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Abstract

This paper explores the notion of social constructionism as it pertains to the process of product development – how within any group of designed objects intended to perform a similar function, a process of selection occurs by users for reasons that do not necessarily align with those expected by the designers.

The mouse repeatedly proved to be the most effective device to interact with a computer. Yet for a variety of socio-economic and cultural reasons, it took two decades to appear as a mass-produced item before being accepted by users as an essential part of computing technology. However, this paper argues that this acceptance was more complex than a technologically deterministic account of the mouse might suggest. The mouse radically altered the perception of office computers, and in effect created a new machine which was a world away from what had previously been seen as an advanced electronic typewriter. This paradigm shift enabled male users to freely adopt computers, as they could disassociate themselves from what was then perceived as the subordinate, feminised activity of typing.

Through interviews with the designers involved in the development of the mouse, and an analysis of the representation of the mouse in popular media, this paper explores how the mouse has evolved from being a physical object into a powerful visual symbol.

Many people would say that the design history of the mouse has already been written. Indeed, with only a little effort it is easy to locate a great deal which has been produced about the evolution of the computer mouse – computer magazine articles, journal articles, book chapters, web encyclopaedia entries, etc. The issue has been thoroughly covered, one might think.

However, as has been the case with previous forays into computer history, I find that the subject has been dealt with largely from a technical history perspective; occasionally from a design perspective, but I can find nothing which traces the history of the consumption of the computer mouse. Why did it take so long to become a mass-produced item? How did people react to the introduction of the mouse? How did it become the single most accepted interface technology? What did the mouse represent, and what does it represent today?

To recap briefly on the already documented story of how the mouse came into being:

Doug Engelbart, a former naval radar technician working at the Stanford Research Institute, first came up with a concept for a device to calculate the area of a two-dimensional flat surface in 1963 by basing the principle on that of a table-sized trackball device being used to do that precise thing. He realised that by using two wheels at right angles to each other, measurements could be taken in one plane by rolling one wheel across a surface and dragging the other wheel at right angles to it without it moving. To measure movement in the other plane, the relative movement of the wheels would be reversed[1].

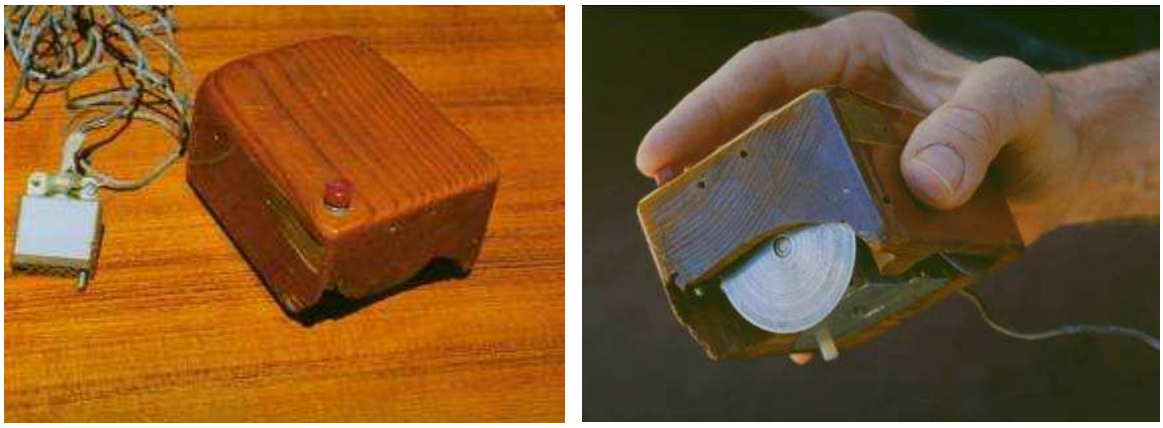


Fig. 1: Engelbart and English's first mouse, circa 1963 (Courtesy the Bootstrap Institute)

Under Engelbart's direction, his colleague Bill English constructed the original prototype – a fairly large wooden box with a single button, with wheels attached to internal potentiometers [Fig. 1]. Apparently the device acquired its nickname early on, when somebody seeing this prototype in action said it looked 'it looks like a one eared mouse!'[2]

Discussing the mouse today, its history has become inextricably entwined with the development of the Graphical User Interface – but few people realise that the mouse is, in fact, only a part of a proposed interface system designed for use with a text-based operating system, not an icon-driven one.

Fig: 2: The On-Line System Interface, 1968 (Courtesy the Bootstrap Institute)

Doug Engelbart worked throughout the 1960s (and is still working today) on a large-scale, long-term project to enable humans to get the most benefit from computing technology. This project he named the 'Augmentation of Human Intellect', and as part of this work, Engelbart created the On-Line System (NLS) to manipulate computer files [Fig. 2]. This system utilised a three-button mouse, a standard qwerty keyboard, and a chordset – an input device having five piano-like keys. Engelbart first publicly demonstrated this system in 1968, and received a standing ovation[3]. It was felt that Engelbart had shown the future of human/computer interaction.

