' (Morrison and Morrison, 1961: 281). Woven in silk at about 1000 threads to the inch, Babbage well understood that its incredible detail was due to the loom's ability to store and process information at unprecedented speed and volume and, when he began work on the Analytical Engine, it was Jacquard's strings of punch cards on which he based his designs. 'It is known as a fact', Babbage wrote, 'that the Jacquard loom is capable of weaving any design which the imagination of man may conceive' (Babbage, 1961: 55). Babbage's own contribution to the relentless drive to perfect the punch card system was to introduce the possibility of repeating the cards, or what, as Ada wrote,

was technically designated backing the cards in certain groups according to certain laws. The object of this extension is to secure the possibility of bringing any particular card or set of cards

onto use any number of times successively in the solution of one problem. (Morrison and Morrison, 1961:264)

This was an unprecedented simulation of memory. The cards were selected by the machine as it needed them and effectively functioned as a filing system, allowing the machine to store and draw on its own information.

The punch cards also gave the Analytical Engine what Babbage considered foresight, allowing it to operate as a machine that remembers, learns and is guided by its own abstract functioning. As he began to work on the Analytical Engine, Babbage became convinced that 'nothing but teaching the Engine to foresee and then to act upon that foresight could ever lead me to the object I desired' (Babbage, 1961: 53). The Jacquard cards made memory a possibility, so that 'the Analytical Engine will possess a library of its own' (1961: 56), but this had to be a library to which the machine could refer both to its past and its future operations; Babbage intended to give the machine not merely a memory but also the ability to process information from the future of its own functioning. Babbage could eventually write that 'in the Analytical Engine I had devised mechanical · means equivalent to memory, also that I had provided other means equivalent to foresight, and that the Engine itself could act on this foresight' (1961: 153).

There is more than one sense in which foresight can be ascribed to the Analytical Engine: more than 100 years passed before it was put to use, and it is this remarkable time lag which inspires Gibson and Sterling to explore what might have happened if it had been taken up in the 1840s rather than the 1940s. Babbage thought it might take 50 years for the Analytic Engine to be developed; many people, particularly those with money and influence, were skeptical about his inventions, and his own eclectic interests gave an unfavourable impression of eccentricity. His own assistant

confessed to thinking that Babbage's 'intellect was beginning to become deranged' (Babbage, 1961 : 54) - when he had started talking about the Engine's ability to anticipate the outcomes of calculations it had not yet made.

When the imperatives of war brought Lovelace's and Babbage's work to the attentions of the Allied military machine, their impact was immense. Her software runs on his hardware to this day. In 1944, Howard Aiken developed Mark 1, what he thought was the first programmable computer, although he had really been beaten by a German civil engineer, Konrad Zuse, who had in fact built such a machine, the Z-3, in 1941. Quite remarkably, in retrospect, the Germans saw little importance in his work, and although the most advanced of his designs, the Z-11, is still in use to this day, it was the American computer which was the first programmable system to really be noticed. Mark 1, or the IBM Automatic Sequence Controlled Calculator, was based on Babbage's designs and was itself programmed by another woman: Captain Grace Murray Hopper. She was often described as the 'Ada Lovelace' of Mark 1 and its successors; having lost her husband in the war, Grace Hopper was free to devote her energies to programming. She wrote the first high-level language compiler, was instrumental in the development of the computer language COBOL, and even introduced the term 'bug' to describe soft- or hardware glitches after she found a dead moth interrupting the smooth circuits of Mark 1. Woman as the programmer again.

Crucial to the development of the 1940s computer was cybernetics, the term coined by Norbert Wiener for the study of control and communication in animal and machine. Perhaps the first cybernetic machine was the governor, a basic self-regulating system, which, like a thermostat, takes the information feeding out of the machine and loops or feeds it back on itself. Rather than a linear operation, in

which information comes in, is processed and goes out without any return, the cybernetic system is a feedback loop, hooked up and responsive to its own environment. Cybernetics is the science - or rather the engineering - of this abstract procedure, which is the virtual reality of systems of every scale and variety of hard and software.

It is the computer which makes cybernetics possible, for the computer is always heading towards the abstract machinery of its own operations. It begins with attempts to produce or reproduce the performance of specific functions, such as addition, but what it leads to is machinery which can simulate the operations of any machine and also itself. Babbage wanted machines that could add, but he ended up with the Analytical Engine: a machine that could not only add but perform any arithmetical task. As such, it was already an abstract machine, which could turn its abstract hand to anything. Nevertheless, the Analytical Engine was not yet a developed cybernetic machine, although it made such machinery possible. As Ada Lovelace recognized: 'The Analytical Engine has no pretensions whatever to originate anything. It can do whatever we know how to order it to perform' (Morrison and Morrison, 1961: 285). It was an abstract machine, but its auton omous abilities were confined to its processing capacities: what Babbage, with terminology from the textiles industry, calls the mill, as opposed to the store. Control is dispersed and enters the machinery, but it does not extend to the operations of the entire machine.

Not until the Turing Machine is there a further shift onto the software plane. Turing realized that, in effect, the mill and the store could work together, so that 'programs that change themselves could be written': programs which are able to 'surrender control to a subprogram, rewriting themselves to know where control had to be returned after the execution of a given subtask' (De Landa, 1992: 162). The

Turing Machine is an unprecedented dispersal of control, but it continues to bring control back to the master program. Only after the introduction of silicon in the 1960s did the decentralized flow of control become an issue, eventually allowing for systems in which 'control is always captured by whatever production happens to have its conditions satisfied by the current workspace contents' (De Landa, 1992: 63-4). The abstract machine begins at this point to function as a network of 'independent software objects'. Parallel processing and neural nets succeed central ized conceptions of command and control; governing functions collapse into sys tems; and machine intelligence is no longer taught, top-down, but instead makes its own connections and learns to organize, and learn, for itself.

This is the connectionist zone of self-organizing systems and self-arousing ma chines: autonomous systems of control and synthetic intelligence. In human hands and as a historical tool, control has been exercised merely as domination, and mani fest only in its centralized and vertical forms. Domination is a version of control, but also its confinement, its obstacle: even self-control is conceived by man as the achievement of domination. Only with the cybernetic system does self-control no longer entail being placed beneath or under something: there is no 'self' to control man, machine or any other system: instead, both man and machine become elements of a cybernetic system which is itself a system of control and communi cation. This is the strange world to which Ada's programming has led: the possi bility of activity without centralized control, an agency, of sorts, which has no need of a subject position.

Ada Lovelace considered the greatest achievement of the Analytical Engine to be that 'not only the mental and the material, but the theoretical and the practical in the mathematical world, are brought into more intimate and

effective connexion with each other' (Morrison and Morrison, 1961: 252). Her software already encouraged the convergence of nature and intelligence which guides the subsequent develop ment of information technology.

The Analytical Engine was the actualization of the abstract workings of the loom; as such it became the abstract workings of any machine. When Babbage wrote of the Analytical Engine, it was often with reference to the loom: 'The anal ogy of the Analytical Engine with this well-known process is nearly perfect' (1961: 55). The Analytical Engine was such a superb development of the loom that its discoveries were to feed back into the processes of weaving itself. As Ada wrote:

It has been proposed to use it for the reciprocal benefit of that art, which, while it has itself no apparent connexion with the domains of abstract science, has yet proved so valuable to the latter, in suggesting the principles which, in their new and singular field of application, seem likely to place algebraical combinations not less completely within the province of mechanism, than are all those varied intricacies of which intersecting threads are susceptible. (Morrison and Morrison, 1961:265)

The algebraic combinations looping back into the loom, converging with the inter secting threads of which it is already the consequence.

Once they are in motion, cybernetic circuits proliferate, spilling out of the specific machinery in which they first emerged and infecting all dynamic systems. That Babbage's punch-card system did indeed feed into the mills of the mid-19th century is indicative of the extent to which cybernetic machines immediately become entangled with cybernetic processes on much bigger scales. Perhaps it is no coincidence that Neith, the Egyptian divinity of weaving, is also the spirit of intelligence, where the latter too consists in

the crossing of warp and weft. 'This image', writes one commentator, ' clearly evokes the fact that all data recorded in the brain results from the intercrossing of sensations perceived by means of our sense organs, just as the threads are crossed in weaving' (Lamy, 1981: 18).

The Jacquard loom was a crucial moment in what de Landa defines as a 'migration of control' from human hands to software systems. Babbage had a long-standing interest in the effects of automated machines on traditional forms of manufacture, publishing his research on the fate of cottage industries in the Midlands and North of England, The Economy of Manufactures and Machinery, in 1832, and the Jacquard loom was one of the most significant technological innovations of the early 19th century. There was a good deal of resistance to the new loom, which 'was bitterly opposed by workers who saw in this migration of control a piece of their bodies literally being transferred to the machine' (De Landa, 1992: 168). In his maiden speech in the House of Lords in 1812, Lord Byron contributed to a debate on the Frame-Work Bill. 'By the adoption of one species of frame in particular', he observed, 'one man performed the work of many, and the superfluous labourers were thrown out of employment'. They should, he thought, have been rejoicing at 'these improvements in arts so beneficial to mankind', but instead 'conceived themselves to be sacrificed to improvements in mechanism' Gennings, 1985: 132). His daughter was merely to accelerate the processes which relocated and redefined control.

* * *

The connection between women and weaving runs deep: even Athena and Isis wove their veils.

The traditional picture of the wife was one in which she spun by the village fire at night, listening to the children's riddles, and to

the myth-telling of the men, eventually making cloth which her husband could sell to make wealth for the family; doth-making was a service from a wife to a husband. (Mead, 1963:247)

This is from Margaret Mead's research with the Tiv of Nigeria, but it is a pattern repeated in many societies before manufactured cloth and automated weaving made their marks. Continuing their story, Mead's researchers observe that mechaniz ation was a radical disruption of this domestic scene. After this, it was no longer inevitable that women would provide the materials: 'When manufactured cloth was introduced, the women demanded it of the men'. Now 'the man had to leave home to make money to buy cloth for his wife' who, moreover 'had ceased to fit the traditional picture of a wife' (Mead, 1963: 247).

Mead's study suggests that weaving was integral to the identity of Tiv women; washing, pounding and carrying water may fulfill this role in other cultures where they, like weaving, are always more than utilitarian tasks. The disruption of family relations caused by the introduction of mechanics to any of these tasks shatters the scenery of female identity: mechanization saves time and labour, but these were not the issue: if women were not the weavers and water-carriers, who would they be? These labours themselves had been woven into the appearance of woman; weaving was more than an occupation and, like other patriarchal assignments, functioned as 'one of the components of womanhood'.

Certainly Freud finds a close association. 'It seems', he writes, 'that women have made few contributions to the discoveries and inventions in the history of civilization; there is, however, one technique which they may have invented- that of plaiting and weaving.' Not content with this observation, Freud is of course characteristically 'tempted to

guess the unconscious motive for the achievement. Nature herself', he suggests,

would seem to have given the model which this achievement imitates by causing the growth at maturity of the pubic hair that conceals the genitals. The step that remained to be taken lay in making the threads adhere to one another, while on the body they stick into the skin and are only matted together. (1973: 166-7)

This passage comes out of the blue in Freud's lecture on femininity. He even seems surprised at the thought himself: 'If you reject this idea as fantastic', he adds, 'and regard my belief in the influence of a lack of a penis on the configuration of femininity as an idee fixe, I am of course defenceless' (1973: 167). Freud is indeed quite defenceless about the absence of the penis as its driving force, but is it foolish to suggest that weaving is women's only contribution to 'the discoveries and inventions of the history of civilization'? If this were to be the case, what a contribution it would be! Weaving has been the art and the science of software, which is perhaps less a contribution to civilization than its terminal decline. Perhaps weaving is even the fabric of every other discovery and invention, perhaps the beginning and the end of their history. The loom is a fatal innovation, which weaves its way from squared paper to the data net.

It seems that weaving is always already entangled with the question of female identity, and its mechanization an inevitable disruption of the scene in which woman appears as the weaver. Manufactured cloth disrupted the marital and familiar relationships of every traditional society on which it impacted. In China, it was said that if 'the old loom must be discarded, then 100 other things must be discarded with it, for there are somehow no adequate substitutes' (Mead, 1963: 241).

'The woman at her hand-loom', writes Margaret Mead,

controls the tension of the weft by the feeling in her muscles and the rhythm of her body motion; in the factory she watches the loom, and acts at externally stated intervals, as the operations of the machine dictate them. When she worked at home, she followed her own rhythm, and ended an operation when she felt - by the resistance against the pounding mallet or the feel between her fingers - that the process was complete. In the factory she is asked to adjust her rhythm to that of the rhythm prescribed by the factory; to do things · according to externally set time limits.(1963: 24 1)

Mead again provides an insight into the intimacy of the connection between body and process established by weaving, and its disruption by the discipline of the factory. 'She is asked to adjust her rhythm to that of the rhythm prescribed by the factory', but what is her own rhythm, what is the beat by which she wove at home? What is this body to which weaving is so sympathetic? If woman is identified as weaver, her rhythms can only be known through its veils. Where are the women? Weaving, spinning, tangling threads at the fireside. Who are the women? Those who weave. It is weaving by which woman is known; the activity of weaving which defines her. 'What happens to the woman', asks Mead, 'and to the man's relationship with her, when she ceases to fulfill her role, to fit the picture of womanhood and wifehood?' (1963:238). What happens to the woman? What is woman without the weaving? A computer programmer, perhaps? Ada's computer was a complex loom: Ada Lovelace, whose lace work took her name into the heart of the military complex, dying in agony, hooked into gambling, swept into the mazes of number and addiction. The point at which weaving, women and cybernetics converge in a movement fatal to history.

