Women, Work and Computing

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The first significant wave of optimism concerning the computer's potential for changing gender relations was fuelled by the assumption that the machine itself was an object of indeterminate gender identity. By the late 1970s, women's progress and participation in the more traditional scientific and technical fields, such as physics and engineering, was recognised as being increasingly problematic, with many feminist commentators concluding that these areas had developed an unshakeably masculine bias. A consensus emerged which held that science and technology – the knowledge which constituted their epistemological fields, the people who inhabited the fields, the artefacts they produced and the cultures that they engendered – had become, in a whole variety of ways, more determined by, and more reflective of, the interests of men than those of women. Although clearly rooted in the domains of both science and technology, the advent of the computer challenged this perspective. It was considered by many to be a relatively novel type of artefact, a machine which was the subject of its own newly created disciplinary field: 'Computer Science' (Poster 1990: 147). The fact that it was not quite subsumed within either of its parent realms led commentators to argue that the computer was also somewhat ambiguously positioned in relation to their identity as quintessentially masculine. As such, it was argued that its future trajectory as equally masculine could not be assumed, and the field of computer science need not be littered with the same obstacles that had hampered previous female forays into scientific and technical areas.

The computer's alleged potential for introducing a new energy into previously male-dominated areas consequently became the basis of expectations that women would play an unparalleled part in the revolution it galvanised. During the late 1970s and early 1980s many commentators and practitioners began to predict that, as compared to other scientific and technical fields, women would both find this area more attractive, and perhaps more importantly, would be less likely to find themselves marginalised within it. Estimates of the numbers of women destined for a career in computing were significantly inflated by these hopes. Shirley Williams, the British Social Democrat, for example, claimed that 'the computer is sex-blind and colour-blind' (cited in Griffiths 1988: 145; see also Zientara 1987) in support of her belief that women would freely enter the profession as the 1980s advanced. Further, the rationalisations shaping the decision of individual women to enter the field often mirrored those which were buoying up the optimism of the commentators, practitioners and policy-makers. Female computer professionals reported applying for their first job because they believed the area to be 'one of the first businesses with no sex prejudice' (Judith Cowan cited in *The Guardian*, 17 February 1989).

As the 1980s progressed, however, it became increasingly difficult to deny that the expectations and predictions symptomatic of this first wave of optimism were seriously overstated. Indeed, the most salient points to emerge from a retrospective review of the position of women in the computing field over the last three decades is that they have been disproportionately absent from it, that in many significant instances their absence has grown more pronounced over time, and that any inroads made have in fact been far more limited than those made into some more traditional scientific and technical realms during the same period. As Elizabeth Gerver suggested at the close of the 1980s, computing was established as a 'strangely single-gendered world', and although women's under-representation may have varied 'from sector to sector and to some extent from country to country', the evidence of it by that date was so ubiquitous that it tended 'to become monotonous' (1989: 483).

2 Women and computing: a quantitative assessment

As well as women's under-representation, another point emerges from a review of available statistics on the past and current sex distribution of computing cultures in the US and the UK:[1] where women have been present, they have been almost invariably clustered in the lower echelons of the field. These two general observations hold true for almost every specific area of activity we may care to examine, whether it is educational, occupational or recreational.

Computing in education

In the educational sphere in the UK, although the achievements of girls are now proportionately matching, if not surpassing, those of boys even in traditional scientific and technical subjects (HMSO 1994; Equal Opportunities Commission (EOC) 1995–1998), the numbers undertaking computer science courses remain relatively small, and they become smaller still as qualification status increases. At GCSE level, girls gained approximately 38% of A–C passes in the combined regions of England, Scotland and Wales in the 1993–4 cohort, but they gained only 17.6% of A level (A–E) and Higher (A–C) passes in the same year (EOC 1995).

In the US, the picture is significantly different in relation to children educated to high-school level in computer science. In 1982 girls accounted for 43% of such children, but by 1992 they had overtaken boys and represented 52% (US Department of Education 1995). However, more detailed studies of these figures suggest that boys may have been scoring more highly than girls within the field during at least some of this period (Fetler 1985: 181). The sex distribution of voluntary computer camps and clubs in the US also suggests that the high-school figures mask some persistent underlying inequalities between girls and boys in relation to computing. The ratio of boys to girls in camps during the 1980s has been estimated at three to one (Lockheed 1985: 117; Hess and Muira 1985: 193) and in clubs anything between two to one and twenty to one (Lockheed *et al.* 1983; Becker 1985: 137; Perry and Greber 1990). Where camp enrolment was directly linked to the goal of passing an educational course, indications emerging from a large-scale survey taken in the mid-1980s were that the ratio of boys to girls increased along with course standard and cost, as well as with the school grade of the child. These trends were so marked that those undertaking the survey were led to conclude that, if they continued, future male control of information technology was to be expected (Hess and Muira 1985: 193). Although camps specifically aimed at improving computing competence are uncommon in the UK, the picture which has emerged is not significantly different to that of the US if we look at the sex distribution of computer clubs in schools, which are more commonplace. As research in this area has made clear, such clubs have been invariably over-populated by boys, and organised and supervised by male teachers (Haddon 1989; Spear 1985).