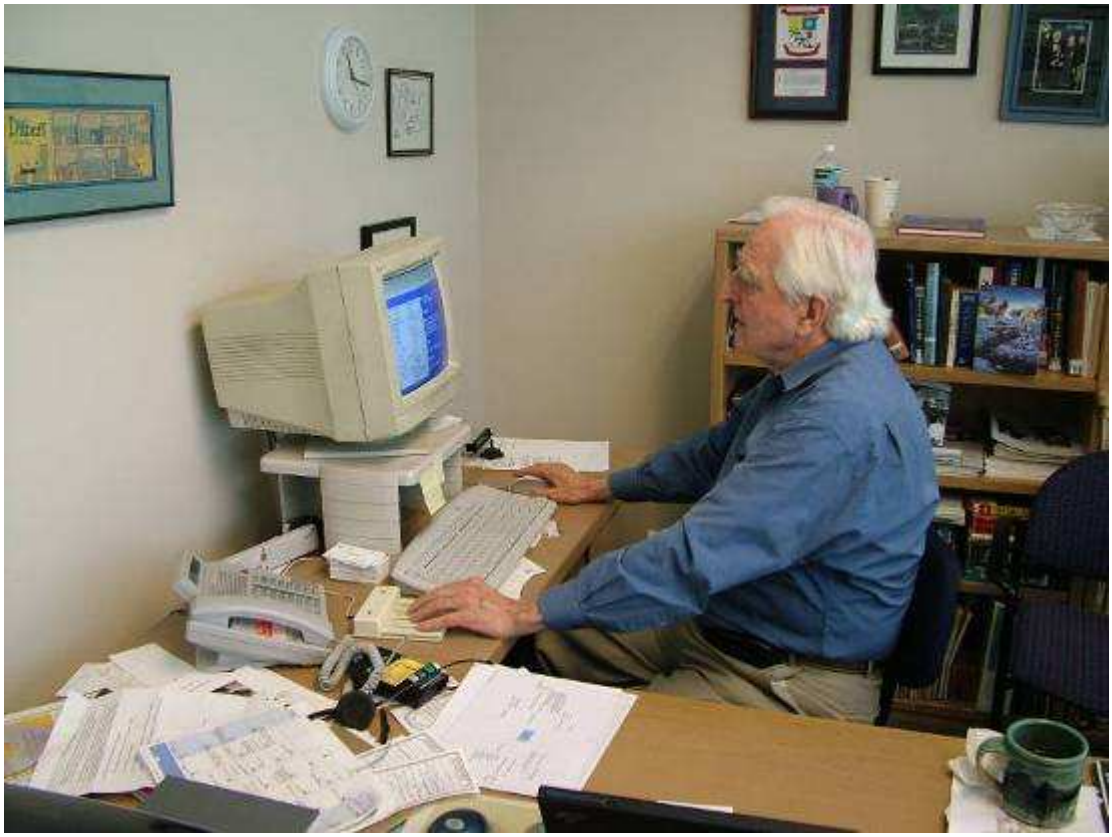


Fig. 3: Doug Engelbart using a Chordset and mouse interface (Photo by the author)

Engelbart still uses this system today, and complains about its lack of adoption by the computer industry [Fig. 3]. If only people would accept the commitment involved in becoming familiar with what he admits is a complicated system to learn, he believes we could achieve much higher levels of efficiency in interacting with computers. Stu Card, the Xerox Palo Alto Research Centre scientist who did a lot of the early ergonomic testing of computer mice, agrees.

> The Engelbart system is the 'verb first' system, because you did the action first then the selection, and you can do the scoping in the action, so if you want to delete a word, you would say 'delete word here' and then whatever you point to it would take it to the scope of the word. In the system that we have now that went into Small Talk and later things, you do the scoping with the mouse, so in the Mac, you double click it and get a word…. There are other ways of doing it, [but] the complexity has got to be somewhere….In the Engelbartian system you do your commands [with the chordset] and you do

> your selection [with the mouse] and then you bring your hands over the keyboard and do what you have to do. This means that that the user looks like this giant bird flapping back and forth and it takes four hands to operate it!....In Word today you would do a command [like] 'hold down mouse' that is of course very slow and requires visual attention. Nobody has been able to go more than half the speed that you could with an Engelbart interface. When they would do a demo they were worthless because everybody would stand around and watch them do an edit and there was this flash and it would all be done. You would never get to see what they actually did, so the only way I could see what they actually did was to video tape it and play it back in slow motion because it was so fast. So if you had a system like Engelbart's which ran at something like the power of my pocket calculator, you could do your editing twice as fast as you do now[4].

The problem is that teaching people to use a mouse as a pointing device is one thing, but teaching them how to input a large number of shortcut commands using a chordset is quite another[5]. And, as icon driven interfaces became the norm, the need was primarily for a pointing device.

Fig 4: The Alto-1, 1972 and Xerox Star Computer, 1981
(Photos courtesy of Palo Alto Research Center, Inc.)

It was during the research work into computing at Xerox Parc that the mouse became associated with the Graphical User Interface (GUI). First of all through an experimental computer system called the Alto-1 in 1972, and later through the Star computer released in 1981 [Fig. 4]. Although these radical computers were in no way a financial success (depending on the source, only 200 Alto computers were ever made, and less than 100 sold), they were highly influential in persuading Microsoft (via a former Xerox employee, Charles Simonyi) to develop a mouse to use with

Microsoft Word for the text-based IBM PC, and in informing the work of Apple in developing their GUI operating system. This work led to the unsuccessful Apple Lisa in 1983, and the massively successful Apple Macintosh in 1984 [Fig. 5]. This is the point in time, January 1984 – 21 years after its conception, at which the computer mouse first enters into the public consciousness[6]. And it was a public that at first took some time to become accustomed to such an unusual object.

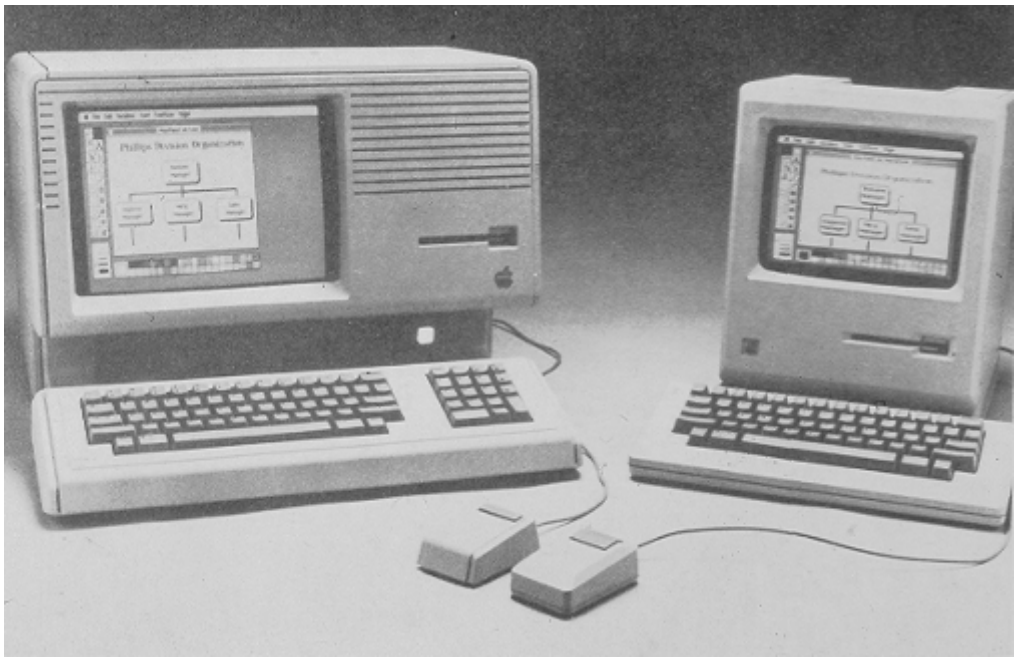


Fig 5: The Apple Lisa, 1983 and Apple Macintosh, 1984 (Courtesy of Apple)

The first manuals for the Macintosh had to devote entire sections on how to use the new device, reassuring users that they would soon get used to it [Fig.6]. Even well into the 1990s, tutorials and games designed to train people to use mice were included in software from both Apple and Microsoft.

Fig 6: The Apple Macintosh Plus manual, 1984 (Courtesy of Apple)

The success of the Macintosh and the novelty of the mouse as an input device were such that it very soon began to make an appearance in popular culture [Fig. 7]. The film 'Star Trek IV: the Voyage Home', released only two years after the appearance of the Macintosh, contains a scene in which the engineer Scotty, transported back in time to Earth in 1986, attempts to command a computer by talking to it. When told to use the mouse, he picks it up and tries to use it as a microphone.