Irigaray argues that human history is a movement from darkness to the light of pure intellect; a flight from the earth. For man to make history is for him to deny and

transcend what he understands as nature, reversing his subordination to its whims and forces, and progressing towards the autonomy, omnipotence and omnipresence of God, his image of abstraction and authority. Man comes out of the cave and heads for the sun; he is born from the womb and escapes the mother, the ground from which humanity arose and the matter from which history believes itself destined for liberation. Mother Nature may have been his material origin, but it is God the Father to whom he must be faithful; God who legitimates his project to 'fill the earth and subdue it'. The matter, the womb, is merely an encumbrance; either too inert or dangerously active. The body becomes a cage, and biology a constraint which ties man to nature and refuses to let him rise above the grubby concerns of the material; what he sees as the passive materiality of the feminine has to be overcome by his spiritual action. Human history is the self-narrating story of this drive for domination; a passage from carnal passions to self-control; a journey from the strange fluidities of the material to the self-identification of the soul.

Woman has never been the subject, the agent of this history, the autonomous being. Yet her role in this history has hardly been insignificant. Even from his point of view, she has provided a mirror for man, his servant and accommodation, his tools and his means of communication, his spectacles and commodities, the possibility of the reproduction of his species and his world. She is always necessary to history: man's natural resource for his own cultural development. Not that she is left behind, always at the beginning: as mirror and servant, instrument, mediation and reproduction, she is always in flux, wearing 'different veils according to the historic period' (Irigaray, 1991: 118).

As Irigaray knows, man's domination cannot be allowed to become the annihilation of the materials he needs: in order to build his culture, 'man was, of course, obliged to

draw on reserves still in the realm of nature; a detour through the outer world was of course dispensable; the "I" had to relate to things before it could be conscious of itself' (Irigaray, 1985: 204). Man can do nothing on his own: carefully concealed, woman nevertheless continues to function as the ground and possibility of his quests for identity, agency and self-control. Stealth bombers and guided missiles, telecommunications systems and orbiting satellites epitomize this flight towards autonomy, and the concomitant need to defend it.

Like woman, software systems are used as man's tools, his media and his weapons; all are developed in the interests of man, but all are poised to betray him. The spectacles are stirring, there is something happening behind the mirrors, the commodities are learning how to speak and think. Women's liberation is sustained and vitalized by the proliferation and globalization of software technologies, all of which feed into self-organizing, self-arousing systems and enter the scene on her side.

This will indeed seem a strange twist to history to those who believe that it runs in straight lines. But as Irigaray asks: 'If machines, even machines of theory, can be aroused all by themselves, may woman not do likewise?' (1985: 232).

The computer, like woman, is both the appearance and the possibility of simulation. 'Truth and appearance, according to his will of the moment, his appetite of the instant' (Irigary, 1991: 118). Woman cannot be anything, but she can imitate anything valued by man: intelligence, autonomy, beauty .... Indeed, if woman is anything, she is the very possibility of mimesis, the one who weaves her own disguises. The veil is her oppression, but 'she may still draw from it what she needs to mark the folds, seams, and dressmaking of her garments and dissimulations' (Irigaray, 1991 : 116). These mimetic abilities throw woman into a

universality unknown and unknowable to the one who knows who he is: she fits any bill, but in so doing, she is already more than that which she imitates. Woman, like the computer, appears at different times as whatever man requires of her. She learns how to imitate; she learns simulation. And, like the computer, she becomes very good at it, so good, in fact, that she too, in principle, can mimic any function. As Irigaray suggests: 'Truth and appearances, and reality, power . . . she is - through her inexhaustible aptitude for mimicry - the living foundation for the whole staging of the world' (Irigaray, 1991: 118).

But if this is supposed to be her only role, she is no longer its only performer: now that the digital comes on stream, the computer is cast in precisely the same light: it too is merely the imitation of nature, providing assistance and additional capacity for man, and more of the things in his world, but it too can do this only insofar as it is already hooked up to the very machinery of simulation. If Freud's speculations about the origins of weaving lead him to a language of compensation and flaw, its technical development results in a proliferation of pixelled screens which compensate for nothing, and, behind them, the emergence of digital spaces and global networks which are even now weaving themselves together with flawless precision.

Software, in other words, has its screens as well: it too has a user-friendly face it turns to man, and for it, as for woman, this is only its camouflage.

The screen is the face it began to present in the late 1960s, when the TV monitor was incorporated in its design. It appears as the spectacle: the visual display of that which can be seen, and also functions as the interface, the messenger; like Irigaray's woman, it is both displayed for man and becomes the possibility of his communication. It

too operates as the typewriter, the calculator, the decoder, displaying itself on the screen as an instrument in the service of man. These, however, are merely imitations of some existing function; and indeed, it is always as machinery for the reproduction of the same that both women and information technology first sell themselves. Even in 1968, McLuhan argued that 'the dense information environment created by the computer is at present still concealed from it by a complex screen or mosaic quilt of antiquated activities that are now advertised as the new field for the computer' (McLuhan and Fiore, 1968: 89). While this is all that appears before man, those who travel in the information flows are moving far beyond the screens and into data streams beyond his conceptions of reality. On this other side run all the fluid energies denied by the patrilineal demand for the reproduction of the same. Even when the computer appears in this guise and simulates this function, it is always the site of replication, an engine for making difference. The same is merely one of the things it can be.

Humanity knows the matrix only as it is displayed, which is always a matter of disguise. It sees the pixels, but these are merely the surfaces of the data net which 'hides on the reverse side of the screen' (McCaffrey, 1991: 85). A web of complexity weaving itself, the matrix disguises itself as its own simulation. On the other side of the terminal looms the tactile density craved even by McLuhan, the materiality of the data space. 'Everyone I know who works with computers', writes Gibson, 'seems to develop a belief that there's some kind of actual space behind the screen, someplace you can't see but you know is there' (McCaffrey, 1991: 272).

This actual space is not merely another space, but a virtual reality. Nor is it as it often appears in the male imaginary: as a cerebral flight from the mysteries of matter. There is no escape from the meat, the flesh, and cyberspace

is nothing transcendent. These are simply the disguises which pander to man's projections of his own rear-view illusions; reproductions of the same desires which have guided his dream of technological authority and now become the collective nightmare of a soulless integration. Entering the matrix is no assertion of masculinity, but a loss of humanity; to jack into cyberspace is not to penetrate, but to be invaded. Neuromancer's cowboy, Case, is well aware of this:

he knew - he remembered - as she pulled him down, to the meat, the flesh the cowboys mocked. It was a vast thing, beyond knowing, a sea of information coded in spiral and pheromone, infinite intricacy that only the body, in its strong blind way, could ever read. (Gibson, 1985: 285)

Cyberspace is the matrix not as absence, void, the whole of the womb, but perhaps even the place of woman's affirmation. This would not be the affirmation of her own patriarchal past, but what she is in a future which has yet to arrive but can nevertheless already be felt. There is for Irigaray another side to the screens which

already moves beyond and stops short of appearance, and has no veil. It wafts out, like a harmony that subtends, envelops and subtly 'fills' everything seen, before the caesura of its forms and in time to a movement other than scansion in syncopations. Continuity from which the veil itself will borrow the matter-foundation of its fabric. (Irigaray, 1991: 116)

This fabric, and its fabrication, is the virtual materiality of the feminine; home to no-one and no thing, the passage into the virtual is nevertheless not a return to the void. This affirmation is 'without subject or object', but 'does not, for all that, go to the abyss': the blind immateriality of the black hole was simply projected by man, who had to believe that there was nothingness and lack behind the veil. Perhaps

Freud's comments on weaving are more powerful than he knows. For him, weaving is already a simulation of something else, an imitation of natural processes. Woman weaves in imitation of the hairs of her pubis criss-crossing the void: she mimics the operations of nature, of her own body. If weaving is woman's only achievement, it is not even her own: for Freud, she discovers nothing, but merely copies; she does not invent, but represents. 'Woman can, it seems, (only) imitate nature. Duplicate what nature offers and produces. In a kind of technical assistance and substitution' (Irigray, 1985: 115). The woman who weaves is already the mimic; always appearing as masquerade, artifice, the one who is faking it, acting her part. She cannot be herself, because she is and has no thing, and for Freud, there is weaving because nothing, the void, cannot be allowed to appear. 'Therefore woman weaves in order to veil herself, mask the faults of Nature, and restore her in her wholeness' (Irigaray, 1985: 116). Weaving is both her compensation and concealment; her appearance and disappearance: 'this disavowal is also a fabric(ation) and not without possible duplicity. It is at least double' (Irigaray, 1985: 116). She sews herself up with her own veils, but they are also her camouflage. The cloths and veils are hers to wear: it is through weaving she is known, and weaving behind which she hides.

This is a concealment on which man insists: this is the denial of matter which has made his culture - and his technologies - possible. For Irigaray, this flight from the material is also an escape from the mother. Looking back on his origins, man sees only the flaw, the incompletion, the wound, a void. This is the site of life, of reproduction, of materiality, but, it is also horrible and empty, the great embarrassment, the unforgivable slash across an otherwise perfect canvas. And so it must be covered, and woman put on display as the veils which conceal her: she becomes the cover girl, star of the screen. Like every good commodity,

she is packaged and wrapped to facilitate easy exchange and consumption. But as her own veils she is already hyperreal: her screens conceal only the flaw, the void, the unnatural element already secreted within and as nature. She has to be covered, not simply because she is too natural, but because she would otherwise reveal the terrifying virtuality of the natural. Covered up, she is always already the epitome of artifice.

Implicit in Irigaray's work is the suggestion that the matter denied by human culture is a virtual system, which subtends its extension in the form of nature. The virtual is the abstract machine from which the actual emerges; nature is already the camouflage of matter, the veils which conceal its operations. There is indeed nothing there, underneath or behind this disguise, or at least nothing actual, nothing formed. Perhaps this is nature as the machinic phylum, the virtual synthesizer; matter as a simulation machine, and nature as its actualization. What man sees is nature as extension and form, but this sense of nature is simply the camouflage, the veil again, which conceals its virtuality.

If the repression of this phylum is integral to a flight from matter which, for Irigaray, has guided human history, the cybernetic systems which bring it into human history are equally the consequences of this drive for escape and domination. Cybernetic systems are excited by military technology, security and defence. Still confident of his own indisputable mastery over them, man continues to turn them on. In so doing he merely encourages his own destruction. Every software development is a migration of control, away from man, in whom it has been exercised only as domination, and into the matrix, or cyberspace, 'the broad electronic net in which virtual realities are spun' (Heim, 1991: 31). The matrix weaves itself in a future which has no place for historical man: he was merely its tool, and

his agency was itself always a figment of its loop. At the peak of his triumph, the culmination of his machinic erections, man confronts the system he built for his own protection and finds it is female and dangerous. Rather than building the machinery with which they can resist the dangers of the future, instead, writes Irigaray, humans 'watch the machines multiply that push them little by little beyond the limits of their nature. And they are sent back to their mountain tops, while the machines progressively populate the earth. Soon engendering man as their epiphenomenon' (Irigaray, 1991: 63).

Dreams of transcendence are chased through the scientific, the technical and the feminine. But every route leads only to crisis, an age, for Irigaray,

in which the 'subject' no longer knows where to turn, whom or what to turn to, amid all these many foci of 'liberation', none rigorously homogeneous with another and all heterogeneous to his conception. And since he had long sought in that conception the instrument, the lever, and, in more cases than one, the term of his pleasure, these objects of mastery have perhaps brought the subject to his doom. So now man struggles to be science, machine, woman ... to prevent any of these from escaping his service and ceasing to be interchangeable. (Irigary, 1985: 23 2)

This, however, is an impossible effort: man cannot become what is already more than him: rather it is 'science, machine, woman' which will swallow up man; taking him by force for the first time. He has no resolution, no hope of the self-identical at the end of these flights from matter, for 'in none of these things - science, machine, woman - will form ever achieve the same completeness as it does in him, in the inner sanctuary of his mind. In them form has always already exploded' (Irigaray, 1985: 232).

Misogyny and technophobia are equally displays of man's fear of the matrix, the virtual machinery which subtends his world and lies on the other side of every patriarchal culture's veils. At the end of the 20th century, women are no longer the only reminder of this other side. Nor are they containable as child-bearers, fit only to be one thing, adding machines. And even if man continues to see cybernetic systems as similarly confined to the reproduction of the same, this is only because the screens still allow him to ignore the extent to which he is hooked to their operations, as dependent on the matrix as he has always been. All his defences merely encourage this dependency: for the last 50 years, as his war machine has begun to gain intelligence, women and computers have flooded into history: a proliferation of screens, lines of communication, media, interfaces and simulations. All of which exceed his intentions and feed back into his paranoia. Cybernetic systems are fatal to his culture; they invade as a return of the repressed, but what returns is no longer the same: cybernetics transforms woman and nature, but they do not return from man's past, as his origins. Instead they come around to face him, wheeling round from his future, the virtual system to which he has always been heading.

The machines and the women mimic their humanity, but they never simply become it. They may aspire to be the same as man, but in every effort they become more complex than he has ever been. Cybernetic feminism does not, like many of its predecessors, including that proposed in Irigaray's recent work, seek out for woman a subjectivity, an identity or even a sexuality of her own: there is no subject position and no identity on the other side of the screens. And female sexuality is always in excess of anything that could be called 'her own'. Woman cannot exist 'like man'; neither can the machine. As soon her mimicry earns her equality, she is already something, and somewhere, other than him. A computer which passes the Turing test is always

more than a human intelligence; simulation always takes the mimic over the brink.

'There is nothing like unto women', writes Irigaray: 'They go beyond all simulation' (Irigaray, 1991: 39). Perhaps it was always the crack, the slit, which marked her out, but what she has missed is not the identity of the masculine. Her missing piece, what was never allowed to appear, was her own connection to the virtual, the repressed dynamic of matter. Nor is there anything like unto computers: they are the simulators, the screens, the clothing of the matrix, already blatantly linked to the virtual machinery of which nature and culture are the subprograms. The computer was always a simulation of weaving; threads of ones and zeros riding the carpets and simulating silk screens in the perpetual motions of cyberspace. It joins women on and as the interface between man and matter, identity and difference, one and zero, the actual and the virtual. An interface which is taking off on its own: no longer the void, the gap, or the absence, the veils are already cybernetic.

