The origin of PCs : perspectives on the history of the office computer

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Paul Atkinson

Introduction

On the desks of offices all over the developed world, there rests a computer. An anonymous beige box, beige monitor, keyboard and mouse make up a self-referential design subject to no nationalistic or cultural diversity, or constructed product differentiation in the way it is marketed. It is a truly 'universal' design - a rare example of a global, mass-produced, multi-purpose object.

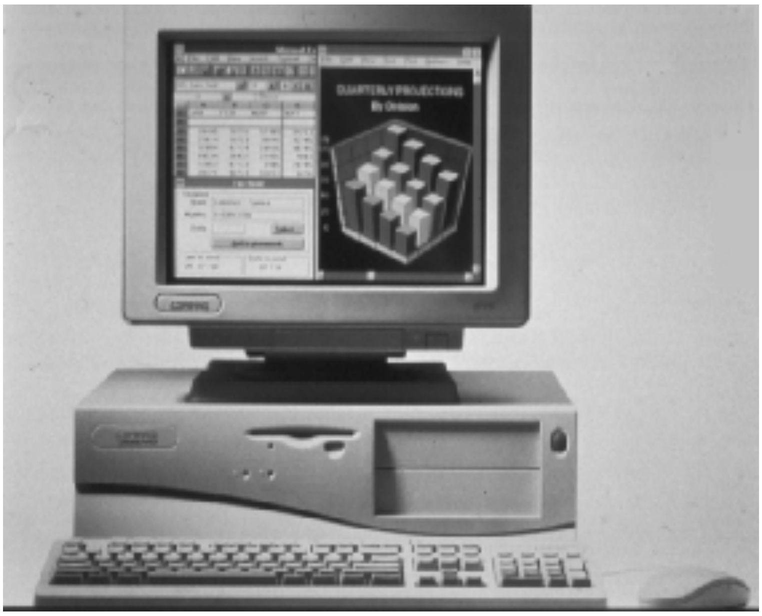

Fig. 1 - Compaq Deskpro

The personal computer might easily be regarded as the most influential invention of the late 20th Century, and its impact in the 21st Century shows no sign of abating. As an object, which, without doubt, has directly or indirectly affected the lives of the majority of people, it might be assumed that its design history is a well-known and documented story. This is not, however, the case. The form of the computer has been static for so long that its past identities appear to have faded into the ether. Perhaps because of their seemingly inherent technological obsolescence

they are viewed as ephemeral objects unworthy of notice.
This paper suggests that the computer presents a series of unique problems to design historians, and that the various methodologies which have been used to construct its history to date have been, at least in part, responsible for the way in which computers are perceived today. This paper aims to construct an overview of some of these histories; a meta-narrative of the different perspectives that have been used to document this development, and perhaps suggest more fruitful avenues for exploration.
The computer revolution (as opposed to the computer as an object) has been the subject of intense scrutiny creating a huge amount of material discussing the very latest improvements, the possibilities of the near future or the long-term implications of the present direction of development. Earlier texts seem to be enthusiastic about the potential of future computers (Hollingdale &Tootill 1965), with concerns about the changes in society resulting from the introduction of technology starting to appear in the 1970's - most notably in the work of American Futurologist Alvin Toffler in '*Future Shock*' (1970) and others (Rothman & Mosmann, 1972, Holoien 1977, et.al.). By 1980, the computer appears as the main component of a broader ranging 'revolution' having wide-ranging implications (Toffler 1980, Bolter 1984, Shallis 1984, et.al.) Bolter stated "progress in the computers and in the rest of our current technology is so rapid that it tends to negate history...for in high technology anything more than a few years old is obsolete."[1] Computers have always, by their very nature, been of the moment. They have always looked to the future, rather than their own past.
The history of the technology leading to the computer has, however, been explored in detail, perhaps as an attempt to cast light on a largely new phenomenon. Such texts usually start with the abacus, continue through the work of Babbage and his mechanical calculating engines, and go on to discuss Hollerith's punched card census processing equipment as the source of the modern, programmable computer (Evans 1981, Holoien 1977, Trainor & Krasnewich 1992, Williams 1997, et.al.) thereby

firmly placing the computer (sometimes in the space of only a few pages) as merely a development of the familiar industrial revolution rather than a frighteningly new technological or cultural revolution.