Fig 7: An early appearance of the computer mouse in popular culture, 1986. Star Trek Engineer Scotty tries to operate an Apple Macintosh by speaking into the mouse.

During the two decades since Star Trek IV, the mouse has appeared in advertising and popular culture to greater and greater extent. And as it is has become more commonplace and identifiable as an everyday artefact in its own right, it has come to be represented as any number of wildly differing objects [Figs. 8 to 11].

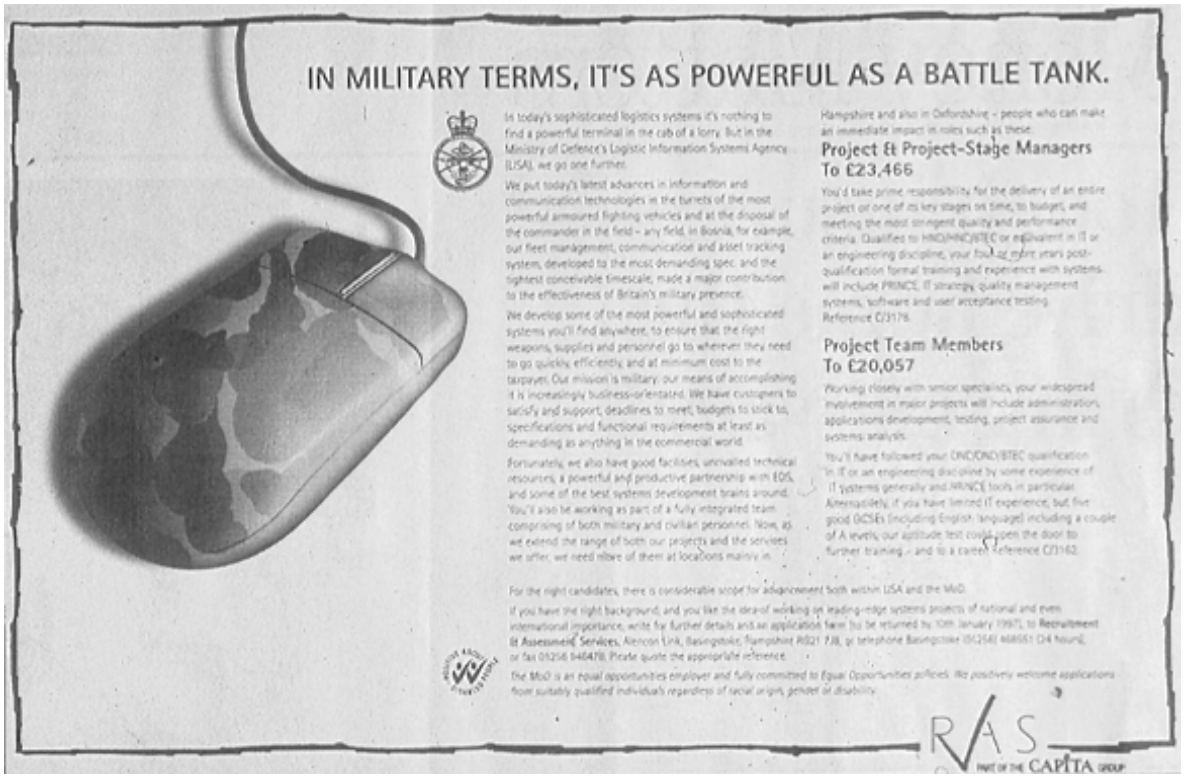
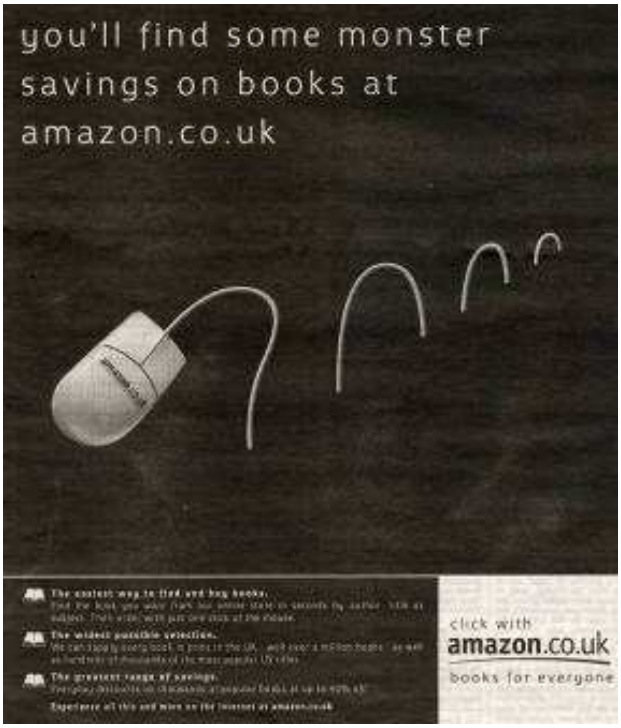


Fig. 8: Camouflaged as a tank



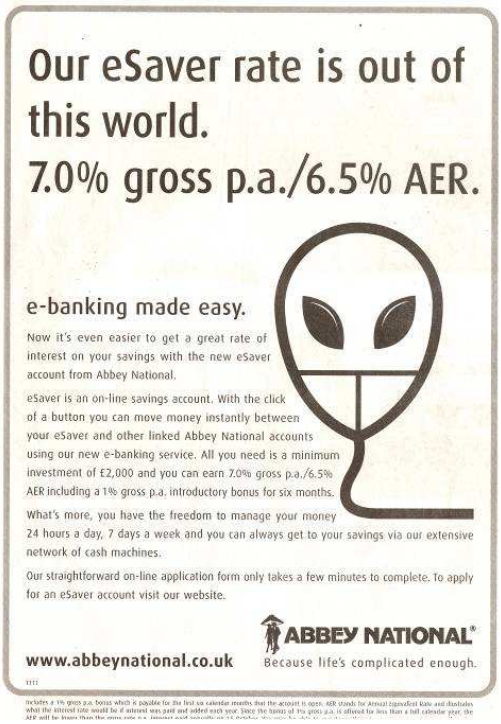


Fig. 9: As the Loch Ness monster and as an alien

Fig. 10: As a source of power or light

Fig. 11: As a fossil, an Egyptian hieroglyph, and a medieval mace.