The picture does not improve if we focus upon higher educational establishments. In the US the number of men earning degrees in computer and information sciences far outstripped those earned by women throughout the 1970s, 1980s and early 1990s. Men gained 86.5% of American BA degrees in computing in the period 1971–2, giving them a near monopolistic hold over the field's qualifications. By 1981–2 women were contesting this stronghold by increasing their share of computer science BAs to 35%. However, expectations that this 20% growth signalled that the tide was irrevocably turning against male domination soon floundered. By 1991–2 the proportion of women earning degrees in this field had once again fallen to 28.7%; and this figure was still falling into 1992–3 (US Department of Education 1994).

UK higher education figures mirror those that have emerged from the US in two important respects. First, in the UK too, against the backdrop of a general increase in the numbers of women entering degree level courses (Hammond and Holton 1991: 30), the numbers of those undertaking computer science have been markedly low. Second, the ratio of men to women on computing courses increased rather than decreased as the 1980s progressed into the 1990s.

The statistics issued by the universities' central agency over the past twenty years tell a dramatic story of falling female numbers in computer science programmes in universities prior to the 1992 Act which precipitated the convergence of polytechnics with universities. From a high of 24% of computer science entrants to universities in 1978, numbers fell to 22% in 1981–2, and by 1985 women were only accounting for 10% of undergraduates in this area. Since the mid-eighties the proportion of female entrants in the field has stabilised at around 12% in universities (Hammond and Holton 1991; Virgo 1993; EOC 1985–1995; Higher Education Statistical Agency, 'Students', 1994; HMSO 1994; University Statistics, 1992–1994; Henwood 1993). However, this tale of substantial decline, which has been repeatedly referred to by many commentators in the field, is slightly misleading as it is the product of research which focuses only on the performance of women in universities and ignores those taking computing at undergraduate degree level in polytechnics. Without factoring in this latter group, the decline looks very steep indeed, and far more pronounced than the US dip. If this additional group is accounted for the picture begins to look more like that which has evolved in the States. HESA statistics which take into account undergraduate degrees earned in both sets of institutions, and which have been compiled subsequently to the abolition of the two-tier system, show women as gaining around 21–22% of all of those earned; a finding which adds support to the view that females, as a group, become increasingly under-represented in computing at this level as institutional prestige increases, given the lower status endured by polytechnic universities (or new universities) in the UK. Unsurprisingly, this tendency is also to be found in the US where the percentage of women taking computer science classes in the more illustrious institutions approaches only half the national average. In both 1986 and 1996, for instance, only 14% of students attending computer science classes in Harvard were female (Gutek and Larwood 1987; personal correspondance with staff at Harvard University, 22 October 1996).

Similarly, there has been a tendency for women to drop away during the climb up the higher educational ladder. For instance, although the proportion of women in the US who take MAs in computer science is similar to the proportion taking BAs, females still only account for 10–14% of doctoral candidates in this field, and few have made it into the teaching and research ranks (Damarin 1992: 363; US Department of Education 1994). Similarly, in the UK, although women make up between 20% and 25% of the total number of postgraduates undertaking computer studies (HESA, 'Students', 1994–8; University Statistics, 1992–4), a disproportionately low number make the grades of senior lecturer, researcher and professor (University Statistics, 1992–4). Given these figures it is not surprising that the academic literature of the field in both countries has also become dominated by men. Estimates put women's authorship of articles in computer science at only 5–6% (Damarin 1992: 363).

Computing as a career

Although the diffusion of information technologies through the two economies of the US and UK has clearly led to the contraction of job numbers in many sectors, it has also opened up substantial numbers of new posts within the field of computing itself. Estimates vary widely, but it has been suggested that by 1980 the numbers of such posts had almost doubled (Henwood 1993: 33). In real terms this has meant, for example, that up to 13 million more workers in the US were primarily engaged in computational activity of a technical nature in their daily employment (Zimmerman 1990).

Although growth of this size is impressive by any standards, these new posts have varied greatly in terms of the degrees of remuneration, prestige and the perceived expertise which has been associated with them. Examination of the occupational figures in both the US and the UK reveals the broad continuation of the trends identified above in the educational sphere: women have become concentrated wherever the poorest employment conditions are to be found, whilst men have become over-represented in the more valued areas such as technical management, systems analysis and programming (Zimmerman 1990; Virgo 1994; Hammond and Holton 1992; Strober and Arnold 1987; Henwood 1993: 32–3; Webster 1995; Wajcman 1991).

To be more specific, women make up approximately 70% and 60% of computer operators in the UK and US respectively (EOC 1995–1998; US Bureau of Labour Statistics 1995), as well as dominating data preparation and entry roles. During the 1980s approximately 92% of such roles were taken by them in the USA and 95% in the UK (Henwood

1993: 33–4). Women have also been over-represented on the front and help desks of computing organisations (Virgo 1993; *Computer Economics Survey*, cited in *The Times*, 8 April 1994). All of these task-domains are situated at the bottom end of the occupational ladder where little respect or remuneration has traditionally been received. However, if we examine the population occupying technical and prestigious roles in computing work, it is clear that women have remained significantly under-represented here.