The history of the computer industry as a major component of today's business world has also been well documented. The rise of computer corporations in general (Cortada 1993, Campbell - Kelly & Aspray 1996) and specific case studies such as Olivetti (Kircherer 1990), Philips (Heskett 1990), ICL (Campbell-Kelly 1989), Apple (Moritz 1984, Levy 1994) and especially IBM (Foy 1974, Fisher 1983, Mercer 1987, Chposky 1989, Pugh 1995) are texts which analyse in depth the technical research and development and the changing marketing practice which has created such wealthy, powerful companies. Indeed, computers may have been, and by some still are perceived as the preserve of a small group of technical specialists speaking their own, private language or as a secret development driven by the military or opaque corporations (Edwards 1996); but, at least in the developed world, they are increasingly a major part of most people's lives.

Other, more recent, perspectives of writing on the computer have been from a post modern theoretical or post-structural, ethnographic approach to exploring the effects of computer technology on society - the psychology and sociology of science. Writers such as Turkle (1995) and Plant (1997) accept the role of the technological in changing the way people see the world, and focus on the simulacra of the computer interface as a "world of surface", and on virtual reality and 'cyberspace' as "worlds without origin" [2]. Ethnographic approaches have also been employed in the field of cultural studies in exploring the role of computing technology, especially looking at the effects on domestic family behaviour and structures (Silverstone & Hirsch 1992). The attention in these writings is on the part computer technology has played in shaping the way people think about themselves and others in relation to the computer. They are mentioned here only as another aspect of observing the computer. On the face of it, the importance of this approach is diminished with respect to this paper because when Turkle says "Computers would not be the culturally powerful objects they are turning out to be if people were not falling in love with their machines, and the ideas the machines carry" [3] the love she describes is with the virtual world within the computer rather than the external object which contains it. Such writings, while fascinating, are largely irrelevant to empirical design history as they entirely negate the object.

The computer revolution has become a social and cultural phenomenon which justifies discourse within any academic field, and yet the vast majority of work on the subject of the history of the computer has been written by economic historians and historians of technology rather than historians of design [4]. These writings have tended to follow the path of technological determinism - even going so far as to wholeheartedly adopting evolutionary analogies and Darwinian family trees as explanatory diagrams. Only relatively recently has there been a move towards the perspective of the social construction of technology. Even so, the history of the computer as a cultural object in its own right, especially from the perspective of its consumption rather than its production, is only now starting to appear.

Technological Determinism and Darwinian Analogy

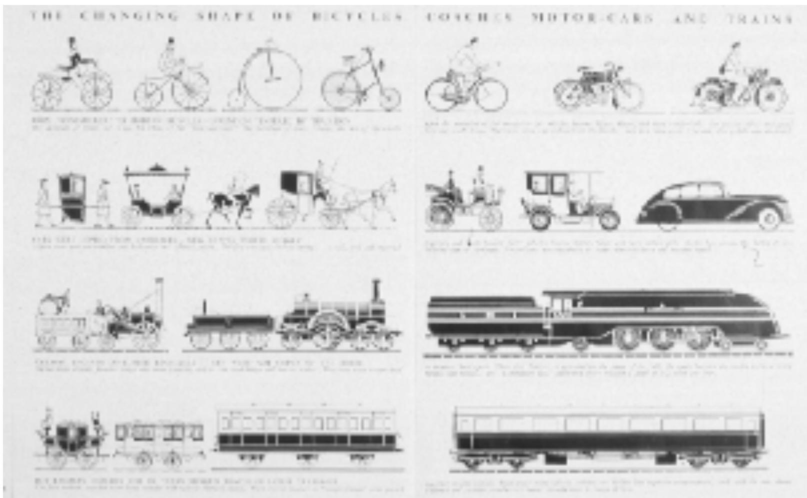

Fig. 2 - The Changing Shape of Things - bicycles, coaches, motor cars and trains, Redmayne & McNally, 1945

It might only be expected that in writing about a technological object, the tendency is to give the technology itself a central role in its history. Yet technological determinism as a perspective for the writing of history can be seen as problematic in a number of different areas. Thomas Misa described the historians role in the process of allowing machines to make history when he stated "it is historians (and others) who decide the extent to which technology acts as an independent force to shape history" [5]. Different levels of technologically deterministic writing were described by Misa as ranging from the pure 'philosophy of technology' at one end to 'labor historians' at the other. Business historians and historians of technology were seen to hold intermediate positions on this sliding scale between emphasising technology's causative role in shaping society and the Marxist philosophies denying its influence altogether.