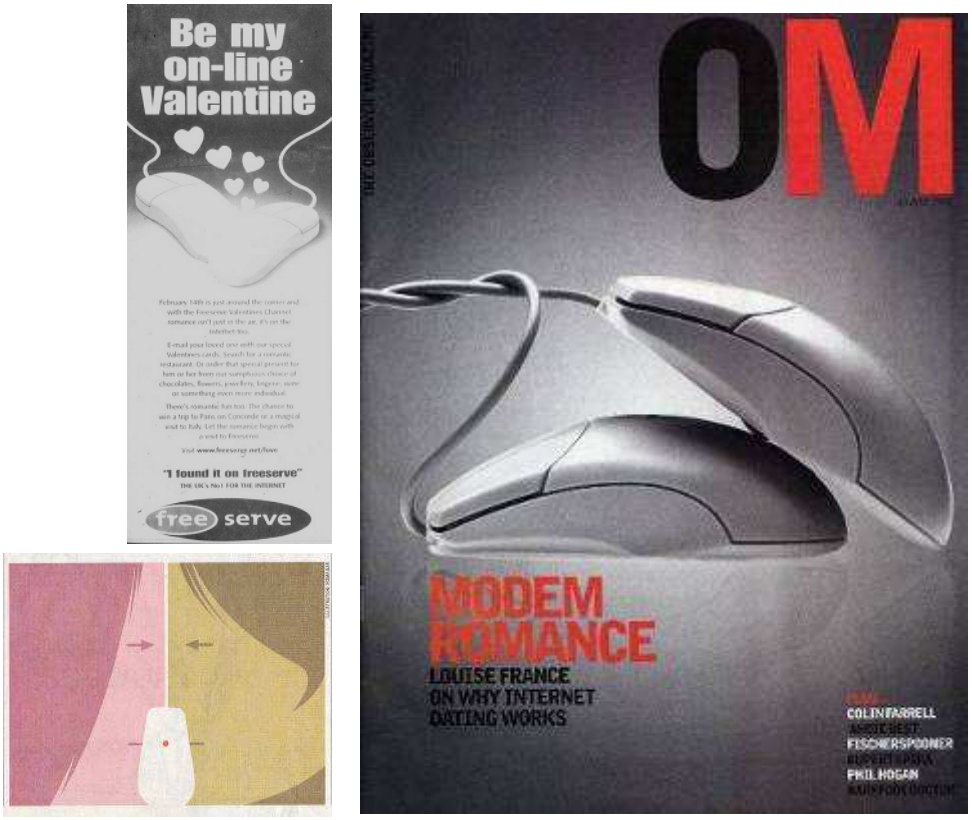


Fig. 12: The mouse in internet dating

The mouse has represented itself as a mouse when promoting internet dating (or, judging by this magazine cover, internet mating) [Fig 12], and perhaps therefore rather relevantly, the mouse has also been represented as sperm on more than one occasion [Fig. 13].

Fig. 13: The mouse as sperm

In fact, looking at the chronological evolution of the representation of the mouse, shortly after its adoption the mouse had become well enough understood to be seen as an interchangeable symbol to represent anything to do with computers – CD Roms, jobs in computing, or even computer companies themselves. With the advent of the internet, however, the mouse quickly came to represent the services available on the internet rather than the computer itself [Figs. 14 to 17].

Fig. 14: The mouse in online banking adverts

Fig. 15: Door hanger promoting online booking of a car service

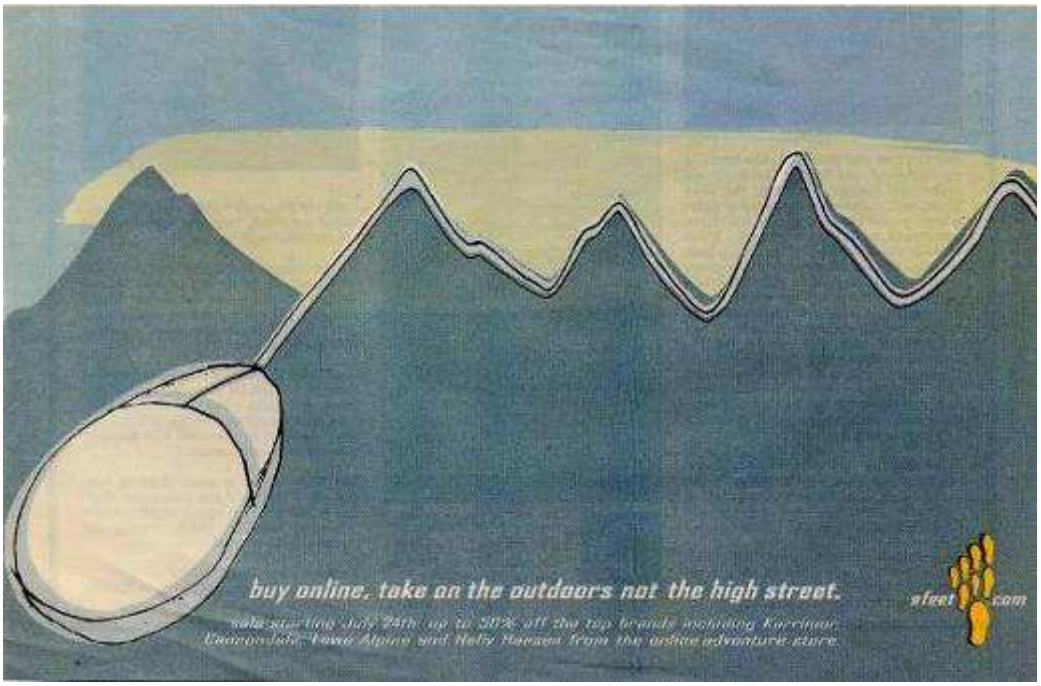


Fig. 16: Advert promoting online purchasing of mountaineering equipment

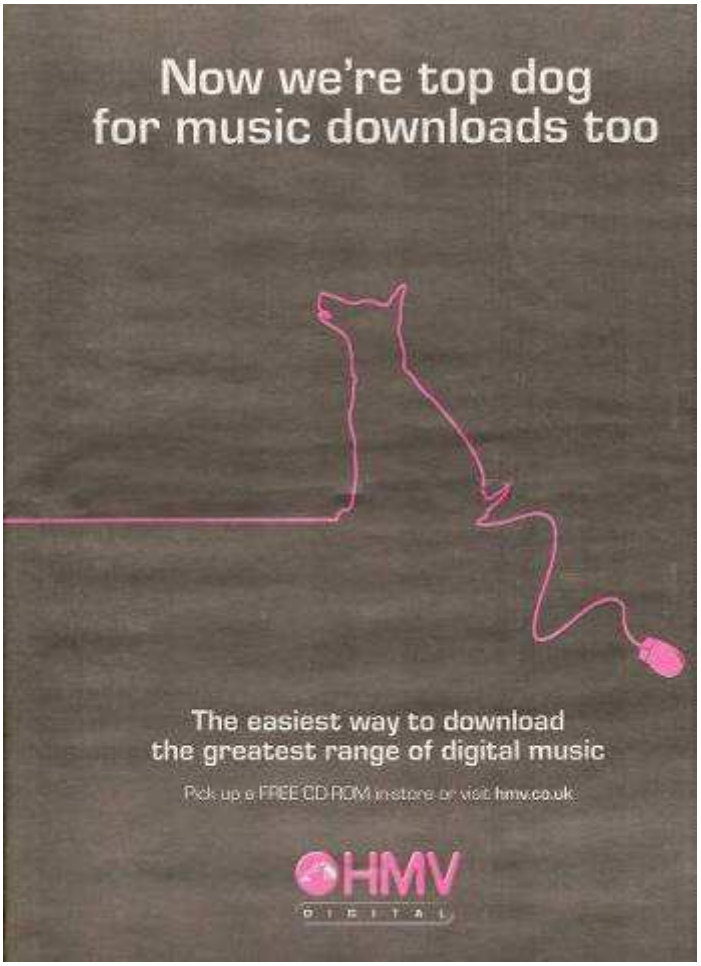


Fig. 17: Advert promoting online purchasing of music

Fig. 18: Advert for BT Broadband (Courtesy of BT)