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Ada refused to publish her commentaries on Menabrea's papers for what appear to have been spurious confusions around publishing contracts. She did for Menabrea and Babbage - what another woman had done for Darwin: in translating Menabrea's work from French, she provided footnotes more detailed and substantial - three times as long, in fact - than the text itself.

Footnotes have often been the marginal zones occupied by women writers, who could write, while nevertheless continuing to perform a service for man in the communication of his thoughts. Translation, transcription and elaboration: never within the body of the text, women have nevertheless woven their influence between the lines.

While Ada's writing was presented in this form and signed simply 'A.A.L.', hers was the name which survived in this unprecedented case. More than Babbage, still less Menabrea, it was Ada which persisted: in recognition of her work, the United States Defence Department named its primary program ming language ADA, and today her name shouts from the spines of a thousand manuals. Indeed, as is rarely the case, it really was her own name which survived in Ada's case, neither her initials, nor even the names of her husband or father. It is ADA herself who lives on, in her own name; her footnotes secreted in the software of the military machine.

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ZEROS + ONES DIGITAL WOMEN + THE NEW TECHNOCULTURE

SADIE PLANT

Published in 1997, 'Zeros + Ones: Digital Women + the New Technoculture' explores women's natural and slightly subversive relationship with machines and technology. Split into several short essays, the book investigates several topics from Ada Lovelace's work in computation to the natural bond between women, weaving and software. The essays reproduced here are 'Genderquake', 'Cyborg Manifestos', 'Shuttle Systems', 'Speed Queens', and 'Automata', each selected not only for being representative of the whole book, but also because they weave a net of connections with the other texts present in this reader.

g e n d e r q u a k e

"The idea that a 'nothing to be seen '... might yet have some reality, would indeed be intolerable to man." Luce Irigaray, Speculum of the Other Woman

In the 1990s, Western cultures were suddenly struck by an extraordinary sense of volatility in all matters sexual: differences, relations, identities, definitions, roles, attributes, means, and ends. All the old expectations, stereotypes, senses of identity and security faced challenges which have left many women with unprecedented economic opportunities, technical skills, cultural powers, and highly rated qualities, and many men in a world whose contexts range from alien to unfamiliar.

This was neither a revolutionary break, nor an evolution ary reform, but something running on far more subtle, wide ranging, and profound fault lines. Nothing takes the final credit - or the blame - for this shift which, as though in recog nition of the extent to which it defies existing notions of cultural change, has been defined as genderquake. But the new machines, media, and means of telecommunication that com pose what are variously called high, information, digital, or simply new technologies which have emerged within the last two decades have played an enormous and fascinating role in the emergence of this new culture. This is far from a question of technological, or any other, determinism. If anything, technologies are only ever intended to maintain or improve the status quo, and certainly not to revolutionize the cultures into which they are introduced. It is in spite of their tendencies to reduce, objectify, and regulate everything that moves that computers and the networks they compose run on lines quite alien to those which once kept women in the home.

In some respects, the impact of these new machines is direct and very obvious. In the West, the decline of heavy industry, the automation of manufacturing, the emergence of the service sector, and the rise of a vast range of new manufac turing and information-processing industries have combined to reduce the importance of the muscular strength and hormonal energies which were once given such high economic rewards. In their place come demands for speed, intelligence, and trans ferable, interpersonal, and communications skills . At the same time, all the structures, ladders, and securities with which ca reers and particular jobs once came equipped have been sub sumed by patterns of part-time and discontinuous work which privilege independence, flexibility, and adaptability. These ten dencies have affected skilled, unskilled, and professional workers alike. And, since the bulk of the old full-time, lifelong work force was until recently male, it is

men who have found themselves most disturbed and disrupted by these shifts, and, by the same token, women who they benefit.

These tendencies are far from new. Since the industrial revolution, and with every subsequent phase of technological change, it has been the case that the more sophisticated the machines, the more female the workforce becomes. Automa tion has been accompanied by what is often referred to as the feminization of the workforce ever since the first automatic machines were operated by the first female workers, and the fears of unemployment which have haunted modern discussions of technological innovation have always applied to male workers rather than their female peers.

What is unprecedented is for male workers to be outnum bered by their female counterparts, as will clearly be the case in the United Kingdom and the United States by the end of this century. And with this tipping of the scales comes not only unprecedented degrees of economic power, but also a radical change in the status of female workers, an erosion of the male monopoly on tasks and jobs once reserved for men, and a new standing for the work involved in what were once considered to be pin-money jobs for women supplementing male incomes.

Many of these tendencies are also at work in the emer gence of what the West was once in a position to call "the other side of the world." By the time the cultures of the old white world have noticed they were even on the map, many of the so called "tiger" nations - Singapore, Malaysia, Thailand, Korea, Taiwan, and Indonesia - were already leaping ahead in an economic game which for at least two hundred years had been governed by the West. And they are only the tips of an iceberg of change which brings many regions into play: China, India, East and Southern Africa,

Eastern Europe, South America. Given that the populations of China and India alone vastly outnumber those of the old white world, there seems little doubt that the days of Western empire have well and truly died.

These regions have genderquakes of their own. And while a variety of political and religious fundamentalisms are doing their best to maintain the status quo, there are few regions of the world in which women are not asserting themselves with un precedented ingenuity and, very often, great success. If Western women have dreamt of change for three hundred years, Asian women are playing roles which would have been unthinkable only a decade or so ago. By the mid-1990s, 34 percent of China's self-employed were women, and 38 percent of Sin gaporean women managers were running companies of their own. Thailand's leading hotel chain, Indonesia's largest taxi company, and Taiwan's two largest newspaper groups were owned by women. Japanese women still found themselves treated as "office flowers," composed only 0.3 percent of board members of Japanese firms, and made up just 6.7 percent of the Japanese parliament. But the sexual shift was also evident in Japan: 2.5 million women owned businesses, five out of every six new Japanese firms were set up by women, and "a revolution without marches or manifestos" was underway.

There is enormous resistance to these changes whenever and wherever they occur. As their effects began to be felt in the early 1990s there were men who jerked their knees and went on TV to lament the fact that women and robots had apparently conspired to take their masculinity away. One 1990s survey found one in two fathers still believing that "a husband should be the breadwinner and the wife should look after the home and children"; the fear, if not the fact, of violent crime still keeps many women in at night; domestic violence was preva lent; and in Britain, the benefits system was still conspiring with the high costs and

scarcity of child-care provision to keep many women from working, learning, or - perish the thought - enjoying themselves. As unprecedented numbers of women juggled children, education, and work, many female workers found themselves saddled with the low paying, part-time, insecure jobs rejected by men. In the United States, almost half of em ployed women worked in technical, sales, and administrative support jobs, and pay differentials were still very large: in 1992 American women still earned only 75 cents for every dollar earned by men, and while their participation in U.S. managerial and professional life rose from 40 percent in 1983 to 47 percent in 1992, it was still the case that women occupied relatively few executive posts and prominent public positions: only 10 percent of the voting members of the United States Congress were women, and the United Kingdom had only sixty women members of parliament. Many sectors of education, politics, and business seemed riddled with enough archaic detail and glass ceilings to make even the most determined women feel unwel come. In universities, they were averaging higher marks than men, but relatively few gained first-class degrees; they were more numerous and successful as undergraduates and in master's programs, but less prominent when it came to Ph.D. candidacy. Even highly successful career women were more likely to drop out of their jobs than their male counterparts.

But many women had already set their sights beyond these traditional focal points. While the members of an older male workforce had found a sense of identity in their work, women were not only less able, but also less willing to define themselves through employment or a single career. Many of them were actively seeking opportunities to make and break their own working lives, not necessarily in favor of family commitments, but also in an effort to free themselves from the imposition of external constraints on their time and economic capacity. There may have been men who still

thought they were protecting their own positions of power by locking women out of the higher echelons of the universities, corporations, and public institutions, but it was no longer obvious that top positions were the most important or desirable of roles to be played. High grades and doctorates were no longer enough to guarantee success outside an academic world itself poised on the brink of redundancy, and corporate executives were increasingly small pawns in global economic games. As for the attractions of public service, who was going to disagree with the young women who said that "politics is all talk and no action"? They simply felt they had better things to do.

Some of these things were far more lucrative as well: in the twenty years after 1970, the number of women-owned small businesses went from 5 percent to 32 percent in the United States, and in Britain nearly 25 percent of the self-employed were women by 1994, twice as many as in 1980. Taking the skills, contacts, and experience gained in their periods of paid employment, these women have tended to be far more success ful than their self-employed male counterparts: in the United States, where most new businesses failed, those which were owned by women enjoyed an 80 percent success rate and employed more people than the companies on the Fortune 500 list.

Having had little option but to continually explore new avenues, take risks, change jobs, learn new skills, work independently, and drop in and out of the labor market more frequently than their male colleagues, women seem far "better prepared culturally and psychologically" for the new economic conditions which have emerged at the end of the twentieth century. They are advanced players of an economic game for which self employment, part-time, discontinuous work, multiskilling, flexibility, and maximal adaptability were suddenly crucial to survival. Women had been ahead of the race for all their work ing lives, poised to

meet these changes long before they arrived, as though they always had been working in a future which their male counterparts had only just begun to glimpse. Perhaps they really were the second sex, if seconds come after firsts.

" Let the man get some sleep, Armitage, ' Molly said from her futon, the components of the fletcher spread on the silk like some expensive puzzle. 'He's coming apart at the seams.'" William Gibson, Neuromancer

But there was much more to come. Abandoned by the eco nomic power and social privilege which once made them such attractive, even necessary, mates, the sperm counts fell, birth rates crashed, and the hormonal energy and muscular strength which once served them so well were now becoming liabilities. Women were becoming mothers on their own terms, or not at all. Heterosexual relations were losing their viability, queer con nections were flourishing, the carnival had begun for a vast range of paraphilias and so-called perversions, and if there was more than one sex to have, there were also more than two to be. Anything claiming to be normal had become peculiar.

"He was thoroughly lost now; spatial disorientation held a peculiar horror for cowboys." William Gibson, Neuromancer

It was falling apart. They were coming undone. Everything was moving much too fast. What had once seemed destined to become a smoothly regulated world was suddenly running away with itself. Control was slipping through the fingers of those who had thought it was in their hands. Something was wrong. They were losing it all : their senses of security and identity, their grip, the plot, and even their jobs. Couldn't see the point to anything. What else could the masters of the old white world do but redouble their efforts, intensify their drives for security, heighten and perfect their powers? But the more they struggled to adapt

and survive, the faster the climate seemed to change. The more they tried to regain control, the more their narrative lost its thread; the closer they came to living the dream, the weaker their grasp on power became. Was it even possible that, regardless of their labors, their hopes and dreams, they had been "the sex organs of the machine world, as the bee of the plant world, enabling it to fecundate and to evolve ever new forms"? All that time, the effort and the pain, the trouble they had taken to maintain control.

"And instead they watch the machines multiply that push them little by little beyond the limits of their nature. And they are sent back to their mountain tops, while the machines progressively populate the earth. Soon engendering man as their epiphenomenon."
Luce Irigaray, Marine Lover

cyborgmanifestos

For years, decades, centuries, it seemed as though women were lagging behind the front runners of the human race, struggling to win the rights attained by men, suffering for want of the status which full membership of the species would supposedly have given them. And as long as human was the only thing to be, women have had little option but to pursue the possibility of gaining full membership of the species "with a view to win back their own organism, their own history, their own subjectivity." But this is a strategy which "does not function without drying up a spring or stopping a flow." And there are processes of parallel emergence, noncausal connections and simultaneous developments which suggest that sexual relations continually shift in sympathy with changes to the ways many other aspects of the world work. If Simone de Beauvoir's Second Sex found itself compelled to call for "men and women" to "univocally affirm their brotherhood" in 1949, this was also the point at which the first sex began

to find itself subsumed by self-organiz ing tendencies beyond its ken or its control. By 1969, when Monique Wittig published Les Guerilleres, these tendencies were emerging as networks which didn't even try to live up to the existing definitions of what it was to be a proper one of any thing at all. And by the 1970s, when Luce Irigaray wrote This Sex Which Is Not One, fluid complexities were giving a world which had once revolved around ones and others a dynamic which obsolesced the possibility of being one of anything at all.

As personal computers, samplers, and cyberpunk narratives proliferated in the mid-1980s, Donna Haraway's cyborgs were writing manifestos of their own. "By the late twentieth century," they declared, "our time, a mythic time, we are all chimeras, theorized and fabricated hybrids of machine and or in short, we are all cyborgs." And while the shiny screens of the late twentieth century continued to present themselves as clean-living products of the straight white lines of a peculiarly man-made world, Haraway's text excited a wave of subversive female enthusiasm for the new networks and ma chines. In the early 1990s, a cyberfeminist manifesto appeared on an Australian billboard and declared, "The clitoris is a direct line to the matrix," a line which refers to both the womb - matrix is the Latin term, just as hystera is the Greek - and the abstract networks of communication which were increasingly assembling themselves.

"You may not encounter ALL NEW GEN as she has many guises. But, do not fear, she is always in the matrix, an omni - present intelligence, anarcho cyber terrorist acting as a virus of the new world disorder."
VNS Matrix

They say she wears "different veils according to the historic period." They say her "original attributes and

epithets were so numerous... in the hieroglyphics she is called 'the many named, ' 'the thousand-named'... 'the myriad-named. '" They say, "the future is unmanned." They say, "let those who call for a new language first learn violence. They say, let those who want to change the world first seize all the rifles. They say that they are starting from zero. They say that a new world is beginning." They say, "if machines, even the machines of the ory, can arouse themselves, why not women?"

s h u t t l e s y s t e m s

There is always a point at which, as Freud admits, "our mate rial - for some incomprehensible reason - becomes far more obscure and full of gaps." And, as it happens, Freud's weaving women had made rather more than a small and debatable contribution to his great narrative of inventions and discoveries. Far more than a big and certain one as well. It is their micro processes which underlie it all: the spindle and the wheel used in spinning yarn are the basis of all later axles, wheels, and rotations; the interlaced threads of the loom compose the most abstract processes of fabrication. Textiles themselves are very literally the softwares linings of all technology.