In the US, throughout the 1980s and into the 1990s, women constituted approximately 31% of programmers (Lockheed 1985; Gutek and Larwood 1987; US Bureau of Labour Statistics 1995, 1996). In the UK the statistical picture is cloudier, but the majority of assessments have pointed to the proportion of women in programming work being significantly lower than this figure, with females probably constituting between 20–25% of the workforce total through into recent years (Kirkup 1992: 275; Virgo 1993, 1994; EOC 1995–1998). The figures are similar for systems analysis work. In the US about 31% of those who have become engaged in this type of work are women (US Bureau of Labour Statistics 1995); and again, this number has remained stable since at least the mid-1980s (Gutek and Larwood 1987). In the UK, as in the case of programmers, women seem to have fared slightly less well than their US counterparts, representing only 16–20% of systems analysts (EOC 1995–1998; Neighbour 1995; Kirkup 1992: 275).

Unsurprisingly, the management stratum within occupational computing has become significantly more male-dominated than other areas. Some estimates claim that women have accounted for a meagre 3% of data processing managers in the UK (Virgo, 1993; Kirkup, 1992: 275; Henwood, 1993: 33), although the 1994 *Labour Force Survey* puts the percentage of females in data processing and computer systems management roles at around 20% (Office for National Statistics, 1994–1998). The role of project management seems to have held more opportunities in the UK for female computer specialists, with most calculations suggesting that they have made up between 14% and 20% of this category (Neighbour 1995: 5; Virgo 1993; *Computer Economics Survey*, cited in *The Times*, 8 April 1994). In the US, women seem to have forged more inroads into this area, although the type of managing undertaken may be strongly determined by sex. Philip Kraft and Steven Dubnoff's 1983 study of software workers claimed that whilst 22% of women were in a managerial role of some description, they were more likely than their male counterparts to be in charge of female workforces, and only 3% of them were destined for a senior management post (cited in Henwood, 1993: 33).

Given the firm segregation of occupational computing along sex lines, with men clustered at the top end of the market and women at the bottom, the fact that large salary differentials have emerged between them during this period should not be surprising. What is more perplexing, however, is that on both sides of the Atlantic salaries awarded for the same types of work have been strongly determined by the sex of the worker. Conservative assessments suggest that female computer professionals in the US have earned a mere 75–85% of their male co-workers' wages for the same work (Zimmerman 1990: 207; US Bureau of Labour Statistics 1995), with some reckonings indicating that women who have received this proportion of men's wages have actually fared better than average (Henwood 1993: 33). In addition, only 1% of women in computing work have been able to break through the $50,000 ceiling which has distinguished the middle management from the executive strata (US Bureau of Labour Statistics 1995). In the UK, it seems that women have received higher (but not equal) proportions of their male co-workers' wages than their American counterparts (Virgo 1993), although it has also been claimed that pay differentials in both countries have been widening in the 1990s rather than contracting (Virgo 1994). Furthermore, as in the US, most UK women have run up against a fairly steep wall around the £25,000 mark (Henwood 1993: 33), and, according to some sources, countenance a permanent cut of between £5,000 and £10,000 per year following a career break (*The Guardian*, 3 May 1994).

The skewing of female computing workers towards the lower echelons and margins has also been reflected in the fact that men have overwhelmingly dominated the mainstream professional bodies. Women have constituted just 12% of the British Computer Society through most of the 1990s (Duckworth, BCS, personal communication of 23 October 1998), and, similarly, they have made up only 10% of America's Association of Computing Machinery (Kohnke, Rubin Response Services, personal communication of 26 October 1996).

Recreational computing

Attempting to measure gender differences in terms of general access to, or experience of, recreational computing is an even more difficult exercise than trying to measure such differences in the more formalised settings of work and educational establishments. It is obviously impossible to gauge with any precision how many females have become regular users of computers at home or elsewhere for entertainment, or for organisational purposes, but again, the evidence which does exist indicates strongly that they have so far represented fairly small proportions of overall numbers, and that Becker's conclusion that 'recreational computing is almost a uniformly male world' (Becker 1985) remains entirely justified.

From the small but growing stock of in-depth portrayals of computing environments (Weizenbaum 1976; Levy 1984; Kidder 1981; Turkle 1984; Haddon 1989; Hovenden *et al.* 1995), we know that it is the case that males have been far more likely than females to spend their free time engaged in concentrated computational activity. In the first instance, boys have experienced greater general access to computers than girls and have reported more ownership and use of them (Lockheed 1985: 118). Indeed, by the mid-1980s in the UK, having an eleven to fourteen-year-old boy in a household became one of the most important variables linked to the possession of a home computer (Kirkup 1992: 275). In those instances where girls reported ownership, evidence has suggested that their use, and that of their mothers, remained peripheral as compared to that of their brothers or fathers (Glastonbury 1992: 120). Further, with very few exceptions, the evidence indicates that it is boys and young men who have played computer games, who have become hackers and hobbyists, and who have been more likely to become obsessional about information technology (Levy 1984; Cringley 1993; Keller 1990; Haddon 1989; Benston 1988). Early indications have also suggested that the use of the Internet has become strongly sex-segregated. Even in the context of its enormous growth rate during the 1990s, many assessments have put female users at only 10% or fewer (*The Guardian*, 16 September 1993; Herz 1994; Bromley 1995: 5).