Hughes describes an example of the problems associated with deterministic approaches in examining the 'evolution' of technological systems. After prolonged growth and consolidation a technological system can give the impression of acquiring its own momentum. The danger is that "A high level of momentum often causes observers to assume that a technological system has become autonomous" [6]. The notion that technology can achieve a level of self-determining direction may explain how its growth can come to be seen as a process of evolution.

Computer developments have been referred to as evolutionary as far back as the late 1940s when IBM adverts used the strapline 'Evolution not Revolution'. The evolutionary analogy may well have been aided by the continual anthropomorphication of the computer as evidenced through the terminology associated with it. Technological historians have previously classified the development of the computer into five 'generations' (Withington 1974 (in Rosenburg 1992), Aspray and Beaver 1986, Trainor and Krasnewich 1992) with all the biological assumptions such words connote. We discuss their 'memory' (an intrinsic part of our individual identities) as if they actively remember information; and we talk of them being 'infected' by a 'virus'. The majority of computers are not original, but are 'clones' - as if they had been grown rather than manufactured. The language of computing seems to have prepared us for the day when computers will 'evolve' into an artificial 'intelligence'.

Philip Steadman's insightful work 'The evolution of designs' is perhaps the most thorough work on biological analogies in architecture and design. In this he sets out a tripartite view of analogies between organisms, mechanisms and buildings or works of art. These provided the standpoints of 'the organism as a model for design', 'the machine as a model for the work of art' and 'the machine as organism' - which he mentions as being prevalent since the nineteenth century when it was applied to 'boats, carriages or musical instruments' and especially to the development of primitive tools and artefacts [7]. As Steadman points out "A rigorously Darwinian analogy in the evolution of decoration (or of functional objects) would have to assume that all changes in their forms were introduced entirely accidentally and without any forethought or deliberate intention. This is quite plainly a most implausible suggestion." [8].

The visual representation of evolution is perhaps best known in the form of the diagram 'The March of Progress' or 'The Ascent of Man'. The image of a small, squat ape changing slowly into upright, modern man has been described by the evolutionary biologist Stephen Jay Gould as "*the* canonical representation of evolution - the one picture immediately grasped and viscerally understood by all" [9]. This is evident through its continued appropriation in cartoons and adverts whenever a chain of logical, progressive development needs to be portrayed. It has been used across all areas from political caricature and religious satire to advertising such products as beer, television rental services and even pension products (Fig. 3).

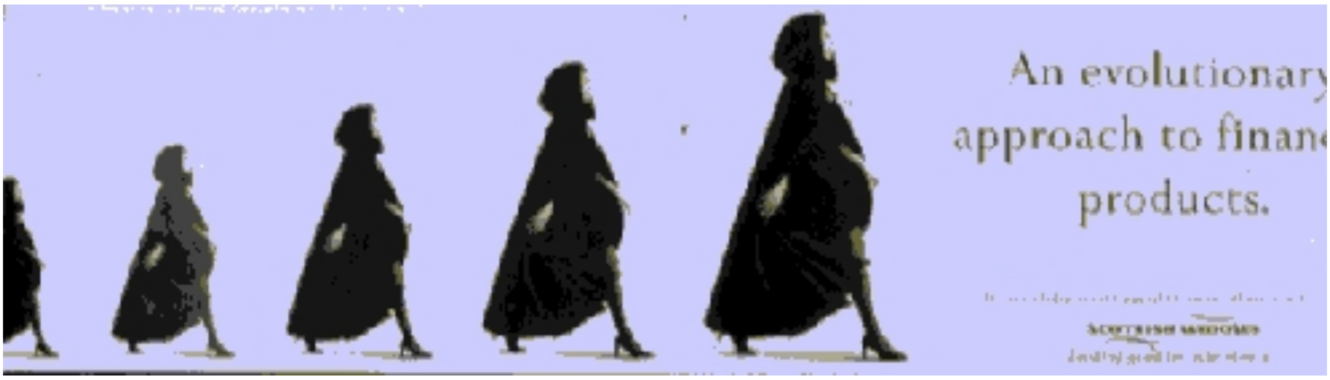

Fig. 3 - 'The March of Progress' - an advert for financial products, Scottish Widows, 2000