String, which has been dated to 20,000 B.C., is thought to be the earliest manufactured thread and crucial to "taking the world to human will and ingenuity," not least because it is such multipurpose material. It can be used for carrying, holding, tying, and trapping, and has even been described as "the unseen weapon that allowed the race to conquer the earth ." Textiles underlie the great canvases of Western art, and even the materials of writing. Paper now tends to be made from wood, but it too was woven in its early form, produced from the dense interlacing of natural fibers. The Chinese, with whom the pro duction of paper is thought to have begun some 2,000 years ago, used

bamboo, rags, and old fishing nets as their basic materials; papyrus, from which the word paper is itself derived, was used in ancient Egypt, and later Arab cultures used the same flax from which linen is produced. Wood pulp gradually took over from the rags which Europe used until the nineteenth century, and most paper is now produced from fibers which are pulped and bleached, washed and dried, and then filtered onto a mesh and compressed into a fine felt.

Evidence of sophisticated textile production dates to 6,000 B.C. in the southeast regions of Europe, and in Hungary there is evidence that warp-weighted looms were producing designs of extraordinary extravagance from at least 5,000 B.C. Archaeo logical investigations suggest that from at least the fourth millennium B.C. Egyptian women were weaving linen on horizontal looms, sometimes with some two hundred threads per inch, and capable of producing cloths as wide as nine feet and seventy-five feet long. Circular warps, facilitating the production of seamless tubes for clothing, and tapestry looms, able to weave the dense complications of images visible in weft threads so closely woven as to completely conceal the warps, were also in use in ancient Egypt where, long before individual artisans stamped their work with their own signatures, trademarks and logos were woven in to indicate the workshop in which cloths had been produced. Cloths were used as early currency, and fine linens were as valuable as precious metals and stones. In China, where the spinning wheel is thought to have first turned, sophisticated draw looms had woven designs which used thousands of different warps at least two and a half thousand years before such machines were developed in the West.

It may be a bare necessity of life, but textiles work always goes far beyond the clothing and shelter of the family. In terms of quality, sophistication, and sheer

quantity, the production of textiles always seems to put some kind of surplus in play. The production of "homespun" yarn and cloth was one of the first cottage industries, pin money was women's earliest source of independent cash, and women were selling surplus yarn and cloth and working as small-scale entrepreneurs long before the emergence of factories, organized patterns of trade, and any of the mechanisms which now define the textiles industry. Even when cloths and clothes can be bought off the rack, women continue to absorb themselves in fibrous fabrications.

There is an obsessive, addictive quality to the spinning of yarn and the weaving of cloth; a temptation to get fixated and locked in to processes which run away with themselves and those drawn into them. Even in cultures assumed to be subsis tence economies, women who did only as much cooking, cleaning, and childcare as was necessary tended to go into over drive when it came to spinning and weaving cloth, producing far more than was required to clothe and furnish the family home. With time and raw materials on their hands, even "Neo lithic women were investing large amounts of extra time into their textile work, far beyond pure utility," suggesting that not everything was hand to mouth. These prehistoric weavers seem to have produced cloths of extraordinary complexity, woven with ornate designs far in excess of the brute demand for simple cloth. And wherever this tendency to elaboration emerged, it fed into a continual exploration of new techniques of dyeing, color combination, combing, spinning, and all the complica tions of weaving itself.

Even in Europe there had been several early and sophisticated innovations. Drawlooms had been developed in the Middle Ages, and while many of Leonardo da Vinci's "machines for spinning, weaving, twisting hemp, trimming felt, and making needles" were never made, he certainly introduced the flyer and bobbin which brought tension

control to the spinning wheel. Unlike "the spinster using the older wheel," she now "slackened her hold on the yarn to allow it to be wound on to the bobbin as it was being twisted."

It is often said that Leonardo's sixteenth-century work anticipated the industrial revolution "in the sense that his 'ma chines' (including tools, musical instruments, and weapons) all aspired toward systemic automation." But it was his intuition that textiles machines were "more useful, profitable, and perfect than the printing press" which really placed him ahead of his time. If printing had spread across the modern world, textiles led the frantic industrialization of the late eighteenth and early nineteenth centuries. "Like the most humble cultural assets, textiles incessantly moved about, took root in new regions..." The first manufactory was a silk mill on an island in the Derwent near Derby built early in a century which also saw the introduction of the spinning jenny, the water frame, the spinning mule, the flying shuttle, the witches' loom, and the power loom. A spiral of "inventions in both spinning and weav ing (interacting and mutually stimulating) had attracted capital, concentrated labour, increased output and swollen imports and exports." This was cloth capitalism, a runaway process which quite literally changed the world. In the 1850s, it was said that "if Providence had never planted the cotton shrub those majes tic masses of men which stretch, like a living zone, through our central districts, would have felt no existence; and the magic impulse which has been felt... in every department of national energy, our literature, our laws, our social condition, our political institutions, making us almost a new people, would never have been communicated." Textiles had not merely changed the world: they seemed to have mutated its occupants as well. "Almost a new people..." "I was surprised at the place but more so at the people," wrote one commentator of Bir mingham, the site of the

first cotton-spinning mill . "They were a species I had never seen."

While the industrial revolution is supposed to have made the break between handheld tools and supervised machines, the handmade and the mass-produced, the introduction of technol ogy to more primitive textiles techniques is both a break with the old ways and a continuation of the lines on which the women were already at work. Even before its mechanization, the loom was described as the "most complex human engine of them all," not least because of the extent to which it "reduced everything to simple actions: the alternate movement of the feet worked the pedals, raising half the threads of the warp and then the other, while the hands threw the shuttle carrying the thread of the woof." When John Heathcote, who patented a lace making machine just after Jacquard built his loom, flrst saw "a woman working on a pillow, with so many bobbins that it seemed altogether a maze," his impression was that lace was a "heap of chaotic material." In an attempt to unravel the mys tery, he "drew a thread, which happened to draw for an inch or two longitudinally straight, then started off diagonally. The next drew out straight. Then others drew out in various directions. Out of four threads concurring to make a mesh, two passed one way, the third another and the fourth another still. But at length I found they were in fact used in an orderly manner..." It was then a matter of producing "a fabric which was an exact imitation of the thread movements of handmade lace." This is both the ordering of chaos, and also how its networks replicate themselves.

There were other spin-offs from textiles too. The weaving of complex designs demands far more than one pair of hands, and textiles production tends to be communal, sociable work allowing plenty of occasion for gossip and chat. Weaving was already multimedia: singing,

chanting, telling stories, dancing, and playing games as they work, spinsters, weavers, and needle workers were literally networkers as well. It seems that "the women of prehistoric Europe gathered at one another's houses to spin, sew, weave, and have fellowship." Spinning yarns, fabricating fictions, fashioning fashions...: the textures of woven cloth functioned as means of communication and infor mation storage long before anything was written down. "How do we know this? From the cloth itself." This is not only be cause, like writing and other visual arts, weaving is often "used to mark or announce information" and "a mnemonic device to record events and other data." Textiles do communicate in terms of the images which appear on the right side of the cloth, but this is only the most superficial sense in which they process and store data. Because there is no difference between the pro cess of weaving and the woven design, cloths persist as records of the processes which fed into their production: how many women worked on them, the techniques they used, the skill they employed. The visible pattern is integral to the process which produced it; the program and the pattern are continuous.

Information can be stored in cloth by means of the meaningful messages and images which are later produced by the pen and the paintbrush, but data can also be woven in far more pragmatic and immediate ways . A piece of work so absorbing as a cloth is saturated with the thoughts of the people who pro duced it, each of whom can flash straight back to whatever they were thinking as they worked. Like Proust's madeleines, it carries memories of an intensity which completely escapes the written word. Cloths were also woven "to 'invoke magic' - to protect, to secure fertility and riches, to divine the future, per haps even to curse," and in this sense the weaving of spells is far more than a metaphorical device. "The weaver chose warp threads of red wool for her work, spun one direction, spun the other way.

She divided the bunch spun one way into 3 sets of 8, and the other bunch into 4 sets of 6, and alternated them. All this is perhaps perfectly innocent, but..." If the weaving of such magical spells gives priority to the process over the completion of a task, this tendency is implicit in the production of all textiles. Stripes and checks are among the most basic of colored and textured designs which can be woven in. Both are implicit in the grids of the woven cloth itself slightly more complex, but equally integral to the basic web, are the lozenges, or diamonds, still common in weaves across the world. These open diamonds are said to indicate fertility and tend to decorate the aprons, skirts, and belts which are themselves supposed to be the earliest forms of clothing. "These lozenges, usually with little curly hooks around the edge, rather graphically, if schematically, represent a woman's vulva." These images are quite unlike those which are later painted on the canvas or written on the page. The lozenge is emergent from the cloth, diagonal lines implicit in the grids of the weave. And even the most ornate and complex of woven designs retains this connection to the warps and wefts. When images are later painted, or written in the form of words on a page, patterns are imposed on the passive backdrop provided by the canvas or the page. But textile images are never imposed on the surface of the cloth: their patterns are always emergent from an active matrix, implicit in a web which makes them immanent to the processes from which they emerge.

As the frantic activities of generations of spinsters and weaving women makes abundantly clear, nothing stops when a particular piece of work has been finished off. Even when magical connections are not explicitly invoked, the finished cloth, unlike the finished painting or the text, is almost incidental in relation to the processes of its production. The only incentive to cast off seems to be the chance completion provides to start again, throw another shuttle, cast another spell.

As writing and other visual arts became the privileged bearers of memory and messages, weaving withdrew into its own screens. Both canvases and paper reduce the complexities of weaving to raw materials on which images and signs are imposed: the cloths from which woven patterns once emerged now become backcloths, passive matrices on which images are imposed and interpreted as if from on high. Images are no longer carried in the weave, but imprinted on its surface by the pens and brushes with which shuttles become superficial carri ers of threads. Guided by the hand-eye coordinations of what are now their male creators, patterns become as individuated and unique as their artists and authors. And whereas the weave was once both the process and the product, the woven stuff, images are now separated out from matrices to which they had been immanent. The artist sees only the surface of a web which is covered as he works; the paper on which authors now look down has no say in the writing it supports.

The processes themselves become dematerialized as myths, legends, and metaphors. Ariadne's thread, and the famous con test in which the divine Athena tore mortal Arachne's weaving into shreds, are among the many mythical associations between women and webs, spinsters and spiders, spinning yarns and storylines. For the Greeks, the Fates, the Moirai, were three spinsters - Klotho, Lachesis, and Atropos - who produced, allotted, and broke the delicate contingency of the thread of life. In the folktales of Europe, spindles become magic wands, Fates become fairies, and women are abandoned or rescued from impossible spinning and weaving tasks by supernatural entities, godmothers and crones who transform piles of flax into fine linen by means more magical than weaving itself, as in "Rum pelstiltskin," "The Three Spinsters," and "The Sleeping Beauty." "European folktales are full of references to the mak ing of magical garments, especially girdles, in

which the magic seems to be inherent in the weaving, not merely in special decoration."

As for the fabrics which persist: evaluated in these visual terms, their checks and diagonals, diamonds and stripes become insignificant matters of repeating detail. This is why Freud had gazed at work which was so literally imperceptible to him. Struggling only to interpret the surface effects of Anna's work as though he was looking at a painting or a text, the process of weaving eluded him: out of sight, out of mind, out of his world.

This was a process of disarmament which automation should have made complete. But if textiles appear to lose touch with their weaving spells and spans of time, they also continue to fabricate the very screens with which they are concealed. And because these are processes, they keep processing. "Behind the screen of representation," weaving wends its way through even the media which supplant it. While paper has lost its associations with the woven fabrics with which it began, there are remnants of weaving in all writing: yarns continue to be spun, texts are still abbreviated textiles, and even grammar glamor - and spelling retain an occult connectivity. Silkscreens, printing presses, stencils, photographic processes, and typewrit ers: by the end of the nineteenth century images, texts, and patterns of all kinds were being processed by machines which still used matrices as means to their ends, but also repeated the repeating patterns downgraded by the one-off work of art. And while all these modes of printing were taking technologies of representation to new heights, they were also moving on to the matrices of times in which these imprinting procedures would reconnect with the tactile depth of woven cloth.

s p e e d q u e e n s

"The professor fixed his gaze on Lord Ewald's face as he replied calmly: 'It Is not a living being!'
"At these words the younger man also stared in turn at the scientist, as if demanding whether he had heard rightly.
"'Yes, ' the professor continued, replying to the unspoken question in the young man's eyes. 'I affirm that this form which walks, speaks, and obeys, is not a person or a being in the ordinary sense of the word.'
"Then, as Lord Ewald still looked at him in silence, he went on:
"'At present it is not an entity; It is no one at all! Hadaly, externally, is nothing but an electromagnetic thing a being of limbo - a possibility.'"
Villiers de l'Isle Adam, L'eve future

The decade which brought Hadaly alive also revolutionized the speeds, techniques, and quantities of counting, timetabling, reg istering, recording, and filing. Unprecedented scales of infor mation processing were demanded by attempts to regulate the new cities and populations, industries and workers, social, sex ual, and political trends which swept across the US in the 1880s. Just as textiles had revolutionized Europe, electricity, oil, and the automobile gave America and, by extension, the West ern world a new dynamic, and a wave of new movements: unrest in the factories, the colonies, the streets and, as women won their property rights and homosexuality was legally de fined, in matters of sexual relations and identities as well.

A statistician working on the information gathered from the 1880 U.S. census developed the first of the new machines to process the vast quantities of data in which the late nineteenth century found itself awash. Herman Hollerith found his work so overwhelming that it threatened to extend beyond the next census, due to be conducted in

1890. The machine he devel oped used an electromechanical punched-card system to deal with the collation of results. Spawning a host of punched-card machines, this calculator coincided with the telephones and typewriters of a bureaucratic state which was hand in glove with the corporate structures which would remain in place for an other hundred years. Remington-Rand grew out of the com mercial success of the typewriter; AT&T and Bell were the earliest telephone companies; and IBM emerged from the success of early punched-card calculating systems.