Summary

Despite the optimistic beliefs in evidence before the 1980s which held that computing would prove to be a gender-neutral activity, and the computer industry would provide a blueprint for a bright, new future for women in scientific or technology-oriented occupations, it was clear by the end of this decade that women in both the US and the UK were engaging in computational activity of all kinds with significantly less frequency and less ostensible success than men. As Griffiths asserted at the time, 'computers have been appropriated by men – and it has taken them only a little over a decade to do it' (Griffiths 1988: 145). In the majority of areas where women have made tentative inroads, and where the promise of more equal levels of participation and performance between the sexes has been glimpsed, subsequent re-colonisations by men and boys have occurred. Progress has, therefore, nearly always proved to be provisional and fragile, and the default population of the computer field has remained steadfastly male into the 1990s. Although differences are evident between the UK and US pictures, the grounds upon which some commentators (Newton 1991: 144; Morris 1989: 9) have attempted to make a clear distinction between what they perceive to be the conspicuously bad problems of the UK and the far more favourable circumstances of the US are not robust enough to carry the point. Indeed, suggestions such as Morris's – that the US situation can be considered 'a little more hopeful' because 'a woman in a technical position is a fairly common sight' (Morris 1989: 9) – betray just how tenuous such distinctions are. Whilst the available evidence suggests that the situation may indeed be slightly less grim in the US, the general conclusion that computing on both sides of the Atlantic has become largely male-dominated, and that women face substantial problems within the field, seems unassailable.

A common line of argument for why this quantitative domination by men has occurred hinges on the claim that the computer speedily became an unambiguously masculine artefact following its inception; contrary to hopes that it would maintain an indeterminate gender identity. According to this line of explanation, the quantitative domination is best understood as both a symptom and a cause of the qualitative dominion over the field's culture by a specific brand of masculinity. Rather than being situated equivocally in relation to its parent fields of science and technology, it is suggested that the computer belonged from the first to these two most prototypically masculine realms and that the expectation that it could escape this patrilineage was consequently always utopian. The bases of this claim will be explored in the remainder of this chapter.

3 Computers as culture

There is by now a long-established tradition of speaking of information technology in the same breath as of major, society-wide changes, upheavals and revolutions (Bell 1973; Toffler 1970, 1980). The suggestion has consistently been that IT is strongly, indeed causally linked with the production and reproduction of national and international culture, and mainstream commentaries have primarily concentrated on mapping the past, present and future course of its impact. Fewer commentators have examined the way in which elements of the wider cultural framework itself can influence and determine the nature of the immediate computing environment, or have reflected in detail upon the way the nature of the immediate context continues to surround and shape the production of the technology. This task has largely been taken up by those social theorists who have worked under Marxist, feminist or social constructivist banners (Bijker *et al.* 1987; Cooley 1980; Kramarae 1988; Noble

1984; MacKenzie and Wajcman 1985; Rothschild 1983). A key part of much of their work has been the development of a fuller appreciation of the extent to which the contexts within which new technology is produced and used are distinctive cultures; or an appreciation of the relationship between these cultures and the principal structures giving shape to the wider social framework such as the gender, class, or economic system.

The question of whether or not the field of computing can legitimately be considered to be a distinctive culture, as well as the questions of what kind of culture it may be and how it may be linked to both the production of technical artefacts and to the wider socio-cultural framework, begs the prior, but in this field rarely examined question of what constitutes a culture *per se*. Becker and Geer's definition suggests that for a social space to constitute a specific culture it requires 'a somewhat different set of common understandings around which action is organised, and these differences will find expression in a language whose nuances are peculiar to those and fully understood only by its members' (1970: 134).

In other words, computing's internal social environment must be sufficiently distinct, and distinct in key ways, from non-computing environments. It should, for instance, have produced its own status hierarchy and its own particular set of norms and values, part of which may overlap with the social space outside of the culture, but part of which must also in essence be differently configured and articulated. The particular features of the social grouping must be significant enough to warrant those individuals who constitute the group to meaningfully differentiate themselves from non-members by dint of their membership, even if they do not differentiate themselves from non-members in some other respects. This differentiation must also be in some way integral to their self-perception, as well as to their social identity. Membership should accordingly involve the adoption of signifiers – artefacts, clothing, ways of being and speaking – which mark members out as different and render them recognisable to themselves and others.

Given these criteria, there seem to be valid grounds for thinking about the computing field in cultural terms. It has, for instance, become commonplace for sociologists to point to the high degree of both explicit and implicit differentiation between those who belong to it and those who do not. Research into university students engaging fully with computing for the first time indicates that such a social division is quickly established and thereafter maintained: 'a we–they distinction': the computationally competent and everyone else (Sproull *et al.* 1984: 44).

Although this 'we–they' distinction is essentially based upon the degree of technical knowledge possessed, researchers have consistently pointed out that members of computer culture are bound together by far more than just a set of skills, and that differences in understanding merely act as a basis upon which a whole range of cultural distinctions flourish (Sproull *et al.* 1984; Newton 1991: 144). Those monitoring above-average computational engagement in educational, occupational and recreational spheres have accordingly presented evidence indicating strongly that individuals who sign up for any significant amount of activity also sign up for a series of life-style changes, and novices in the field appear to undergo a process of re-socialisation as they enter it (Massey *et al.* 1992: 90; Cringley 1993). Attention has specifically been drawn to the distinctive 'core ideology' of computer culture: its shared norms, values and humour (Kling and Iacano 1990: 215; Sproull *et al.* 1984; Newton 1991: 144). Specifically noted is the fact that the differentiation between the in-group and the out-group, between the 'we' and the 'they', is hierarchical: membership is valued significantly more positively than non-membership for the in-group, and they therefore evaluate themselves according to a separate status system (Sproull *et al.* 1984: 44). Others have also focused on the particular vocabulary of the initiated, the density of the jargon within the culture which ostracises outsiders (Bloomfield 1989: 417; Glastonbury 1992: 112). Accepting that jargon can, in some part, be accounted for as a means of facilitating communication about technical matters, Bloomfield claims that it is also, and perhaps primarily, a function of the desire of the culture's members to form exclusive social bonds and a robust group identity.