Yet, even in the field of evolutionary biology, the image of 'The March of Progress' is highly problematic, as Gould states: "Life is a copiously branching bush, continually pruned by the grim reaper of extinction, not a ladder of predictable progress". Misguided attempts to extract a single line of advance from the copious branching draws us to "bushes so near to the brink of total annihilation that they retain only one surviving twig. We then view this twig as the acme of upward achievement, rather than the last gasp of a richer ancestry". [10] He goes on to state that another error lies in acknowledging the "branching character of evolutionary lineages, yet still portray[ing] the tree of life in a conventional manner chosen to validate our hopes for predictable progress".[11] To state that any grouping can be traced to a common ancestor means accepting the 'evolutionary tree' must have a single, 'unique' trunk, and that each branch of the tree will either cease or diversify further - there is no possibility that discrete branches will ever connect. This view of technological development denies the new. Without a starting point or direct ancestor, a completely new technology has no place in the scheme of things.

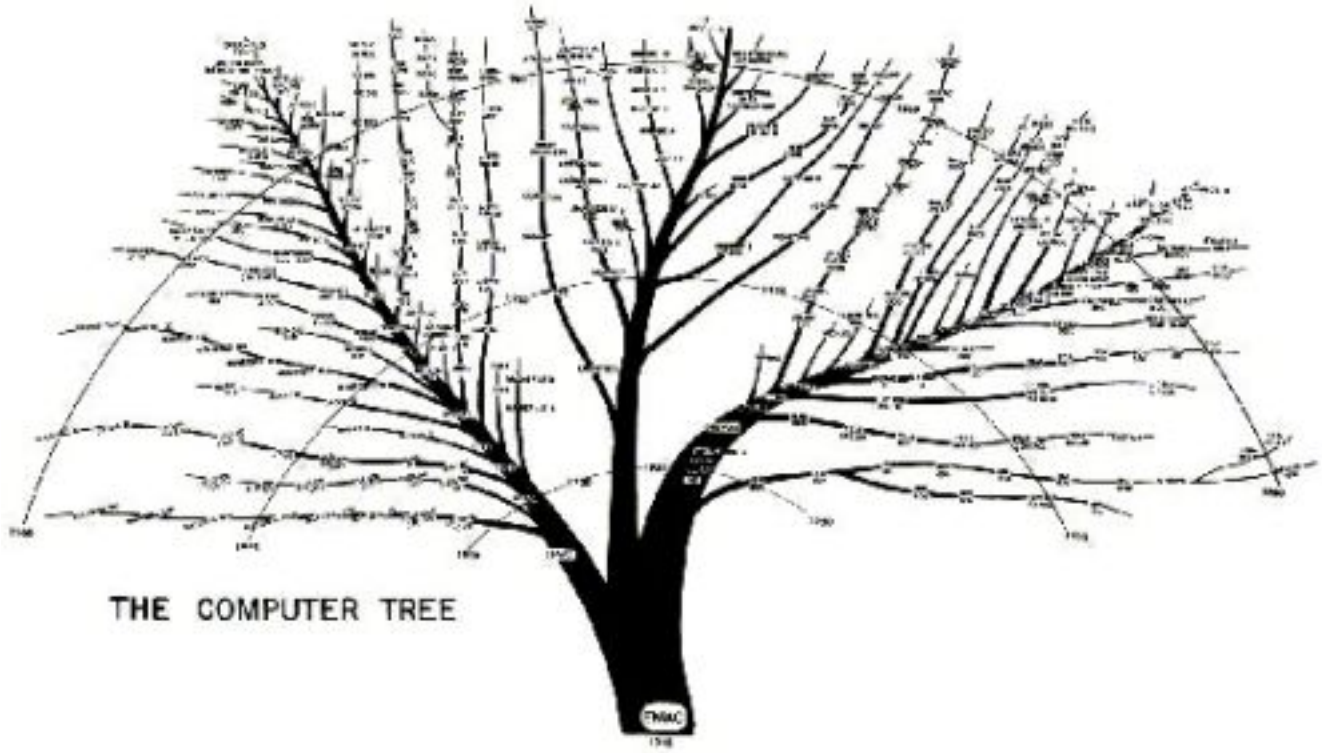

Fig. 4 - A version of the image 'The Computer Tree'