Office machinery was intended to produce faster, more accurate, ordered, and efficient versions of existing modes and structure of work. The typewriter was a new and improved handwriting clerk; the calculator was described as a new and improved bookkeeper "which adds, subtracts, multiplies, and divides by electricity. It so completely does the work of a hu man being that it is almost uncanny in its efficiency and speed." More instruments, more tools, more of the same for more of the same male employees. But when typewriters, duplicators, switching systems, calculators, computers, and a vast range of punched-hole machinery arrived in the office, these male workers found themselves replaced by new networks of women and machines. Their fingers were finer and cheaper than the old hired hands. "The 'craftsman' clerk of the early 1900s thus became 'as rare as a rolltop desk,' and 'help-wanted' columns summoned girl high school graduates with 'no experience necessary.' They could be trained in a few weeks to do a single job such as routine billing, cardpunching, calculating, or filing." They also worked at speeds and levels of efficiency which left their male predecessors standing: "She adds the yards of the comptometer and then extends the bills on the arithometer, and does the work of six men with great ease." By 1930 the number of office women in the U.S. "was approaching 2,000,000... and for the first time women outnumbered men." By 1956 there were six million

such white collar workers and, across the employment board, four times as many women employed as there had been at the turn of the century.

Several typewriters had competed for attention in the 1800s, including the Hammond, the Randall, the Columbia, the Herrington. But the machine which caught on was also one of the first, a typewriter which had been developed in 1867 by Christopher Latham Scholes. Scholes had assembled his type writer piecemeal, using old components such as the telegraph key. Later perfected by Remington engineers, its impact was enormous and as fast as the speeds of writing it made possible. "I don't know about the world... but feel that I have done something for the women who have always had to work so hard," said Scholes when he got the machine to work. "This will help them earn a living more easily. "

If handwriting had been manual and male, typewriting was fingerprinting: fast, tactile, digital, and female. "An English lady who demonstrated this machine in Paris achieved a writing speed of more than ninety letters per minute, i.e. more than twice the speed attained in writing by hand." Text was no longer in the grasp of the hand and eye, but guided by contacts and keystrokes, a matter of touch sensitivity. An activity which had once been concentrated on a tight nexus of coordinated organs - hand and eye - and a single instrument - the pen - was now processed through a distributed digital machinery com posed of fingers, keys, hammers, platterns, carriages, levers, cogs, and wheels. The noisy tactility of typewriting destroyed the hushed and hallowed status of the written word. If writing had turned language into a silent, visual code, the new machines made a music of their own: In secretarial schools, women were taught to type in rhythmic patterns which had nothing to do with either the meaning or the sounds of words but was more akin to the abstract beat of drumming and dance.

Typing was judged in terms of the speeds and accuracy rates which only repetitive rhythm guarantee. Words per minute, beats per minute, the clatter of the typist's strokes, the striking of the keys, thump of carriage return marked by the ringing of a bell at the end of every line.

"She says: 'It's hard to tell, because they don't tell it with words, exactly..."
"Turner felt the skin on his neck prickle. Something coming back to him..."
William Gibson, Mona Lisa Overdrive

The telephone was first received either as a new and improved message boy or dismissed as an "electronic toy." As the chief of U.K. post office declared: "I have one in my office; but more for show. If I want to send a message - I use a sounder or employ a boy to take it." But speed is always irresistible. Within a couple of years, what once seemed a smart irrelevance had become an indispensable machine hooked into the "complexi ties of an elaborate worldwide communications system" which was suddenly beyond even the most fleet-footed of messenger boys. Once it was realized that this immense network could "be manipulated by the girl" instead, telephony "provided opportu nity for a large number of girls at a low rate of pay, comparing in this respect with the factory system." The "earliest telephone companies, including AT&T, were among the foremost em - ployers of American women. They employed the daughters of the American middle class in great armies: in 1891, eight thousand women; by 1946, almost a quarter of a million." Thou sands of women were also employed on private branch as changes and as telephonists, receptionists, and switchboard operators. This was already the emergence of a lattice of con nections later known as the Net.

The future was at her fingertips. "Basically, you, Miss Luthor, are the 'switching system.' "

In terms of conventional modes of social organization and political collectivity, this new meshwork of digital microproces sors, women, and machines, was dislocated and fragmented, scattered too wide for any form of union. It had no history on which to draw, no precedents to follow, no consciousness to raise. It was composed of cyborgs, softbot machines trained to perform a specific set of tasks, positioned in well-established hierarchies. Computers worked in parallel, and typists were ac tually collected into pools: fluid resources to be used by the firm. Each woman was reduced to a number; she was one of a kind, and the kind was everywhere. She "leads a very clear-cut, calculated life proceeding by delimited segments: the telegrams she takes one after the other, day after day, the people to whom she sends the telegrams; their social class and the different ways they use telegraphy; the words to be counted."

Sometimes she was kept in a cage or a booth; under the strict supervision of a supervising eye. Like Foucault's prisoners, she was "the object of information, never a subject in communication." This was a new working mass engaged in an emergent layer of continuous tasks, uniform processes, interchange able skills : ordering, classifying, typing, filing, sorting, processing, counting, recording, duplicating, calculating, re trieving, copying, transposing. The tasks endlessly repeated by women composed the infrastructure of the bureaucratic world. Although some functions were relatively skilled, many were tedious in the extreme: semiautomatic, impersonal tasks wield ing litle overt institutional power. "The girl at the head of the line interprets the order, puts down the number and indicates the trade discount; the second girl prices the order, takes off the discount, adds carriage charges and totals; the third girl gives the order a number and makes a daily record; the fourth girl puts this information on an alphabetical index; the fifth girl time stamps it; it next goes along the belt to one of several typists, who makes a copy in septuplicate and

puts on address labels, the seventh girl..." Remotely controlled by a faceless machine, she could also found herself on strangely intimate terms with those who organized her work. As the secretary, she dealt with the most private and confidential details of her company's affairs or her boss's personal and working life. She spoke for him, she signed her name "pp" on his behalf, and functioned as a second skin to those whose secrets she carried and concealed. She was his voice, his smile, his interface; connecting and protecting him from the world, the screen on which he presented himself, a superficial front, a processing filter, and a shield, a protective coat.

Like all ideal women and machines, secretaries and short hand typists were only supposed to be processing information which had been produced and organized elsewhere. But female literacy rates soared up when the typewriter was introduced, and if women's typing was supposed to be intended for the eyes of men, the development of new techniques by Pitman and Gregg (which prefigured the use of acronyms, tags, and emotes on the Net;-)), made shorthand a private female code, "another language, another alphabet..."

a u t o m a t a

She works automatically. Only has half a mind on the task. Transported by rhythm and monotony, she wanders off, drifts away, loses herself in the sequences she types, the numbers she records, the codes behind the keys; the figures she transcribes. Microprocessing. She hears, but she isn't listening. She sees, but she does not watch. Pattern recognition without consciousness.

Tactile vibrations on taut membranes. "A rich couple comes into the post office and reveals to the young woman, or at least confirms, the existence of another world; coded,

multiple tele grams, signed with pseudonyms. It is hard to tell who is who anymore, or what anything means. Instead of a rigid line com posed of well-determined segments, telegraphy now forms a supple flow marked by quanta that are like so many little seg mentations-in-progress grasped at the moment of their birth, as · on a moonbeam, or on an intensive scale." Wired to an un dernet of imperceptible connections and lines, she decrypts and encodes, switching and swapping in the exchange. Letters to digits, words to keys, voice to fingers, faces to anonymous char acters. The telephone becomes an "extension of ear and voice that is a kind of extra sensory perception." There are samples in her ear, voices in her head, snippets of overheard conversation, moments of unknown, disconnected lives, "invisible voices conducted through the tips of her fingers."

Poised as an interface between man and the world, she is also wired to a network of digital machines: typists connected to QWERTY alphabets, bodies shaped by the motion of the keys, one hundred words a minute, viral speed. Thousands of opera tors, relays, calls, exchanges humming in virtual conjunction, learning the same phrases, flipping the same switches, repeating the same responses, pushing plugs into the answering jacks, maybe two hundred, three hundred times an hour. She has "a fingertip mastery of the ringing, listening, dial, and other keys on her key shelf; of the row or rows of cords for making con - nections; of the location and meaning of all parts of the honey combed formation of jacks and trunks for recording, for switch ing, for toll circuits, for tandem, for information..." It becomes second nature. It grows on her. "Having done this stuff a few hundred thousand times, you become quite good at it. In fact you're plugging, and connecting, and disconnecting ten, twenty, forty cords at a time." After a while these processes become "quite satisfying in a way, rather like weaving on an upright loom."

WHERE IS THE FEMINISM IN CYBERFEMINISM

FAITH WILDING

In the essay 'Where is the Feminism in Cyberfeminism?', Faith Wilding reflects on the First Cyberfeminist International, and takes a critical look at the development of the movement. She emphasises the importance of building a movement by keeping practices alive, and learning from previous struggles. By taking a closer look at online feminist groups, Wilding urges the creative energy of cybergrrls to be put into political action. Furthermore, the refusal to define cyberfeminism is seen as detrimental to the movement, because contextualization is more likely to connect and mobilize people.

The First Cyberfeminist International took place in Kassel, Germany, September 20-28, 1997, as part of the Hybrid Workspace at Documenta X. After eight days of intense daily life and work with over 30 participants at this event, Faith Wilding reflects on the significance of these discussions and their implications both for the attempts to define, and the arguments against defining, cyberfeminism. While these and subsequent on-line discussions, especially through the FACES list, provide a browser through which possible practices of a cyberfeminist movement become visible, what concerns her is how such politics might be translated into practice for an engaged (cyber)feminist politics on the Net.

Against Definition

The question of how to define cyberfeminism is at the heart of the often contradictory contemporary positions of

women working with new technologies and feminist politics. Sadie Plant's position on cyberfeminism, for example, has been identified as an absolutely post-human insurrection the revolt of an emergent system which includes women and computers, against the world view and material reality of a patriarchy which still seeks to subdue them. This is an alliance of the goods against their masters, an alliance of women and machines.[1] This utopian vision of revolt and merger between woman and machine is also evident in VNS Matrix's Cyberfeminist Manifesto for the 21st Century: we are the virus of the new world disorder/ rupturing the symbolic from within/saboteurs of big daddy mainframe/ the clitoris is a direct line to the matrix.[2] Another position in this debate is offered by Rosi Braidotti: cyberfeminism needs to cultivate a culture of joy and affirmation... Nowadays, women have to undertake the dance through cyberspace, if only to make sure that the joy-sticks of cyberspace cowboys will not reproduce univocal phallicity under the mask of multiplicity.[3]

The press release issued at the cyberfeminist discussions in Kassel declared that: The First CYBERFEMINIST INTERNATIONAL slips through the traps of definition with different attitudes towards art, culture, theory, politics, communication and technology - the terrain of the Internet. What strangely emerged from these discussions was the attempt to define cyberfeminism by refusal, evident not only in the intensity of the arguments, but also in the 100 antitheses devised there - for example:

cyberfeminism is not a fashion statement/ sajbrfeminizm nije usamljen/ cyberfeminism is not ideology, but browser/ cyberfeminismus ist keine theorie/ cyber feminismo no es una frontera.[4]

Yet the reasons given by those who refused to define cyberfeminism - even though they called themselves

cyberfeminists - indicate a profound ambivalence in many wired women's relationship to what they perceive to be a monumental past feminist history, theory, and practice. Three main manifestations of this ambivalence and their relevance to contemporary conditions facing women immersed in technology bear closer examination.

Repudiation of "old style"(1970s) feminism

According to this argument, "old style"(1970s) feminism is characterized as monumental, often constricting (politically correct), guilt inducing,essentialist, anti-technology, antisex, and not relevant to women's circumstances in the new technologies (judging from the Kassel discussions,this conception is common in the US and Western Europe). Ironically, in actual practice cyberfeminism has already adopted many of the strategies of avantgarde feminist movements, including strategic separatism (women only lists, self-help groups, chat groups, networks, and woman to woman technological training), feminist cultural, social, and language theory and analysis, creation of new images of women on the Net to counter rampant sexist stereotyping (feminist avatars, cyborgs, genderfusion), feminist net critique, strategic essentialism, and the like. The repudiation of historical feminism is problematic because it throws out the baby with the bathwater and aligns itself uneasily with popular fears, stereotypes, and misconceptions about feminism.

Why is it that so many younger women (and men) in the US (and Europe) know so little about even very recent histories of women, not to speak of past feminist movements and philosophies? It is tempting to point the finger at educational systems and institutions that still treat the histories of women, and of racial ethnic, and marginalized populations, as ancillary to "regular" history, relegating them to specialized courses or departments.

But the problems lie deeper than this. The political work of building a movement is expertise that must be relearned by every generation, and needs the help of experienced practitioners. The struggle to keep practices and histories of resistance alive today is harder in the face of a commodity culture which thrives on novelty, speed, obsolescence, evanescence, virtuality, simulation, and utopian promises of technology. Commodity culture is forever young and makes even the recent past appear remote and mythic. While young women are just entering the technological economy, many older feminists are unsure how to connect to the issues of women working with new technology, and how to go about adapting feminist strategies to the conditions of the new information culture. The problem for cyberfeminism, then, is how to incorporate the lessons of history into an activist feminist politics which is adequate for addressing women's issues in technological culture.

To be sure, the problem of losing historical knowledge and active connection to radical movements of the past is not limited to feminism - it is endemic to leftist movements in general. By arguing for the importance of knowing history I am not paying nostalgic homage to moments of past glory. If cyberfeminists wish to avoid making the mistakes of past feminists, they must understand the history of feminist struggle. And if they are to expand their influence on the Net and negotiate issues of difference across generational, economic, educational, racial, national, and experiential boundaries, they must seek out coalitions and alliances with diverse groups of women involved in the integrated circuit of global technologies. At the same time, close familiarity with postcolonial studies, and with the histories of imperialist and colonialist domination - and resistance to them - are equally important for an informed practice of cyberfeminist politics.