However, whilst it may be accepted that some prototypical computing environments, and their inhabitants, may be similar enough in kind to be considered to be a relatively independent culture, the cultural status of the full spectrum of people and places involved in computing activities is obviously more open to debate. It is fairly easy to recognise that there would have been a relatively high degree of cultural consolidation within, and between, early computer environments of the 1960s and 1970s. However, the degree to which computing technology has more recently diffused throughout the US and the UK means that we can also expect a significant degree of cultural divergence and dilution to have occurred. Computers, and those engaged in concentrated computational activity, are now to be found in a disparate range of geographical and organisational places, most of which already have strong cultural associations: bedrooms, banks, private studies, offices, laboratories, etc. Obviously all cultures are dynamic and fluid phenomena, and in connection with this it may be better to speak of the *cultures* of computing, but for it to remain possible to characterise these cultures as linked to each other in some significant manner, concentrated interaction with the machine would have to carry enough social force to override, for at least some of the time, the large degree of divergence that is introduced by the alternative social rules and roles associated with these arenas. The characteristics which a thus transformed space would have in common with all other spaces containing computers, and computational activity, would have to be qualitatively more significant than the differences between them. This rule should also hold true across the diverse range of machines which we would define as computers.

Despite the evident cultural dilution which has occurred as the computer has moved beyond the laboratory, there is substantial support for the view that it is still appropriate to theorise the more diffused field as marked by a specific character. Bloomfield, speaking specifically of occupational computing, suggests that key elements of the overarching culture are reproduced in each new instantiation: 'a central part of the process whereby computer-departments' practices become instituted involves subtle changes whereby organisational settings become further instances of computer cultures – that is social locations with particular beliefs, myths, shared bodies of knowledge, ways of thinking and speaking and operational procedure corresponding to the use of computer technology' (Bloomfield 1989: 410).

Kling and Ianoco (1990: 215), and Sproull *et al.* (1984: 34), also argue that the ideological kernel of computing culture transcends the particulars of immediate time and space so that, although the particulars might differ, its general features are identifiable and widely shared across the diversity of computer settings.

In sum, there is widespread acceptance of the view that we should think about computing as forming a definite culture, rather than just as a set of loosely connected participants, activities, skills and technologies. There is also broad agreement regarding what the most salient and characteristic features of the culture are: what particular life-style changes accompany membership; what specific beliefs, myths, shared bodies of knowledge, and ways of thinking, speaking and acting mark members out from non-members, and it is to the detail of these that I now turn.

Computer culture and its inhabitants

As has already been noted above, qualitative studies of computer culture remain relatively thin on the ground. Those which do exist, however, have consistently highlighted several key features as fundamentally illustrative of its quintessential character; features that are expressed in their clearest form in its most stereotypical inhabitants. An understanding of these figures is therefore often taken to be a crucial step towards achieving a better awareness of its general nature.

Whether thought of negatively or positively, as bums or wizards, nerds or geniuses, the fundamental characteristic of these individuals is agreed upon by those who observe them. They are people for whom computers eclipse everything. This fact forms the basis for a subsequent re-organisation of their lives by the drawing of a sharp conceptual and practical distinction between the technical and the social realm, in terms of which the technical realm is overwhelmingly privileged and the social realm seriously neglected. Joseph Weizenbaum's portrait of the compulsive computer user, which first appeared in 1976, in many ways has not been bettered:

> Wherever computer centers have become established . . . bright young men of dishevelled appearance, often with sunken glowing eyes, can be seen sitting at computer consoles . . . When not so transfixed, they often sit at tables strewn with computer printouts over which they pore like possessed students of a cabalistic text. Their food, if they arrange it, is brought to them: coffee, Cokes, sandwiches. If possible, they sleep on cots near the computer. But only for a few hours – then back to the console or the printouts. Their rumpled clothes, their unwashed and unshaven faces, and their uncombed hair all testify that they are oblivious to their bodies and to the world in which they move. They exist, at least when so engaged, only through and for the computers. These are computer bums, compulsive programmers. They are an international phenomenon. (Weizenbaum 1976: 116)

These figures, whose non-technical life is obliterated by the technical realm, have remained sharply delineated to the present day, as a brief examination of some more recent computing compulsives of prominence will attest.