A famous appropriation of this model in the field of computing history is the 'Computer Tree'. Various versions exist - one showing electromechanical devices as the roots of the tree and the 1944 'Harvard Mk 1' Automatic Computer as the trunk, and another, more widely known version (Fig. 4) having no roots at all (perhaps then, a modernist version?) showing the 1945 'ENIAC' Electronic Computer as the trunk. This model highlights the nature of the myth - that all computers have a single, common source; that each new development is indebted only to its own direct predecessor; and that no connection can be drawn or new one made between one strand of development and another. Such a model is, on the face of it, completely deterministic - it is self-referential and acknowledges no outside influence of the technological development other than technology itself. It exists apart from and outside of our social sphere.

This 'tree' model is referred to in evolutionary terms as a 'cone of increasing diversity', starting with the singular and simplistic, and progressing upward to the multitudinous, and by implication, 'better' or complex. As Gould points out, the

problem with this model is that in moving through time from simple to complex, the place of any element in the model becomes irrevocably associated with worth. This, certainly in design terms, we know to be untrue.
However, models of evolution continue to be adopted as models of historical analysis. The "false iconographies of ladder and cone" [12] both suggest structural connections or misleading order within diversity. While denying the placement of anything new or completely original, they paradoxically provide the security of ever increasing diversity and inevitable progress. And herein lies the problem. Once the term 'evolution' becomes synonymous or interchangeable with 'progress' the reverse also becomes accepted - technological progress comes to be incorrectly seen as evolution, and by implication, natural.

The Social Construction of Technology and Structural Analysis

The conclusion Misa came to was to suggest that the social construction of technology held more promise as a conceptual framework for analysis than technological determinism, as it could "understand the interplay of content and context in technology" [13], and would not side with either the view of 'technology as a social force' or 'technology as a social product' but would present technology "at once as socially constructed and society-shaping" [14]. According to Misa, seeing technology as a social process in this way would 'set the machine in history'.
William Aspray also criticised those writing 'one-dimensional' accounts of computing history which did not pay "sufficient attention to business, economic, social, or political dimensions" [15]. He raised concerns, however, that "the scholarship by historians does not always exhibit the same depth of technical understanding" compared to computer professionals, and stated their work to be "marred by technical error or superficiality" [16].
Faced with the complexity and range of the subject matter, such an opinion is hardly surprising. When I first started to examine the history of the form of the computer, it was from the starting point of noticing how boringly similar in design recent

computers were compared to how conceptually exciting they appeared to have been in previous decades [17]. My initial approach to exploring this change was to collect as many images as possible of computers having different physical forms. These were largely from an archive of manufacturer's catalogues covering the period from the 1940s to the 1980s at the National Archive for the History of Computing at the University of Manchester. Adopting a structuralist approach these images were grouped into computers which shared similar characteristics in the arrangement of their component parts, and which were represented by a generic line drawing to enable comparison.