Cybergrrl-ism

Judging by a quick net browse, one of the most popular feminist rebellions currently practiced by women on the Net is cybergrrl-ism in all of its permutations: webgrrls, riot grrls, guerrilla girls, bad grrls, etc.

As Rosi Braidotti [5] and others have pointed out, the often ironic, parodic, humorous, passionate, angry, or aggressive work of many of these recent grrrl groups is an important manifestation of new subjective and cultural feminine representations in cyberspace. Currently there is quite a wide variety of articulations of feminist and protofeminist practices in these various groups which range from anyone female can join chatty mailing lists, to sci - fi, cyberpunk, and femporn zines; antidiscrimination projects; sexual exhibitionism; transgender experimentation; lesbian separatism; medical self-help; artistic self-promotion; job and dating services; and just plain mouthing off. Cybergrrl-ism generally seems to subscribe to a certain amount of net utopianism - an "anything you wanna be and do in cyberspace is cool" attitude. Despite the gripings against men in general, which pervade some of the discussions and sites, most cybergrrls don't seem interested in engaging in a political critique of women's position on the Net - instead they adopt the somewhat anti-theory attitude which seems to prevail currently; they'd rather forge ahead to express their ideas directly in their art and interactive practices.

While cybergrrls sometimes draw (whether consciously or unconsciously) on feminist analyses of mass media representations of women - and on the strategies and work of many feminist artists - they also often unthinkingly appropriate and recirculate sexist and stereotyped images of women from popular media - the buxom gun moll, the supersexed cyborg femme, and the 50's tupperware cartoon women are favorites - without any analysis or critical

recontextualization. Creating more positive and complex images of women that break the gendered codes prevailing on the Net (and in the popular media) takes many smart heads, and there is richly suggestive feminist research available, ranging from Haraway's monstrous cyborgs, Judith Butler's fluid gender performativity, to Octavia Butler's recombinant genders. All manner of hybrid beings can unsettle the old masculine/feminine binaries. Cybergrrlish lines of flight are important as vectors of investigation, research, invention, and affirmation. But these can't replace the hard work that is needed to identify and change the gendered structures, content, and effects of the new technologies on women worldwide. If it is true, as Sadie Plant argues that 'women have not merely had a minor part to play in the emergence of the digital machines... [that] women have been the simulators, assemblers, and programmers of the digital machines[6] then why are there so few women in visible positions of leadership in the electronic world? Why are women a tiny percentage of computer programmers, software designers, systems analysts, and hackers, while they are the majority of teletypers, chip-assemblers and installers, and lowskilled teleoperators that keep the global data and infobanks operating? Why is the popular perception still that women are technophobic? Sadly, the lesson of Ada Lovelace is that even though women have made major contributions to the invention of computers and computer programming, this hasn't changed the perception - or reality - of women's condition in the new technologies. Being bad grrls on the Internet is not by itself going to challenge the status quo, though it may provide refreshing moments of iconoclastic delirium. But if grrrl energy and invention were to be coupled with engaged political theory and practice... Imagine!

Imagine cyberfeminists theorists teaming up with brash and cunning grrl net artists to visualize new female representations of bodies, languages, and subjectivities in

cyberspace! Currently (in the US) there is little collaboration between academic feminist theorists, feminist artists, and popular women's culture on the Net. What would happen if these groups worked together to visualize and interpret new theory, and circulate it in accessible popular forms? Imagine using existing electronic networks to link diverse groups of women computer users (including teleworkers and keystrokers) in an exchange of information about their dayto-day working conditions and lives on the Net; imagine using this information network as an action base to address issues of women digital workers in the global restructuring of work. Such projects could weave together both the utopian and political aspirations of cyberfeminism.

Net utopianism

As noted in a previous essay on the political condition of cyberfeminism, there is much to be said for considering cyberfeminism a promising new wave of feminist practice that can contest technologically complex territories and chart new ground for women.[7] There is a tendency though among many cyberfeminists to indulge techno-utopian expectations that the new e-media will offer women a fresh start to create new languages, programs, platforms, images, fluid identities and multi-subject definitions in cyberspace; that in fact women can recode, redesign, and reprogram information technology to help change the feminine condition. This net utopianism declares cyberspace to be a free space where gender does not matter - you can be anything you want to be regardless of your "real" age, sex, race, or economic position-and refuses a fixed subject position. In other words, cyberspace is regarded as an arena inherently free of the same old gender relations and struggles. However, it is of utmost importance to recognize that the new media exist within a social framework that is already established in its practices and embedded in

economic, political, and cultural environments that are still deeply sexist and racist. Contrary to the dreams of many net utopians, the Net does not automatically obliterate hierarchies through free exchanges of information across boundaries. Also, the Net is not a utopia of nongender; it is already socially inscribed with regard to bodies, sex, age, economics, social class, and race. Despite the indisputable groundbreaking contributions by women to the invention and development of computing technology, today's Internet is a contested zone that historically originated as a system to serve war technologies, and is currently part of masculinist institutions. Any new possibilities imagined within the Net must first acknowledge and fully take into account the implications of its founding formations and present political conditions. To be sure, it is a radical act to insert the word feminism into cyberspace, and to attempt to interrupt the flow of masculine codes by boldly declaring the intention to mongrelize, hybridize, provoke, and disrupt the male order of things in the Net environment. Historically, feminism has always implied dangerous disruptions, covert and overt actions, and war on patriarchal beliefs, traditions, social structures - and it has offered utopian visions of a world without gender roles. A politically smart and affirmative cyberfeminism, using wisdom learned from past struggles, can model a brash disruptive politics aimed at deconstructing the patriarchal conditions that currently produce the codes, languages, images, and structures of the Net.

Definition as a political strategy

Linking the terms cyber and feminism creates a crucial new formation in the history of feminism(s) and of the media. Each part of the term necessarily modifies the meaning of the other. "Feminism" (or more properly, "feminisms") has been understood as a historical - and

contemporarytransnational movement for justice and freedom for women, which depends on women's activist participation in networked local, national, and international groups.[8] It focuses on the material, political, emotional, sexual, and psychic conditions arising from women's differentialized social construction and gender roles. Link this with "cyber", which means to steer, govern, control, and we conjure up the staggering possibility of feminism at the electronic helm. Cyberfeminism could imagine ways of linking the historical and philosophical practices of feminism to contemporary feminist projects and networks both on and off the Net, and to the material lives and experiences of women in the integrated circuit, taking full account of age, race, class, and economic differences.

If feminism is to be adequate to its cyberpotential then it must mutate to keep up with the shifting complexities of social realities and life conditions as they are changed by the profound impact communications technologies and technoscience have on all our lives.

While refusing definition seems like an attractive, nonhierarchical, anti-identity tactic, it in fact plays into the hands of those who would prefer a net quietism: "Give a few lucky women computers to play with and they'll shut up and stop complaining." This attitude is one toward which cyberfeminists should be extremely wary and critical. Access to the Internet is still a privilege, and by no means to be regarded as a universal right (nor is it necessarily useful or desirable for everyone). While brilliant consumer marketing has suceeded in making ownership of a PC seem as imperative as having a telephone, computers are in fact powerful tools that can provide the possessor with a political advantage (the personal computer is the political computer).

If the Internet is increasingly the channel through which many people (in the overdeveloped nations) get the bulk of their information, then it matters greatly how women participate in the programming, policy setting, and content formations of the Net, for information coming across the Net needs to be contextualized both by the receiver and by the sender. On the Internet, feminism has a new transnational audience which needs to be educated in its history and its contemporary conditions as they prevail in different countries. For many,cyberfeminism could be their entry point into feminist discourse and activism. While there is a great deal of information about feminism available on the Net - and new sites are opening up all the time-it must be remembered that the more this information can be contextualized politically, and linked to practices, activism, and conditions of every day life, the more it is likely to be effective in helping to connect and mobilize people.[9] A potent example is in the Zamir Network (Zamir "for peace") of BBS and e-mail that was created after the eruption of civil war in Yugoslavia in 1991 to link peace activists in Croatia, Serbia, Slovenia, and Bosnia across borders via host computers in Germany. The point is that computers are more than playful tools, consumer toys, or personal pleasure machines-they are the master's tools, and they have very different meanings and uses for different populations. It will take crafty pilots to navigate these channels.

While cyberfeminists want to avoid the damaging mistakes of exclusion, lesbophobia, political correctness, and racism, which sometimes were part of past feminist thinking, the knowledge, experience, and feminist analysis and strategies accumulated thus far are crucial for carrying their work forward now. If the goal is to create a feminist politics on the Net and to empower women, then cyberfeminists must reinterpret and transpose feminist analysis, critique, strategies, and experience to encounter

and contest new conditions, new technologies, and new formations. (Self)definition can be an emergent property that arises out of practice and changes with the movements of desire and action. Definition can be fluid and affirmative-a declaration of strategies, actions, and goals. It can create crucial solidarity in the house of difference- solidarity, rather than unity or consensus-solidarity that is a basis for effective political action.

Cyberfeminists have too much at stake to be frightened away from tough political strategizing and action by the fear of squabbles, deologizing and political differences. If I'd rather be a cyberfeminist than a goddess, I'd damned well better know why, and be willing to say so.

A Cyberfeminist cell

How might cyberfeminists organize to work for a feminist political and cultural environment on the Net? What are various areas of feminist research and net activity that are already beginning to emerge as cyberfeminist practice? The First Cyberfeminist International (CI) in Kassel serves as an example of feminist Net organiz(m)ation.

Responsibility for organizing the CI workdays was taken on by Old Boys Network(OBN)-an ad hoc group of about six women-in on-line consultation with all participants. Because of the on-line communications between the OBN leadership and participants, collaborative working relationships and the content of the meetings were already established by the time the participants met together face to face in Kassel. A shifting and diverse group of more than thirty women (self-selected by open invitation to members of the FACES listserv, [with a core of about ten]) participated in the CI.

From the first day this collaborative process-a recombinant form of feminist group processes, anarchic

self-organization, and rotating leadership-continued to develop among women from more than eight countries and from different economic, ethnic, professional, and political backgrounds. Each day began with participants meeting in the Hybrid Workspace to work on various taskforces (text, press, technical, final party, etc.) and to organize the public program for the day. This was followed by three hours of public lectures and presentations for Documenta audiences. Afterward the closed group met again for dinner and to discuss issues such as the definition of cyberfeminism, group goals, and future actions and plans. Work was divided according to inclination and expertise;there was no duty list and no expectation that everyone would work the same amount of hours. Flexible schedules permitted conviviality, impulsive actions, brainstorming, and private time. Constant connection of participants to the FACES listserv was maintained electronically.

Practically all group activities were video and audiotaped and photographed. Participants' personal computer equipment was set up in the open work/meeting space and most of the lectures were accompanied by projected images from the lecturers' web-sites. One participant taught the group how to set up CU_SeeMe_ connections and continued to participate virtually after she had to leave, and two young Russians trying to join the CI in Kassel, faxed a diary of their illegal journey as they jumped from country to country to evade visa problems. Thus there was an interesting interplay between virtuality and flesh presence. The face to face interactions were experienced as much more intense and energizing than the virtual communications, and forged different degrees of affinity between various individuals and subgroups, while at the same time they made all kinds of differences more palpable. Brainstorming and spontaneous actions seemed to spring more readily from face-to-face meetings. The opportunity for immediate question and answer sessions and extended

discussion after the lectures also enabled more intimate and searching interchanges than are usually possible through on-line communications. Most important, all presentations, hands-on training, and discussions took place in a context of intense debate about feminism, which produced a constant awareness of the lived relationship of women and technology.

The wide variety of content presented in the lectures, web projects, and workshops touched on many of the hottest topics of concern to cyberfeminism: Theories of the visibility of sexual difference on the Net; digital self-representations of online women as avatars and databodies; analyses of gender representations, sex-sites, cybersex, and femporn; strategies of genderfusion and hybridity to combat stereotyping, essentialism, and sexist representations of women; "feminism as a browser"; the dangers of the fetishistic desire for information and the paranoia created by the new technologies; dissemination of knowledge about women in history; studies of differences between women and men programmers and hackers; an examination of feminist electronic art strategies; feminist models of technological education; health issues of wired women and discussion of how to organize and support feminist networking projects in different countries.[10]

The chief gains from the CI discussions were trust, friendship, a deeper understanding and tolerance of differences; the ability to sustain discussions about controversial and divisive issues without group rupture; and mutual education about issues of women immersed in technology, as well as a clearer understanding of the terrain for cyberfeminist intervention.

While the CI did not result in a formal list of goals, actions, and concrete plans, we reached general agreement on areas in need of further work and research. An ongoing

concern is how to make cyberfeminism more visible and effective in reaching diverse populations of women using technology. Options discussed included creating a cyberfeminist search engine that could link strategic feminist websites; country-by-country reports of net activity and cyberorganization for women; forming coalitions with female technologists, programmers, scientists and hackers, to link feminist Net theory, content and practice with technological research and invention; education projects (for both men and women) in technology, programming, and software and hardware design, that would address traditional gender constructions and biases built into technology; and more research on how the ongoing global restructuring of women's work results from the pervasive changes introduced by information technology.

(Cyber) Feminism is a browser through which to see life.[11]

If cyberfeminists have the desire to research, theorize, work practically, and make visible how women (and others) worldwide are affected by new communications technologies, technoscience, and the capitalist dominations of the global communications networks, they must begin by clearly formulating cyberfeminisms' political goals and positions. Cyberfeminists have the chance to create new formulations of feminist theory and practice that address the complex new social, cultural, and economic conditions created by global technologies. Strategic and politically savvy uses of these technologies can facilitate the work of a transnational movement that aims to infiltrate and assault the networks of power and communication through activistfeminist projects of solidarity, education, freedom, vision, and resistance. To be effective in creating a politicized feminist environment on the Net that challenges its present gender, race, age, and class structures, cyberfeminists need to draw on the researches and strategies of avant garde

feminist history and its critique of institutionalized patriarchy. While affirming new possibilities for women in cyberspace, cyberfeminists must critique utopic and mythic constructions of the Net, and strive to work with other resistant netgroups in activist coalitions. Cyberfeminists need to declare solidarity with transnational feminist and postcolonial initiatives, and work to use their access to communications technologies and electronic networks to support such initiatives.

