The Future Looms: Weaving Women and Cybernetics

SADIE PLANT

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

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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.

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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 nevertheless 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 &c? (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 are 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: 250)

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: 247). 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 sceptical 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 autonomous 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 centralized conceptions of command and control; governing functions collapse into systems; 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 machines: autonomous systems of control and synthetic intelligence. In human hands and as a historical tool, control has been exercised merely as domination, and manifest 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 communication. This is the strange world to which Ada's programming has led: the possibility 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 development 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 analogy 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 intersecting 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' (Jennings, 1985: 132). His daughter was merely to accelerate the processes which relocated and redefined control.

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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; cloth-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 mechanization 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 fulfil 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 *idée 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: 241)

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 fulfil 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 fabri-c(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: 232)

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 programming 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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