Today, with the large-scale take up of the internet by domestic users, the advent of broadband and wireless technologies, and the popularity of real-time global communications, the mouse has moved from being an icon of the computer itself, through being an icon of internet services, to become an icon of a world wide web of easily accessible information [Fig. 18]. The freedom of the wireless mouse has removed it from dependence on the tangible computer and enabled it to represent the intangible freedom of information itself and access to a whole world-wide community of computer users.

There is no doubt that the mouse today is a pervasive, easily recognisable image with clear signifieds. The question remains though, of how it attained this status.

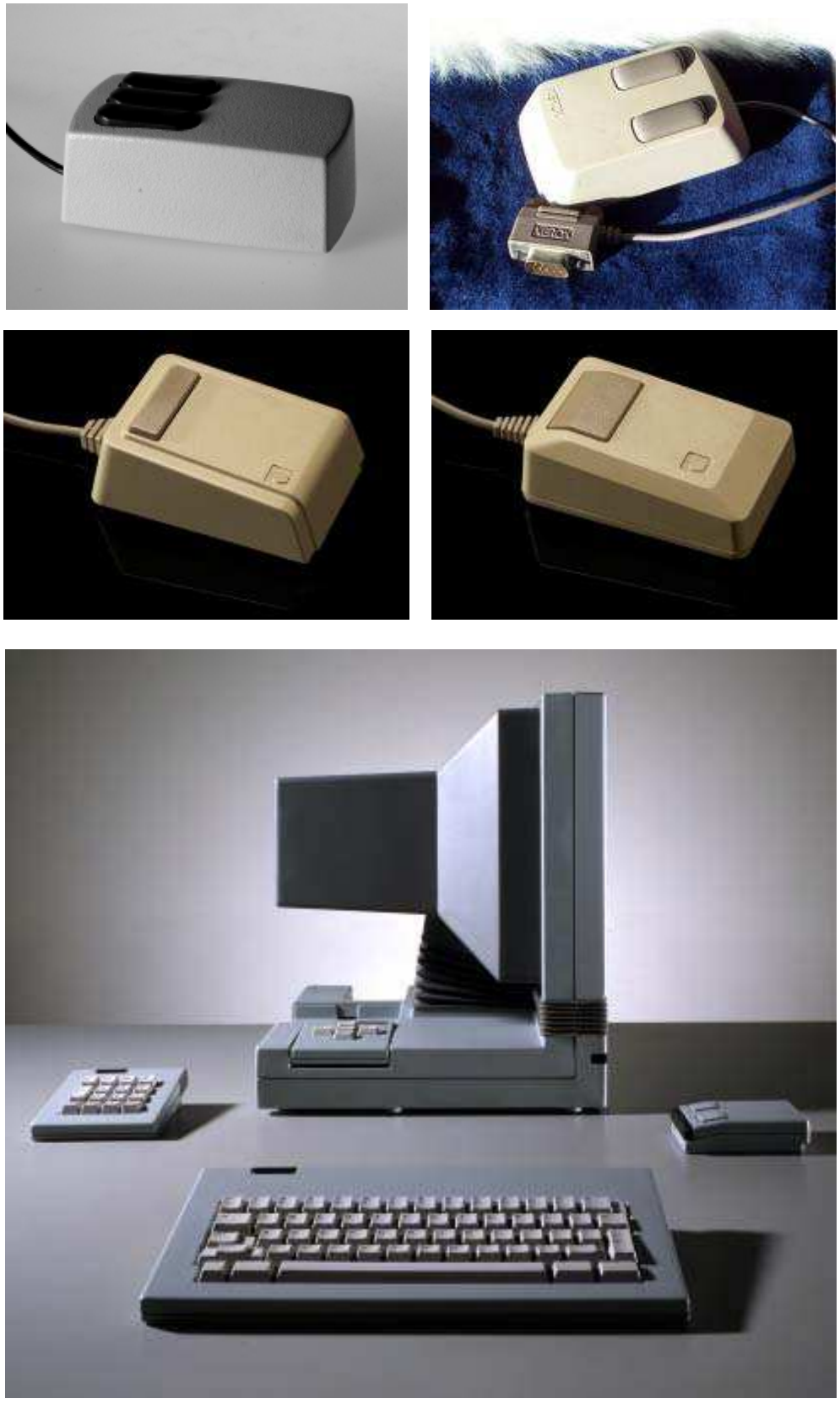


**Fig 19: Top – Alto mouse, 1972, Star Mouse, 1981 (Courtesy of Palo Alto Research Center, Inc.)
Middle – Apple Lisa mouse, 1983, Apple Macintosh Mouse, 1984 (Courtesy of Apple)
Bottom – Metaphor Computer 1984 (Photo by Rick English, courtesy of IDEO)**

Looking at the physical evolution of the computer mouse, it is clear that ergonomics played a limited role in the creation of the earliest mice [Fig. 19]. The styling of the Alto and Star mice, the early Apple mice designed by Hovey-Kelly, along with examples such as the first cordless infra-red mouse for the Metaphor computer (1984) closely reflect the form and material finish of the computers to which they belonged, rather than being purely informed by user requirements. Forms based on the ergonomics of sanding blocks were rejected by Apple in favour of rectilinear forms. Even the first Microsoft mouse, apparently closely based on a lump of clay modelled to fit the hand, was box-like compared to the mice of today.