Faith Wilding, a founding participant of the feminist art movement, is a multi-media artist, writer, and feministactivist currently living in Pittsburgh, USA.

I. Caroline Bassett, 'With a Little Help from Our (New) Friends?' mute, August 1997, 46-49.

2. VNS Matrix webpage: [sysx.apana.org.au/artists/vns]

3. Rosi Braidotti, 'Cyberfeminism with a difference.' [www.let.ruu.nl/womens_studies/rosi/cyberfem.htm] Artists Pages (overleaf)

4. The complete 100 Antitheses can be found at Old Boys Network [http://www.obn/org]

5. Braidotti. Ibid.

6. Sadie Plant, Zeros + Ones: Digital Women + the New Technocultures. New York: Doubleday, 1997. p. 37

7. Faith Wilding and Critical Art Ensemble,'Notes on the Political Condition of Cyberfeminism.' [http://mailer.fsu.edu/~sbarnes] Helen Sear 2XST (left) silver print, 1998 2XVY (right) silver print, 1998

8. Using the term "feminism" is very different from using the term 'women' - although perhaps one should consider using the term "cyberwomanism," which acknowledges the critique of racist white feminism so justly made by Audrey Lorde, Alice Walker, bell hooks, and others.

9. See, for example, the listings of I,000 feminist or women-related sites in Shana Penn The Women's Guide to The Wired World. New York: Feminist Press, I997.

10. For more information on the First Cyberfeminist International and papers see [http://www.obn.org]

11. Alla Mitrofanova, presentation at the First Cyberfeminist International in Kassel, September 1997.

100 ANTI-THESES

Old Boys Network

This series of 100 anti-definitions of cyberfeminism was developed in the form of a manifesto at the end of The First Cyberfeminist International. The first big meeting of people defining themselves as cyberfeminists took place in 1997 at Documenta X, in Kassel, Germany, and was organized by the Old Boys Network. In an attempt to describe the concept of cyberfeminism, the participants could not agree on a single definition. To keep the concept as broad and consensual as possible, they reached a consensus, substituting a single definition for 100 anti-definitions.

cyberfeminism is not...

1. cyberfeminism is not a fragrance
2. cyberfeminism is not a fashion statement
3. sajbrfeminizm nije usamljen
4. cyberfeminism is not ideology
5. cyberfeminism nije aseksualan
6. cyberfeminism is not boring
7. cyberfeminism ist kein gruenes haekeldeckchen
8. cyberfeminism ist kein leerer kuehlschrank
9. cyberfeminism ist keine theorie
10. cyberfeminism ist keine praxis
11. cyberfeminism ist keine traditio
12. cyberfeminism is not an institution
13. cyberfeminism is not using words without any knowledge of numbers
14. cyberfeminism is not complete
15. cyberfeminism is not error 101
16. cyberfeminism ist kein fehler
17. cyberfeminism ist keine kunst
18. cyberfeminism is not an ism
19. cyberfeminism is not anti-male

20. sajbrfeminizm nige nesto sto znam da je
21. cyberfeminism is not a structure
22. cyberfeminismo no es uns frontera
23. cyberfeminism nije poslusan
24. cyberfeminism nije apolitican
25. cyberfeminisme is niet concreet
26. cyberfeminism is not separatism
27. cyberfeminism is not a tradition
28. cyberfeminism is not maternalistic
29. cyberfeminisme id niet iets buitenlands
30. cyberfeminism is not without connectivity
31. cyberfeminismus ist nicht mehr wegzudenken
32. cyberfeminismus ist kein oxymoron
33. cyberfeminism is not on sale
34. cyberfeminism is nor for sale
35. cyberfeminismus ist nicht gut
36. cyberfeminismus ist nicht schlecht
37. cyberfeminismus ist nicht modern
38. cyberfeminismus ist nicht post-modern
39. cyberfeminism is not natural
40. cyberfeminism is not essentialist
41. cyberfeminism is not abject
42. cyberfeminism is not an avatar
43. cyberfeminism is not an alter ego
44. cyberfeminismus ist nicht truegerisch
45. cyberfeminismus ist nicht billig
46. cyberfeminismus ist nicht willig
47. cyberfeminisme n'est pas jaloux
48. cyberfeminism is not exclusive
49. cyberfeminism is not solid
50. cyberfeminism is not genetic
51. cyberfeminismus ist keine entschuldigung
52. cyberfeminism is not prosthetic
53. cyberfeminismo no tiene cojones
54. cyberfeminisme n'est pas triste
55. cyberfeminisme n'est pas une pipe

56. cyberfeminism is not a motherboard
57. cyberfeminism is not a fake
58. cyberfeminism nije ogranicen
59. cyberfeminism nije nekonfliktan
60. cyberfeminism nije make up
61. cyberfeminism nije zatvoren prozor
62. cyberfeminism is not a lack
63. cyberfeminism is not a wound
64. cyberfeminism is not a trauma
65. cyberfeminismo no es una banana
66. cyberfeminism is not a sure shot
67. cyberfeminism is not an easy mark
68. cyberfeminism is not a single woman
69. cyberfeminism is not romantic
70. cyberfeminism is not post-modern
71. cyberfeminism is not a media-hoax
72. cyberfeminism is not neutral
73. cyberfeminism is not lacanian
74. cyberfeminism is not nettime
75. cyberfeminism is not a picnic
76. cyberfeminism is not a coldfish
77. cyberfeminism is not a cyberepilation
78. cyberfeminism is not a horror movie
79. cyberfeminism is not science fiction
80. cyberfeminism is not artificial intelligence
81. cyberfeminism is not an empty space
82. cyberfeminism is not immobile
83. cyberfeminism is not about boring toys for boring boys
84. cyberfeminismus ist keine verlegenheitsloesung
85. cyberfeminism is not a one-way street
86. cyberfeminism is not supporting quantum mechanics
87. cyberfeminism is not caffeine-free
88. cyberfeminism is not a non-smoking area
89. cyberfeminism is not daltonistic
90. cyberfeminism is not nice
91. cyberfeminismo no es callado

92. cyberfeminism is not lady like
93. cyberfeminismus ist nicht arrogant
94. cyberfeminismus ist keine nudelsauce
95. cyberfeminism is not mythical
96. cyberfeminism is not from outer space
97. cyberfeminismo no es rock 'n roll
98. cyberfeminism is not dogmatic
99. cyberfeminism is not stable
100. cyberfeminism has not only one language

XENOFEMINISM: A POLITICS FOR ALIENATION

LABORIA CUBONIKS

Laboria Cuboniks is a xenofeminist collective born in 2014. She seeks to "dismantle gender, destroy 'the family', and do away with nature as a guarantor for inegalitarian political positions". The manifesto promotes embracing alienation, seeing it as freedom rather than restriction, and as grounds for collective organization. It urges the need for the unification of the political left, as well the need to use and repurpose existing technology to reshape our world. If biology and nature decide what is natural and what is not, what restricts one gender from another, she promotes changing the framework on which the classification is made altogether. 'If nature is unjust, change nature!'

ZERO

0x00

Ours is a world in vertigo. It is a world that swarms with technological mediation, interlacing our daily lives with abstraction, virtuality, and complexity. XF constructs a feminism adapted to these realities: a feminism of unprecedented cunning, scale, and vision; a future in which the realization of gender justice and feminist emancipation contribute to a universalist politics assembled from the needs of every human, cutting across race, ability, economic standing, and geographical position. No more futureless repetition on the treadmill of capital, no more submission to the drudgery of labour, productive and reproductive alike, no more reification of the given masked as critique. Our future requires depetrification. XF is not a bid for revolution,

but a wager on the long game of history, demanding imagination, dexterity and persistence.

0x01

XF seizes alienation as an impetus to generate new worlds. We are all alienated-but have we ever been otherwise? It is through, and not despite, our alienated condition that we can free ourselves from the muck of immediacy. Freedom is not a given - and it's certainly not given by anything 'natural'. The construction of freedom involves not less but more alienation; alienation is the labour of freedom's construction. Nothing should be accepted as fixed, permanent, or 'given' - neither material conditions nor social forms. XF mutates, navigates and probes every horizon. Anyone who's been deemed 'unnatural' in the face of reigning biological norms, anyone who's experienced injustices wrought in the name of natural order, will realize that the glorification of 'nature' has nothing to offer us - the queer and trans among us, the differently-abled, as well as those who have suffered discrimination due to pregnancy or duties connected to child-rearing. XF is vehemently anti-naturalist. Essentialist naturalism reeks of theology - the sooner it is exorcised, the better.

0x02

Why is there so little explicit, organized effort to repurpose technologies for progressive gender political ends? XF seeks to strategically deploy existing technologies to re-engineer the world. Serious risks are built into these tools; they are prone to imbalance, abuse, and exploitation of the weak. Rather than pretending to risk nothing, XF advocates the necessary assembly of techno-political interfaces responsive to these risks. Technology isn't

inherently progressive. Its uses are fused with culture in a positive feedback loop that makes linear sequencing, prediction, and absolute caution impossible. Technoscientific innovation must be linked to a collective theoretical and political thinking in which women, queers, and the gender non-conforming play an unparalleled role.

0x03

The real emancipatory potential of technology remains unrealized. Fed by the market, its rapid growth is offset by bloat, and elegant innovation is surrendered to the buyer, whose stagnant world it decorates. Beyond the noisy clutter of commodified cruft, the ultimate task lies in engineering technologies to combat unequal access to reproductive and pharmacological tools, environmental cataclysm, economic instability, as well as dangerous forms of unpaid/underpaid labour. Gender inequality still characterizes the fields in which our technologies are conceived, built, and legislated for, while female workers in electronics (to name just one industry) perform some of the worst paid, monotonous and debilitating labour. Such injustice demands structural, machinic and ideological correction.

0x04

Xenofeminism is a rationalism. To claim that reason or rationality is 'by nature' a patriarchal enterprise is to concede defeat. It is true that the canonical 'history of thought' is dominated by men, and it is male hands we see throttling existing institutions of science and technology. But this is precisely why feminism must be a rationalism - because of this miserable imbalance, and not despite it. There is no 'feminine' rationality, nor is there a 'masculine' one. Science is not an expression but a suspension of gender. If today it is dominated by masculine egos, then it is

at odds with itself - and this contradiction can be leveraged. Reason, like information, wants to be free, and patriarchy cannot give it freedom. Rationalism must itself be a feminism. XF marks the point where these claims intersect in a two-way dependency. It names reason as an engine of feminist emancipation, and declares the right of everyone to speak as no one in particular.

INTERRUPT

0x05

The excess of modesty in feminist agendas of recent decades is not proportionate to the monstrous complexity of our reality, a reality crosshatched with fibre-optic cables, radio and microwaves, oil and gas pipelines, aerial and shipping routes, and the unrelenting, simultaneous execution of millions of communication protocols with every passing millisecond. Systematic thinking and structural analysis have largely fallen by the wayside in favour of admirable, but insufficient struggles, bound to fixed localities and fragmented insurrections. Whilst capitalism is understood as a complex and ever-expanding totality, many would-be emancipatory anti-capitalist projects remain profoundly fearful of transitioning to the universal, resisting big-picture speculative politics by condemning them as necessarily oppressive vectors. Such a false guarantee treats universals as absolute, generating a debilitating disjuncture between the thing we seek to depose and the strategies we advance to depose it.

0x06

Global complexity opens us to urgent cognitive and ethical demands. These are Promethean responsibilities that cannot pass unaddressed. Much of twenty-first century

feminism - from the remnants of postmodern identity politics to large swathes of contemporary ecofeminism - struggles to adequately address these challenges in a manner capable of producing substantial and enduring change. Xenofeminism endeavours to face up to these obligations as collective agents capable of transitioning between multiple levels of political, material and conceptual organization.

0x07

We are adamantly synthetic, unsatisfied by analysis alone. XF urges constructive oscillation between description and prescription to mobilize the recursive potential of contemporary technologies upon gender, sexuality and disparities of power. Given that there are a range of gendered challenges specifically relating to life in a digital age - from sexual harassment via social media, to doxxing, privacy, and the protection of online images - the situation requires a feminism at ease with computation. Today, it is imperative that we develop an ideological infrastructure that both supports and facilitates feminist interventions within connective, networked elements of the contemporary world. Xenofeminism is about more than digital self-defence and freedom from patriarchal networks. We want to cultivate the exercise of positive freedom - freedom-to rather than simply freedom - from - and urge feminists to equip themselves with the skills to redeploy existing technologies and invent novel cognitive and material tools in the service of common ends.

0x08

The radical opportunities afforded by developing (and alienating) forms of technological mediation should no longer be put to use in the exclusive interests of capital,

which, by design, only benefits the few. There 3 0x05are incessantly proliferating tools to be annexed, and although no one can claim their comprehensive accessibility, digital tools have never been more widely available or more sensitive to appropriation than they are today. This is not an elision of the fact that a large amount of the world's poor is adversely affected by the expanding technological industry (from factory workers labouring under abominable conditions to the Ghanaian villages that have become a repository for the e-waste of the global powers) but an explicit acknowledgement of these conditions as a target for elimination. Just as the invention of the stock market was also the invention of the crash, Xenofeminism knows that technological innovation must equally anticipate its systemic condition responsively.

TRAP

0x09

XF rejects illusion and melancholy as political inhibitors. Illusion, as the blind presumption that the weak can prevail over the strong with no strategic coordination, leads to unfulfilled promises and unmarshalled drives. This is a politics that, in wanting so much, ends up building so little. Without the labour of large-scale, collective social organisation, declaring one's desire for global change is nothing more than wishful thinking. On the other hand, melancholy - so endemic to the left - teaches us that emancipation is an extinct species to be wept over and that blips of negation are the best we can hope for. At its worst, such an attitude generates nothing but political lassitude, and at its best, installs an atmosphere of pervasive despair which too often degenerates into factionalism and petty moralizing. The malady of melancholia only compounds political inertia, and - under the guise of being realistic -

relinquishes all hope of calibrating the world otherwise. It is against such maladies that XF innoculates.