During the 1980s and 1990s in the US Kevin Mitnick undertook a series of increasingly daring hacks into a number of key computer systems, earning himself the varying titles of 'computer genius', 'cyberspace's most wanted fugitive', 'electronic terrorist' and 'the technological Lucifer' as a consequence (*The Observer*, 4 April 1994). Amongst other activities, he successfully hacked into the IT systems of universities, phone companies, NASA, and the Pentagon. Those that knew Mitnick personally – his wife and friends – testify to the extent to which his social relationships were invariably sacrificed to his technical desires. By all accounts, his two much-publicised arrests resulted directly from this prioritisation of technical goals over social concerns. In the first instance, Mitnick allegedly irritated one of his closest friends into collaborating with the FBI after undertaking one too many mischievous computational interventions into the latter's private life. In the second instance, following a prison term and time spent in treatment designed to wean him off his 'addiction', Mitnick violated parole conditions which banned him from engaging in computing activity. He subsequently spent a lengthy period as a fugitive, during which he could not easily, if at all, have contact with his family and friends, could not easily establish a settled home, and could not reveal his identity. In this period he did, however, remain an active hacker, a fact which led directly to a much-publicised re-capture by the FBI's hired 'Internet hunter', who successfully tracked him down through cyberspace (*The Guardian*, 7 July 1994). Since this last arrest Mitnick has been confined to a prison cell with no access to computer equipment, and a career which crystallised, in extreme form, the trade-off between the social and the technical self has consequently ended.

The case of Paul Bedworth, a UK schoolboy, also neatly illustrates this trade-off. Bedworth was arrested and charged in 1992 for running amok through, amongst other things, the files of a cancer research charity where he caused an estimated £50,000 damage. His career as an obsessive computer user had begun several years earlier when, as a 'normal' teenager, he had been given a computer as a Christmas present. What followed was a fairly rapid decline into a hermit-like existence. He chose the company of the computer over everything else and became oblivious to fashion, music and friends (*The Guardian*, 18 March 1993). In some of the media commentaries which emerged at the time of his trial, his mother was reported as saying that when her son was in the grip of an obsessive computing episode, it was not uncommon for her to come home from work to find him collapsed from exhaustion and starvation, with his curtains closed, and his face pushed into the carpet of his attic bedroom. Following his arrest, he made considerable efforts to present himself as someone who had gained a critical distance from the problems associated with his previous choices to prioritise the technical realm. He arrived smartly dressed for his court appearance and publicly renounced his former 'pathological' compulsions. Press coverage surrounding his case duly focused on his new-found, sensible and clean-cut image at the time of the trial, and contrasted it with his former unkempt and shambolic state. When reconstructing his history, many commentators strongly emphasised the relationship between his retreat from the social world, his own physical presence and his 'senses', and the development of his precocious computing expertise. So expressed, Bedworth's story, like Mitnick's, tapped into and bolstered a central theme in the emergent stereotype of the compulsive computer user: that there is an inverse relationship between commitment to the social and the technical selves.

The threads contained in the specific tales of Bedworth and Mitnick run throughout more general commentaries on those identified as computer culture's most extreme – though still seen as most typical – inhabitants. Marked themes of anti-sociality recur constantly, with the technical realm completely overshadowing that of the non-technical or social realm. Social and psychological research evidence has added support to the cliché that such figures demonstrate few if any social inclinations or, indeed, skills, and that the association with the machine constitutes the primary alliance (Hovenden *et al.* 1995; Turkle 1988: 42; Levy 1984; Keller 1990). Hackers, for example, according to Keller, despite the fact they may 'work in a group, marry, have families, . . . are essentially and fundamentally solitary; they relate to no-one' (1990: 58).

This solitariness makes for a highly individualistic culture according to all but those producing the most romanticised accounts of computing. The social bonding which does take place between hackers, hobbyists or compulsive computer users, occurs on the basis of a shared ethos which assumes that the quality of such ties is of little importance as compared to the deep cathexis of emotion which is discharged in relation to the machine (Kidder 1982; Cringley 1993; Hovenden *et al.* 1995). For the most part it is held that, for the computerwise, the relationship to the machine is an individual one, rendering the more overt demonstrations of social co-operation and co-ordination 'rarely necessary' (Sproull *et al.* 1984: 34). Although enthusiasm may be shared, programming remains 'an individual sport' (Cringley 1993: 104). With the intense pressure to 'write the best, fastest, biggest program or to build the best, smallest hardware' (Sproull *et al.* 1984: 34), coupled with the fact that, for many, 'shared glory is no glory at all' (Keller 1990: 58), a climate marked by extremely competitive attitudes is not considered an unusual phenomenon in computing's inner circle:

> They spend a great deal of time hunched over a computer or computer terminal, face close to the screen, often with the brightness and contrast turned down to 'protect' their work from accidental 'prying' by others . . . as part of his tendency to secrecy, the hacker does not share his code or his techniques with others and does not normally volunteer help to a colleague with a technical problem (Keller 1990: 58).

Also frequently noted is the high degree of competitive behaviour characterising the technical interactions between experts and non-experts, with the former group observed to regularly 'express considerable contempt' (Keller 1990: 58) and 'arrogance' (Glastonbury 1992: 112) towards the latter.