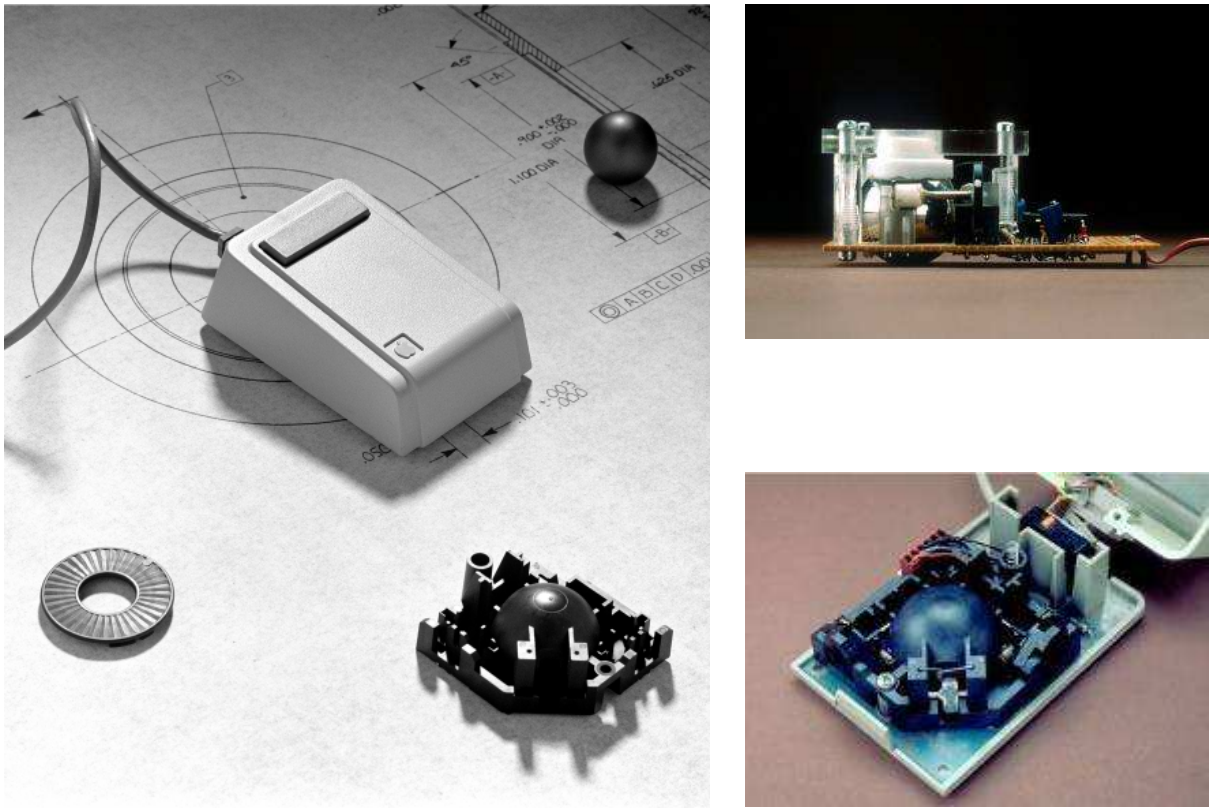


Fig. 20: The Apple Lisa Mouse showing the injection moulded 'ribcage', 1983 (Photos courtesy of IDEO)

An important point to bear in mind is that at this point, mice were incredibly expensive pieces of equipment to produce, and while the Xerox mice were important in terms of the research they embodied, they were not suitable items for mass production. The work that changed that position was carried out by Dean Hovey, Jim Sachs, Jim Yurchenco and Rickson Sun as part of the Hovey-Kelly design team working on the first Apple mice [Fig. 20]. Steve Jobs told this team that he wanted the cost of the mouse reducing from $400 to $10, and that instead of failing every week it was never to fail. The team solved the engineering problems of reliability and assembly by replacing the load-bearing steel ball of the Xerox mouse with a floating ball covered in rubber, and by developing an injection-moulded 'ribcage' which located and held all the important internal mechanics, which turned the mouse from an expensive, skilled assembly job into a cheap, snap-together product[7].

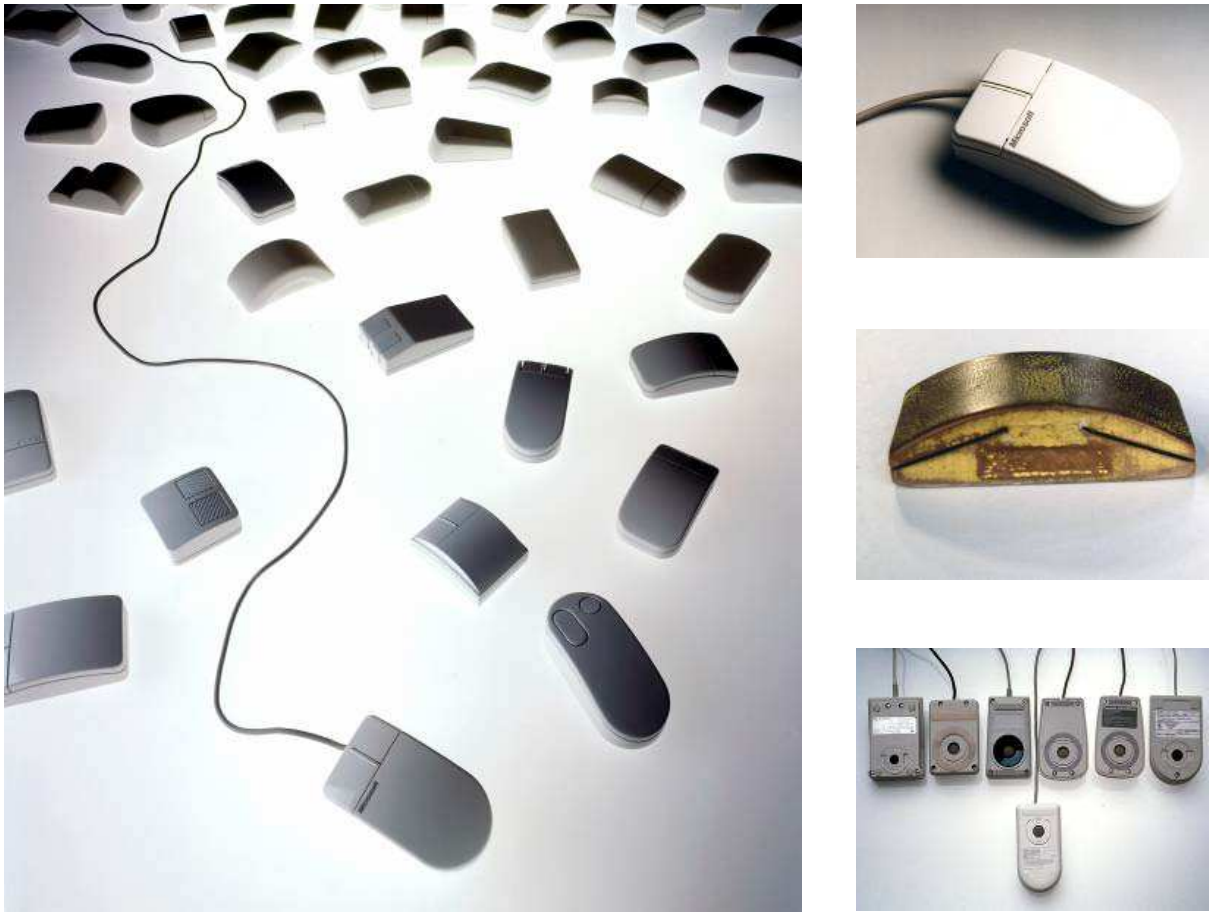


Fig. 21: The 3rd generation Microsoft mouse with development models, sanding block inspiration and showing the forward movement of the ball, 1987 (Photos by Rick English, courtesy of IDEO)