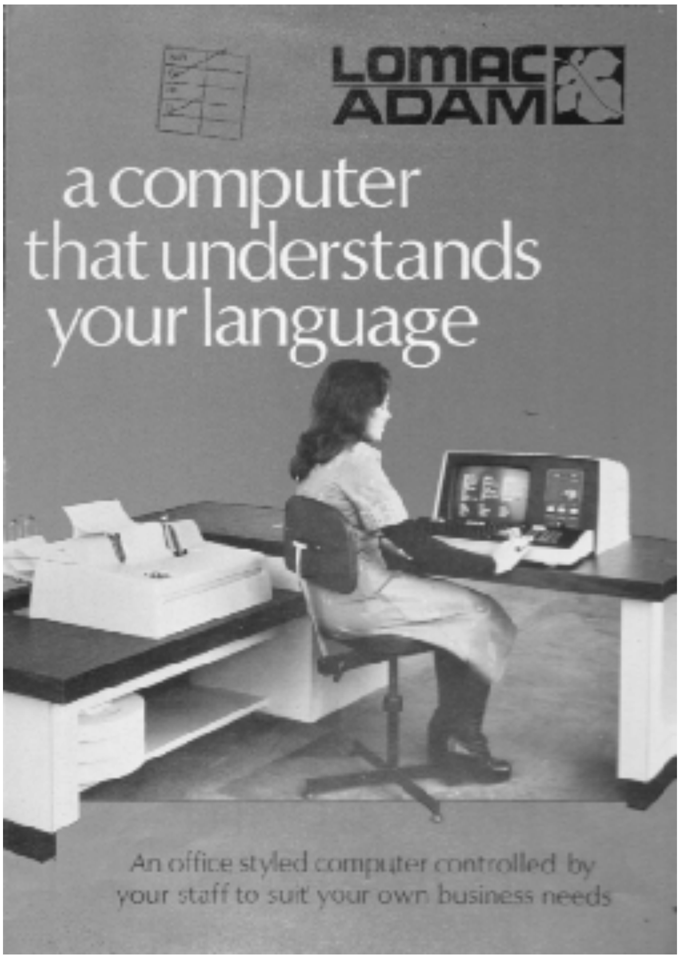

Fig. 5 - Lomac-Adam 1976

Form	C
Earliest Appearance	1964
Latest Appearance	1979
Form Type	Console with Monitor
Keyboard/Controls	In Console
Monitor	In Console
Processor	Remote
Storage	Remote

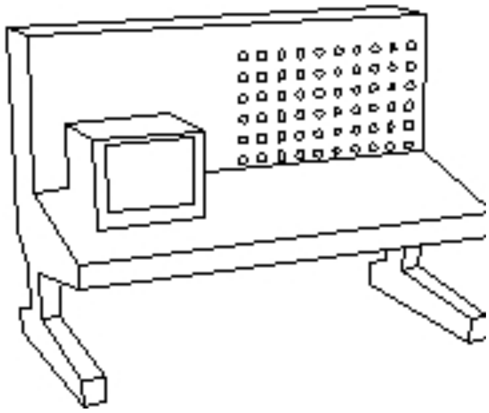

Fig. 6 - Form C

From over 250 images of different computers, 21 distinct forms of office computer could be identified.

Form	N
Earliest Appearance	1976
Latest Appearance	1977
Form Type	Self-Contained Desk
Keyboard/Controls	In Monitor
Monitor	In Keyboard
Processor	In Desk/Remote
Storage	In Desk

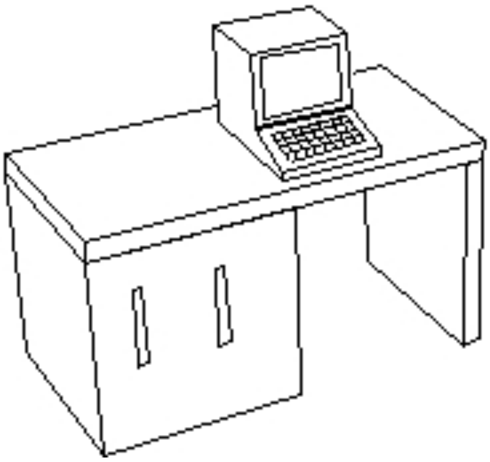

Fig. 7 - Form N

The images within each of these 21 groups were then organised into chronological order to give a tentative indication of when each form appeared, and how long it endured.

Form	U
Earliest Appearance	1985
Latest Appearance	Current
Form Type	Self-Contained Desktop
Keyboard/Controls	Separate & Mouse
Monitor	Separate
Processor	Separate
Storage	In Processor

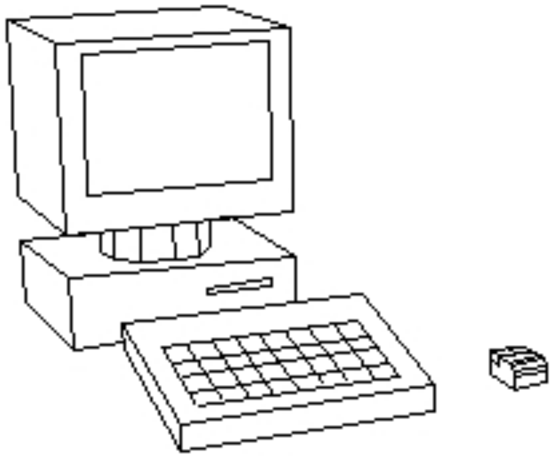

Fig. 8 - Form U

There was, for obvious reasons, no way of ensuring conclusive dates or fully comprehensive coverage of all forms through this process. No archive of this kind can declare itself as complete, and the brochures collated cannot be stated as being the earliest or latest examples of a particular form. In any case, the date of the brochure does not necessarily relate directly to the dates the computers were used in reality. It is important to realise here that although this methodology was structural in its analysis of form, it presumed no connection between different computers in the same period, or from one period to another.