The theme of anti-physicality also recurs constantly. The youthfulness of these stereotypical members, and the culture they partake of, has been frequently stressed in this connection (Sproull *et al.* 1984: 34; Glastonbury 1992: 112; Cringley 1993). The young are attracted to computing because it is associated with the future, with excitement and the potential for change. However, the young age of many enthusiasts is equally a function of the degree of personal commitment and physical stamina required to withstand the punishing number of hours spent in front of the screen that is the norm for the dedicated user. 'True' members of computing culture are always working at their machines regardless of whether it is day or night and happily go without sleep, nutritious food, cleanliness, or time spent in alternative pursuits (Sproull *et al.* 1984: 34). Sherry Turkle's research on MIT hackers reveals a world where the physical punishment withstood in the name of enhancing computing expertise becomes an end in itself: 'hackers call this "sportdeath" – pushing the mind and body beyond their limits, punishing the body until it can barely support the mind and then demanding more of the mind than you believe it could possibly deliver' (Turkle 1988: 42). Cringley, in his account of the development of the culture of commercial computing in the US, *Accidental Empires: How the Boys of Silicon Valley Make Their Millions, Battle Foreign Competition, and Still Can't Get a Date*, describes the evolution of the personal computer industry as precisely the triumph of what he refers to as 'nerds'; a group of young, malnourished technophiliacs, willing to suppress every physical and emotional need in order to code for longer periods, and with more success. The success of Fry's Electronics, the Silicon Valley shop which became a haven for the most devoted computer users, is explained by Cringley in terms of its ability to fulfil the needs of this new group; an ability based upon the shop's open acknowledgement of the basic principles of this culture, and the corresponding marketing strategy, which, put simply, involved stocking 'rows of junk food, soft drinks, girlie magazines, and Maalox' (1993: 33).

This general neglect of the social and physical self dovetails neatly with a basic asceticism which has already been identified by feminist scholars as a fundamental axis along which more traditional scientific and technical cultures turn. It is expressed most clearly as the belief that 'putting down the body elevates the mind' (Hacker 1981: 348). Amongst others, Hacker, a keen-eyed sociologist of such cultures, has argued that a salient feature is their organisation around this mind/body dualism, in which the pleasures and needs of the disembodied intellect completely subsume those which are related to emotional, physical or sensual needs. Based upon a wealth of interviews, her work offers a rich seam of qualitative data which testifies to this deep-rooted preference for the concerns of the non-physical, non-social realm, and the marked privileging of satisfactions resulting from the exercise of purely abstract intellectualising (Hacker 1981).[2]

Hacker claims that within this framework, members of scientific and technical cultures find acceptable ways of fulfilling their need to express transcendent desires (Hacker 1990: 207): desires to escape what is defined as the immediate, the finite and the limited, for a realm of absolutes and purity. The claim in her work that the asceticism in the realms of science and technology parallels that in the religious realm finds resonance in numerous commentaries focusing specifically upon the computing field. Hi-tech experts and their relationship with technology are frequently described in terms laden with religious allusion: as 'possessed' or 'transfixed' (Weizenbaum 1976) by the 'Holy Grail of High Technology' (Massey *et al.* 1992: 5), or as 'a new priesthood . . . with all the rituals and mysticism' we associate with the clerical profession (Glastonbury 1992: 112).

A twist which is not generally, or ideally, associated with asceticisms of a more traditional, religious sort is, however, characteristic of the vein identified here as running through scientific and technical cultures. Ascetic impulses are generally expected to be harnessed in the service of the common good through a programme of self-denial and other-worldliness, whether this be expressed within a religious, political or personal framework. In Hacker's work the elevation of the 'mind' and the neglect of the body – and all that these terms symbolise – are revealed to take place as a means to a fundamentally anti-social, anti-communal end. Nowhere is this tendency more visible than in computing culture. Commentators have noted little attempt to justify the degree of single-minded dedication on the grounds of furthering a common, or a higher, good; except inadvertently, when technical successes reap social benefits. It is suggested, instead, that more customary notions of the 'good' are usurped within the culture's most extreme inhabitants. Their ethical negotiations privilege 'technological progress and deflect competing social values' (Kling and Iacono 1990: 228). The desire to act for the common good is replaced by the desire to compute simply for the sake of computing. Virtue and positioning within the status hierarchy are determined almost exclusively by computational expertise, and those in possession of the cutting-edge machines and techniques are the leaders in this recast moral universe (Sproull *et al.* 1984: 34; Kling and Iacono 1990: 228). In this context the significance of other virtues and vices pales, and they become noteworthy only in relation to the part they play in the central quest for technical advance: 'Pranks, tricks, and games are benignly tolerated, when not actually encouraged. Users can be impolite and irreverent. Mild larceny – faking accounts, stealing time, breaking codes, and copying proprietary software – is also tolerated, if not encouraged' (Sproull *et al.* 1984: 34).

Computer culture and the world of work

Whilst any analysis of general computing culture which argued that its essential features are perfectly refracted through the stereotype of its most extreme inhabitants would not be easily supportable, there is a wealth of evidence to suggest that, until very recently at least, both this figure and its trait of prioritising the technical realm over social and physical concerns have remained central to computing environments wherever these have sprung up. Specifically within the occupational sphere, research findings directly echo those emerging from observation of computer culture's core members in many key respects. Software 'gurus', 'samurais' or 'mavericks', those individuals who are informally held to have reached the pinnacle of their profession, are assumed to have had to make the choice between excellence and 'the baggage of domesticity and mundane relationships' (Hovenden *et al.* 1995: 7) somewhere along the route to technical supremacy and peer recognition. It seems that extraordinary success has come most readily to those computer professionals to whom such work has always been equated with play (Massey *et al.* 1992: 109), and to those who have actively revelled in the 'almost siege-like conditions' of the technical laboratory (Webster 1995: 10). Further research suggests that these figures not only offer a fairly precise match, within an occupational setting, for the figure of the compulsive user outlined above, but that their priorities have been mirrored in the general ethos of workplace computing. The obsessive maverick figure may manifest a few behavioural extremes in relation to his colleagues, but he nevertheless discovers himself in 'a culture that shares, in a grand sense, his own obsession with a mechanistic view of the world, a view that can discount the personal and the social' (Hovenden *et al.* 1995: 45; see also Webster 1995: 10; Emerson 1983: 202).