0x0A

We take politics that exclusively valorize the local in the guise of subverting currents of global abstraction, to be insufficient. To secede from or disavow capitalist machinery will not make it disappear. Likewise, suggestions to pull the lever on the emergency brake of embedded velocities, the call to slow down and scale back, is a possibility available only to the few - a violent particularity of exclusivity - ultimately entailing catastrophe for the many. Refusing to think beyond the microcommunity, to foster connections between fractured insurgencies, to consider how emancipatory tactics can be scaled up for universal implementation, is to remain satisfied with temporary and defensive gestures. XF is an affirmative creature on the offensive, fiercely insisting on the possibility of large-scale social change for all of our alien kin.

0x0B

A sense of the world's volatility and artificiality seems to have faded from contemporary queer and feminist politics, in favour of a plural but static constellation of gender identities, in whose bleak light equations of the good and the natural are stubbornly restored. While having (perhaps) admirably expanded thresholds of 'tolerance', too often we are told to seek solace in unfreedom, staking claims on being 'born' this way, as if offering an excuse with nature's blessing. All the while, the heteronormative centre chugs on. XF challenges this centrifugal referent, knowing full well that sex and gender are exemplary of the fulcrum between norm and fact, between freedom and compulsion. To tilt the fulcrum in the direction of nature is a defensive concession

at best, and a retreat from what makes trans and queer politics more than just a lobby: that it is an arduous assertion of freedom against an order that seemed immutable. Like every myth of the given, a stable foundation is fabulated for a real world of chaos, violence, and doubt. The 'given' is sequestered into the private realm as a certainty, whilst retreating on fronts of public consequences. When the possibility of transition became real and known, the tomb under Nature's shrine cracked, and new histories - bristling with futures - escaped the old order of 'sex'. The disciplinary grid of gender is in no small part an attempt to mend that shattered foundation, and tame the lives that escaped it. The time has now come to tear down this shrine entirely, and not bow down before it in a piteous apology for what little autonomy has been won.

0x0C

If 'cyberspace' once offered the promise of escaping the strictures of essentialist identity categories, the climate of contemporary social media has swung forcefully in the other direction, and has become a theatre where these prostrations to identity are performed. With these curatorial practices come puritanical rituals of moral maintenance, and these stages are too often overrun with the disavowed pleasures of accusation, shaming, and denunciation. Valuable platforms for connection, organization, and skill-sharing become clogged with obstacles to productive debate positioned as if they are debate. These puritanical politics of shame - which fetishize oppression as if it were a blessing, and cloud the waters in moralistic frenzies - leave us cold. We want neither clean hands nor beautiful souls, neither virtue nor terror. We want superior forms of corruption.

0x0D

What this shows is that the task of engineering platforms for social emancipation and organization cannot ignore the cultural and semiotic mutations these platforms afford. What requires reengineering are the memetic parasites arousing and coordinating behaviours in ways occluded by their hosts' self-image; failing this, memes like 'anonymity', 'ethics', 'social justice' and 'privilege-checking' host social dynamisms at odds with the often-commendable intentions with which they're taken up. The task of collective self-mastery requires a hyperstitional manipulation of desire's puppet-strings, and deployment of semiotic operators over a terrain of highly networked cultural systems. The will will always be corrupted by the memes in which it traffics, but nothing prevents us from instrumentalizing this fact, and calibrating it in view of the ends it desires.

PARITY

0x0E

Xenofeminism is gender-abolitionist. 'Gender abolitionism' is not code for the eradication of what are currently considered 'gendered' traits from the human population. Under patriarchy, such a project could only spell disaster - the notion of what is 'gendered' sticks disproportionately to the feminine. But even if this balance were redressed, we have no interest in seeing the sexuate diversity of the world reduced. Let a hundred sexes bloom! 'Gender abolitionism' is shorthand for the ambition to construct a society where traits currently assembled under the rubric of gender, no longer furnish a grid for the asymmetric operation of power. 'Race abolitionism' expands into a similar formula - that the struggle must continue

until currently racialized characteristics are no more a basis of discrimination than than the color of one's eyes. Ultimately, every emancipatory abolitionism must incline towards the horizon of class abolitionism, since it is in capitalism where we encounter oppression in its transparent, denaturalized form: you're not exploited or oppressed because you are a wage labourer or poor; you are a labourer or poor because you are exploited.

0x0F

Xenofeminism understands that the viability of emancipatory abolitionist projects - the abolition of class, gender, and race - hinges on a profound reworking of the universal. The universal must be grasped as generic, which is to say, intersectional. Intersectionality is not the morcellation of collectives into a static fuzz of cross-referenced identities, but a political orientation that slices through every particular, refusing the crass pigeonholing of bodies. This is not a universal that can be imposed from above, but built from the bottom up - or, better, laterally, opening new lines of transit across an uneven landscape. This non-absolute, generic universality must guard against the facile tendency of conflation with bloated, unmarked particulars - namely Eurocentric universalism - whereby the male is mistaken for the sexless, the white for raceless, the cis for the real, and so on. Absent such a universal, the abolition of class will remain a bourgeois fantasy, the abolition of race will remain a tacit white-supremacism, and the abolition of gender will remain a thinly veiled misogyny, even - especially - when prosecuted by avowed feminists themselves. (The absurd and reckless spectacle of so many self-proclaimed 'gender abolitionists" campaign against trans women is proof enough of this).

0x10

From the postmoderns, we have learnt to burn the facades of the false universal and dispel such confusions; from the moderns, we have learnt to sift new universals from the ashes of the false. Xenofeminism seeks to construct a coalitional politics, a politics without the infection of purity. Wielding the universal requires thoughtful qualification and precise self reflection so as to become a ready-to-hand tool for multiple political bodies and something that can be appropriated against the numerous oppressions that transect with gender and sexuality. The universal is no blueprint, and rather than dictate its uses in advance, we propose XF as a platform. The very process of construction is therefore understood to be a negentropic, iterative, and continual refashioning. Xenofeminism seeks to be a mutable architecture that, like open source software, remains available for perpetual modification and enhancement following the navigational impulse of militant ethical reasoning. Open, however, does not mean undirected. The most durable systems in the world owe their stability to the way they train order to emerge as an 'invisible hand' from apparent spontaneity; or exploit the inertia of investment and sedimentation. We should not hesitate to learn from our adversaries or the successes and failures of history. With this in mind, XF seeks ways to seed an order that is equitable and just, injecting it into the geometry of freedoms these platforms afford.

ADJUST

0x11

Our lot is cast with technoscience, where nothing is so sacred that it cannot be reengineered and transformed so as to widen our aperture of freedom, extending to gender

and the human. To say that nothing is sacred, that nothing is transcendent or protected from the will to know, to tinker and to hack, is to say that nothing is supernatural. 'Nature' - understood here, as the unbounded arena of science - is all there is. And so, in tearing down melancholy and illusion; the unambitious and the non-scaleable; the libidinized puritanism of certain online cultures, and Nature as an un-remakeable given, we find that our normative anti-naturalism has pushed us towards an unflinching ontological naturalism. There is nothing, we claim, that cannot be studied scientifically and manipulated technologically.

0x12

This does not mean that the distinction between the ontological and the normative, between fact and value, is simply cut and dried. The vectors of normative anti-naturalism and ontological naturalism span many ambivalent battlefields. The project of untangling what ought to be from what is, of dissociating freedom from fact, will from knowledge, is, indeed, an infinite task. There are many lacunae where desire confronts us with the brutality of fact, where beauty is indissociable from truth. Poetry, sex, technology and pain are incandescent with this tension we have traced. But give up on the task of revision, release the reins and slacken that tension, and these filaments instantly dim.

CARRY

0x13

The potential of early, text-based internet culture for countering repressive gender regimes, generating solidarity among marginalised groups, and creating new spaces for

experimentation that ignited cyberfeminism in the nineties has clearly waned in the twenty-first century. The dominance of the visual in today's online interfaces has reinstated familiar modes of identity policing, power relations and gender norms in self-representation. But this does not mean that cyberfeminist sensibilities belong to the past. Sorting the subversive possibilities from the oppressive ones latent in today's web requires a feminism sensitive to the insidious return of old power structures, yet savvy enough to know how to exploit the potential. Digital technologies are not separable from the material realities that underwrite them; they are connected so that each can be used to alter the other towards different ends. Rather than arguing for the primacy of the virtual over the material, or the material over the virtual, xenofeminism grasps points of power and powerlessness in both, to unfold this knowledge as effective interventions in our jointly composed reality.

0x14

Intervention in more obviously material hegemonies is just as crucial as intervention in digital and cultural ones. Changes to the built environment harbour some of the most significant possibilities in the reconfiguration of the horizons of women and queers. As the embodiment of ideological constellations, the production of space and the decisions we make for its organization are ultimately articulations about 'us' and reciprocally, how a 'we' can be articulated. With the potential to foreclose, restrict, or open up future social conditions, xenofeminists must become attuned to the language of architecture as a vocabulary for collective choreography - the coordinated writing of space.

0x15

From the street to the home, domestic space too must not escape our tentacles. So profoundly ingrained, domestic space has been deemed impossible to disembed, where the home as norm has been conflated with home as fact, as an un-remakeable given. Stultifying 'domestic realism' has no home on our horizon. Let us set sights on augmented homes of shared laboratories, of communal media and technical facilities. The home is ripe for spatial transformation as an integral component in any process of feminist futurity. But this cannot stop at the garden gates. We see too well that reinventions of family structure and domestic life are currently only possible at the cost of either withdrawing from the economic sphere - the way of the commune - or bearing its burdens manyfold - the way of the single parent. If we want to break the inertia that has kept the moribund figure of the nuclear family unit in place, which has stubbornly worked to isolate women from the public sphere, and men from the lives of their children, while penalizing those who stray from it, we must overhaul the material infrastructure and break the economic cycles that lock it in place. The task before us is twofold, and our vision necessarily stereoscopic: we must engineer an economy that liberates reproductive labour and family life, while building models of familiality free from the deadening grind of wage labour.

0x16

From the home to the body, the articulation of a proactive politics for biotechnical intervention and hormones presses. Hormones hack into gender systems possessing political scope extending beyond the aesthetic calibration of individual bodies. Thought structurally, the distribution of hormones - who or what this distribution

prioritizes or pathologizes - is of paramount import. The rise of the internet and the hydra of black market pharmacies it let loose - together with a publicly accessible archive of endocrinological knowhow - was instrumental in wresting control of the hormonal economy away from 'gatekeeping' institutions seeking to mitigate threats to established distributions of the sexual. To trade in the rule of bureaucrats for the market is, however, not a victory in itself. These tides need to rise higher. We ask whether the idiom of 'gender hacking' is extensible into a long-range strategy, a strategy for wetware akin to what hacker culture has already done for software - constructing an entire universe of free and open source platforms that is the closest thing to a practicable communism many of us have ever seen. Without the foolhardy endangerment of lives, can we stitch together the embryonic promises held before us by pharmaceutical 3D printing ('Reactionware'), grassroots telemedical abortion clinics, gender hacktivist and DIY-HRT forums, and so on, to assemble a platform for free and open source medicine?

0x17

From the global to the local, from the cloud to our bodies, xenofeminism avows the responsibility in constructing new institutions of technomaterialist hegemonic proportions. Like engineers who must conceive of a total structure as well as the molecular parts from which it is constructed, XF emphasises the importance of the mesopolitical sphere against the limited effectiveness of local gestures, creation of autonomous zones, and sheer horizontalism, just as it stands against transcendent, or top-down impositions of values and norms. The mesopolitical arena of xenofeminism's universalist ambitions comprehends itself as a mobile and intricate network of transits between these polarities. As pragmatists, we invite

contamination as a mutational driver between such frontiers.

OVERFLOW

0x18

XF asserts that adapting our behaviour for an era of Promethean complexity is a labour requiring patience, but a ferocious patience at odds with 'waiting'. Calibrating a political hegemony or insurgent memeplex not only implies the creation of material infrastructures to make the values it 9 articulates explicit, but places demands on us as subjects. How are we to become hosts of this new world? How do we build a better semiotic parasite - one that arouses the desires we want to desire, that orchestrates not an autophagic orgy of indignity or rage, but an emancipatory and egalitarian community buttressed by new forms of unselfish solidarity and collective self-mastery?

0x19

Is xenofeminism a programme? Not if this means anything so crude as a recipe, or a single-purpose tool by which a determinate problem is solved. We prefer to think like the schemer or lisper, who seeks to construct a new language in which the problem at hand is immersed, so that solutions for it, and for any number of related problems, might unfurl with ease. Xenofeminism is a platform, an incipient ambition to construct a new language for sexual politics - a language that seizes its own methods as materials to be reworked, and incrementally bootstraps itself into existence. We understand that the problems we face are systemic and interlocking, and that any chance of global success depends on infecting myriad skills and contexts with the logic of XF. Ours is a transformation of

seeping, directed subsumption rather than rapid overthrow; it is a transformation of deliberate construction, seeking to submerge the white-supremacist capitalist patriarchy in a sea of procedures that soften its shell and dismantle its defenses, so as to build a new world from the scraps.

0x1A

Xenofeminism indexes the desire to construct an alien future with a triumphant X on a mobile map. This X does not mark a destination. It is the insertion of a topological keyframe for the formation of a new logic. In affirming a future untethered to the repetition of the present, we militate for ampliative capacities, for spaces of freedom with a richer geometry than the aisle, the assembly line, and the feed. We need new affordances of perception and action unblinkered by naturalised identities. In the name of feminism, 'Nature' shall no longer be a refuge of injustice, or a basis for any political justification whatsoever!

If nature is unjust, change nature!

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Colophon

Reader #1: Techno/Cyber/Xeno-Feminism, The Intimate and Possibly Subversive Relationship Between Women and Machines

This reader is the first chapter of Reflections on Book Scanning, A Feminist Reader, part of the OuNuPo Special Issue 5. It was edited, designed and produced by Alice Strete (RO).

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