Another significant move forwards in the industrial design of the mouse came through the work of Paul Bradley on the third generation of the Microsoft mouse [Fig 21]. Like the concepts produced for Apple by Hovey-Kelly, the form of this mouse was closely based on a sanding block to get the hand feel right, and also included major changes to the size and shape of the buttons. These became much larger, stretching right across the surface of the front of the mouse, and were gently indented. The left hand button was larger than the right, as this was the primary button, with a small ridge added to its right hand edge to let users feel the boundary between the buttons. The most important change was a fundamental one, making the mouse far more accurate to control and comfortable to use. The ball inside the mouse which rubbed against rollers to measure movement had always been placed at the back of the device due to the amount of space required at the front of the mouse for switches, etc. This redesign took advantage of miniaturised components to enable the internal space to be reduced, the ergonomics of the form to take precedence, and following the advice of Stu Card, allowing the rolling ball to be moved from the back to the front of the mouse, placing it much closer to the fingers rather than the palm of the hand, improving the dexterity of the mouse[8].

There are a number of technical reasons why the mouse has been proven to be the most suitable device for interacting with an icon-driven GUI – ergonomic tests alone justify this.

But, considering the facts that the mouse was originally designed for use with text-based systems, and then to be used in conjunction with a chordset; that it took so long to be commercialized as a product; and that despite its appearance in popular culture, the instruction manuals and training software clearly indicate that for many people it was in no way a 'natural' input device, it is fair to suppose that there was another significant factor involved in the acceptance of the mouse, based in social constructionism rather than technological determinism. The history of computing technology is littered with technically superior alternatives which for one reason or another fail to be accepted by a relevant social group of users, and so fall by the wayside[9]. What was it that made the mouse so acceptable? How did its use become so widespread?

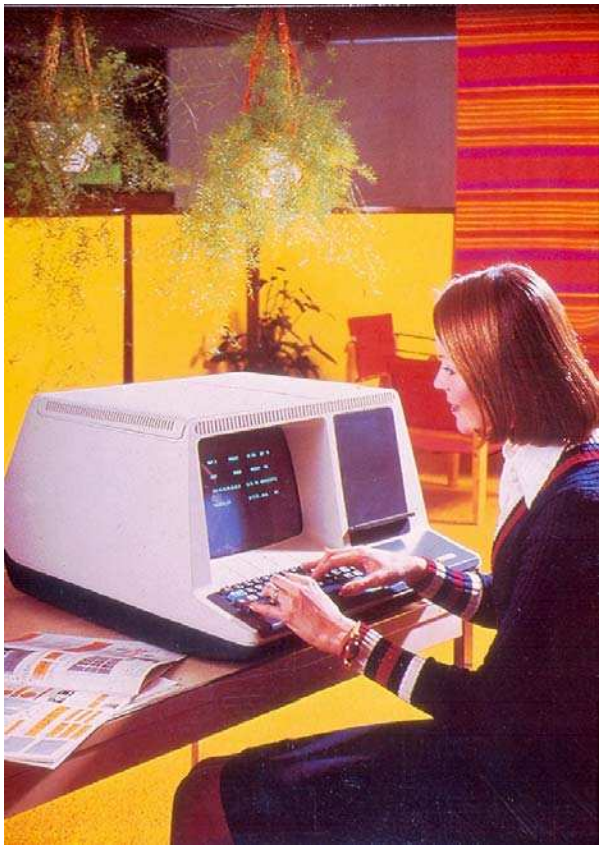
Analysis of the visual material surrounding computer technology in the late 1970s and early 1980s gives a clue to a potential cause of the wholesale adoption of the mouse. Although the images in this visual material are selected from an archive of brochures and adverts created by the computer manufacturers rather than documentary photographic evidence, they nevertheless clearly reflect the stereotypical attitudes and social mores of their day.

It is well documented that with the invention of the typewriter and its adoption into the office, the role of typing came to be seen as a feminine activity. This situation had certainly not changed by the time that computers first made an appearance into the office. Indeed at this point in time, there were distinctly different types of office computer being marketed for different uses – both as a tool of production for (female) data input, and as a tool of (male) managerial control[10].

The gender politics of the time meant that more often than not, women shown using computers were presented as office juniors or secretaries, and the activity they were carrying out was clearly the learned skill of typing – whether dutifully inputting data or producing documents to order [Fig. 22].

The same gender politics meant that males were shown in managerial positions, and when they appeared in these brochures alongside women using computers, the females tended to be shown seated and typing while male managers stood around, dispensing snippets of wisdom, handing over pieces of paper, or looking over the women's shoulders to make sure that everything was safely under control [Fig. 23].

Yet when males were depicted using computers by themselves, it is interesting to note that they are almost never shown as using the keyboard for typing [Fig. 24]. There is always a clipboard or a pad being written on, an important telephone call being made, and the computer is being used to provide important information to make managerial decisions (the text accompanying these images backs up this position – managers consulted computers to obtain forecast data, not to input information). If a hand is seen to be touching the keyboard, it is a single hand – command keys being individually pushed. The resistance to the act of typing in these images is almost tangible.



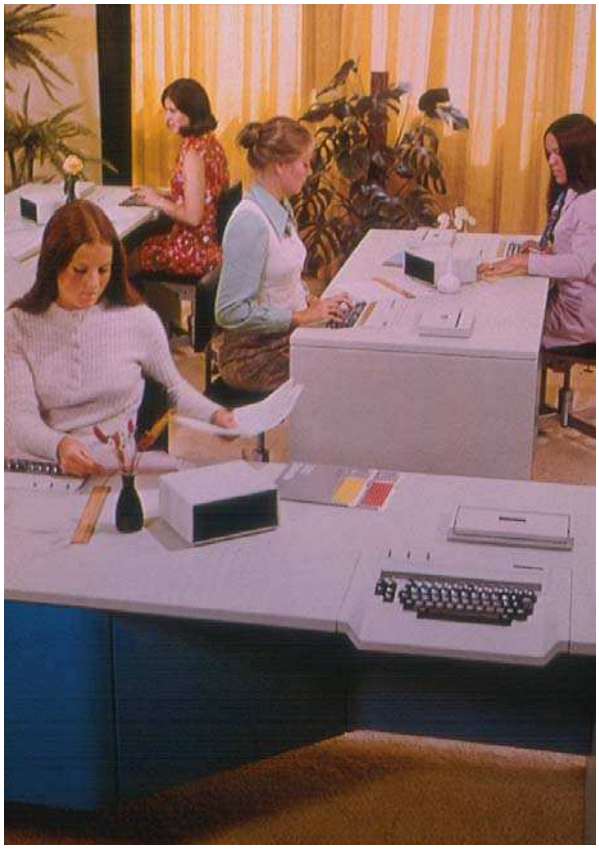


Fig. 22: Females shown using computers in the late 1970s and early 1980s were shown carrying out the feminised skill of typing.
(Images courtesy of National Archive for the History of Computing)