Details which emerged during the court battle between Microsoft and some of its married employees offer a good illustration of this point. The corporation lost its attempted challenge of the claim that it discriminated against some of its technical employees after it was successfully demonstrated that a manager had informed junior workers that marriage, and indeed any priorities other than work, were considered to represent a distinct disadvantage to both the company and their own career paths. The manager's advice was to nurture a singles life-style which would fall in line with the organisation's preference for those workers who 'ate, breathed, slept, and drank Microsoft' and felt that it was 'the best thing in the world' (cited in Cringley 1993: 114).

It is not all employees who object to this working environment, however. There is plenty of evidence that many of the 'average' workers in professional computing have followed their bosses and actively embraced the role model of the 'individual genius fulfilling themselves primarily through an over-riding commitment to their work' (Massey *et al.* 1992: 8) and the possibility that paid work can take over 'from the rest of life' (109). Labouring within what has been called the 'project mentality', working long and non-standard hours under stress, and sidelining responsibilities to family and friends, has become the accepted *modus operandi* (Murray 1993: 74; see also Webster 1995: 10).

The professional context has further mirrored the compulsive's lifestyle in terms of the closely related neglect of the physical self. Physical weakening and mental pressure have been regularly equated with the demonstration of commitment to the fulfilment of technical goals. The manager of a software team interviewed during research conducted by Murray highlights the degree to which willingness to endure physical hardship brought about by mental struggle has become viewed as a fairly routine occupational hazard: 'I was probably keeping myself going during [the project] and then when I'd finished my body said, "Forget it". Management were very sympathetic. I dragged myself back into work for a week to do the budgets. I couldn't delegate it. The last two days I was told I was slurring my words' (Murray 1993: 75).

Within this wider context of formal computing environments, then, the technological fetishism first identified by Weizenbaum in the 1970s, the re-calibration of the relationship between the social and the technical, and the physical and abstract, has become prevalent. Projects have been organised around technical necessities, and non-technical sacrifices have been both expected and routinely made, to meet technical demands. In addition, as is the case with 'compulsive' users, technical competence has remained the primary indicator of personal worth. In sum, occupational computing has followed the development of computing culture in less formal contexts and manifests the same distinctive themes and motifs.

Computer culture and masculinity

There are two basic ways to view this computer culture and its inhabitants. Looked at in an uncritical light, its typical participants are, above everything else, tireless pioneers working at the cutting edge of technical progress. The paring-down of their non-technical lives takes place to better facilitate the pursuit of their technical goals. They are experts whose obsession with information technology and with the 'thrill of inventiveness' (Glastonbury 1992: 112) cannot but guarantee the reaping of intellectually and even – albeit inadvertently – socially useful and justifiable rewards.

This positive perception has formed the basis for a large number of mainstream accounts and images of IT experts, innovators and entrepreneurs that have entered popular consciousness during the last thirty years. Media coverage of key IT figures during the 1980s and through into the 1990s has often been utopian and idealised in this way and has outlined close links between the competence and success of the technical elite and the general fortune of the nation. Even those whose use of computing technology most would consider extreme have been viewed in this way. A column written by Matthew Parris for *The Times* following Paul Bedworth's trial provides a neat illustration in this regard. Typifying a sneaking admiration that many shared for Bedworth's choice to prioritise the technical over the social, Parris ended his editorial by rapping the knuckles of anyone who had naively assumed that there was something dysfunctional about the boy's behaviour, stating that, on the contrary, 'Paul Bedworth's solitary expeditions into the jungle of artificial intelligence were not a substitute for companionship. People like him are the way the human race advances and a symptom of its health. The jungle is the thing. Companionship is the substitute. Other people are the evasion' (*The Times*, 22 March 1993).

As we have seen, however, from as early as 1976 Weizenbaum was spearheading the push for a more negative perception of these figures and of the culture they build. He did this on the basis of the belief that key elements in the culture were antithetical to ideal standards of human health and progress, and argued for a return to the established moral compass. His seminal *Computer Power and Human Reason* therefore provides an evaluation of compulsive computer users primarily in terms of values which were marginalised by the sub-culture. With this portrait, Weizenbaum created a mode of viewing computing culture which judged it to be deeply pathological at core, and judged its pathology to lie precisely in the degree to which it was characterised by a perverted form of asceticism and was consequently cut off from a perspective which could comprehend and accommodate the full range of human propensities and experience. He did not, however, see computing as completely unique in this respect. Rather, he thought of it as an exemplary manifestation of a general malaise endemic to the dominant scientific worldview in the West (Weizenbaum 1976: 127).

As has also been touched upon above, other commentators have elaborated upon the variant of asceticism and anti-humanism in scientific and technical cultures which Weizenbaum is concerned to highlight and address, and have joined him in analysing the social and historical construction of these disciplines and their artefacts in structural terms. In other words, in terms which seek to illuminate and understand their