Fig. 23: Male managers were shown standing next to seated female operators in computer manufacturer's literature (Images courtesy of National Archive for the History of Computing)

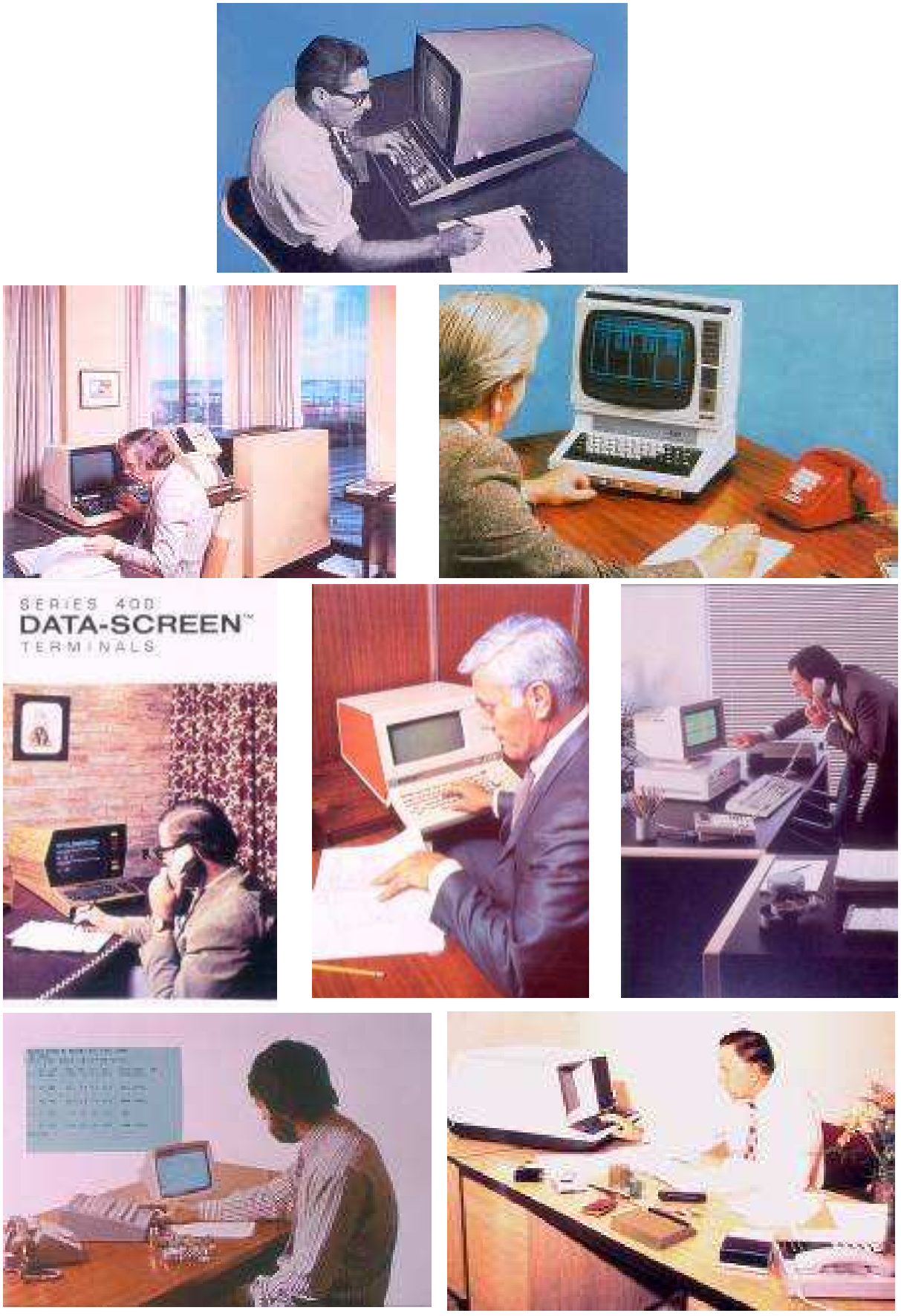


Fig. 24: Male managers using computers were shown accessing information rather than typing (Images courtesy of National Archive for the History of Computing)

Now clearly, there were wide-ranging, far-reaching social changes taking place at this point in time, most notably around the awareness of feminist issues and sexual equality which will have had an impact on the perception of male and female roles within the office. However, I would argue that this is where and why the mouse had such a significant impact. Despite its massive capability and the huge changes that computing technology brought to bear on office practices in the world of work, the office computer had, up to this point, maintained a physical form which presented itself as little more than an advanced electronic typewriter. Regardless of what it could be used to do, the only way of operating it remained the then feminised act of typing. Single handedly (if you'll excuse the pun), the computer mouse changed all that – all of a sudden, here was an object that not only changed the perception of the computer itself, but changed completely the practice of using a computer. With the mouse, one pointed and clicked, dragged and dropped. Actions perhaps far more acceptable to a user group of male managers, as they were actions that could mask the use of typewriter keys.

The mouse mutated the computer from following a clear line of evolution as a low-level piece of office equipment into a completely new piece of technology, operated in a unique way. I would argue that the mouse played a significant role in the wide-scale adoption of the office computer – a computer without preconceived notions of status and gender associations, and in doing so, that it made a substantial contribution to enabling the workplace of today.

Acknowledgements

I would like to take this opportunity to thank all those who gave their time to help in my research for this project: Dennis Boyle, Paul Bradley, Kate Brinks, Stuart Card, Doug Engelbart, Bill Moggridge, Rickson Sun, Bill Verplank, and Jim Yurchenco. An expanded version of this article has been accepted for publication in Design Issues, and will be published during 2007.

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[6] The story of the Apple Macintosh launch is described in Steven Levy's *Insanely Great: The Life and Times of Macintosh, the Computer that Changed Everything*, Penguin Books, 1994, pp. 169-171. The advert can be viewed at http://www.youtube.com/watch?v=OYecfV3ubP8 (accessed 28 Sep 2006)
[7] Interview with Dennis Boyle, Jim Yurchenco and Rickson Sun at the offices of IDEO, Palo Alto, California, 7 April 2006. A detailed description of this work can be seen in the form of primary documentation in the online archive from Stanford University, 'Making the Macintosh, technology and culture in Silicon Valley' (http://library.stanford.edu/mac/ accessed 1 Aug 2006)
[8] Interview with Paul Bradley at the offices of IDEO, Palo Alto, California, 7 April 2006
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