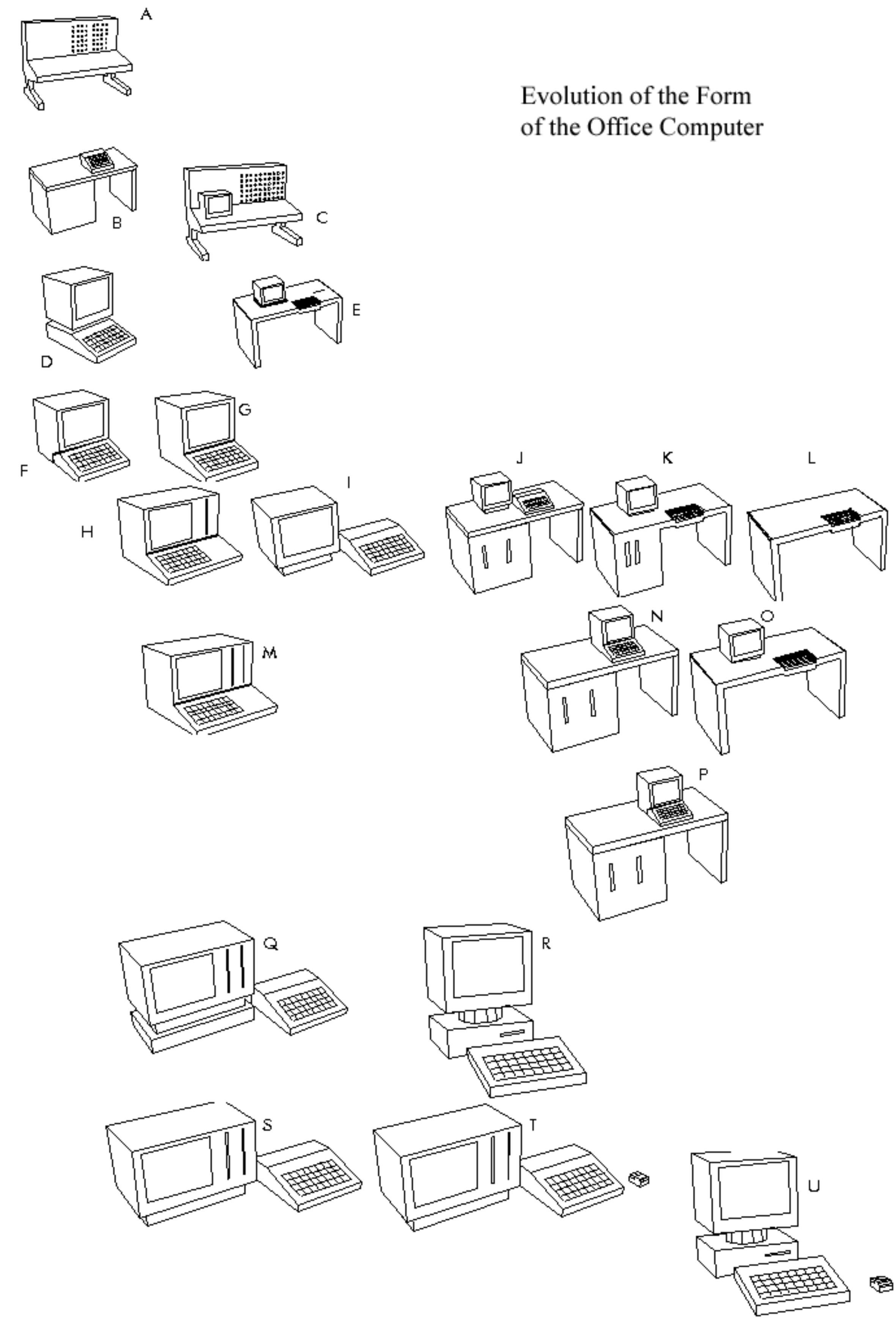

Fig. 9 - Evolution of Computer Form

[Not that I could condone this, but how tempting to make such connections, how easy to draw a line of simplistic cause and effect from start to end! (Fig 9)]

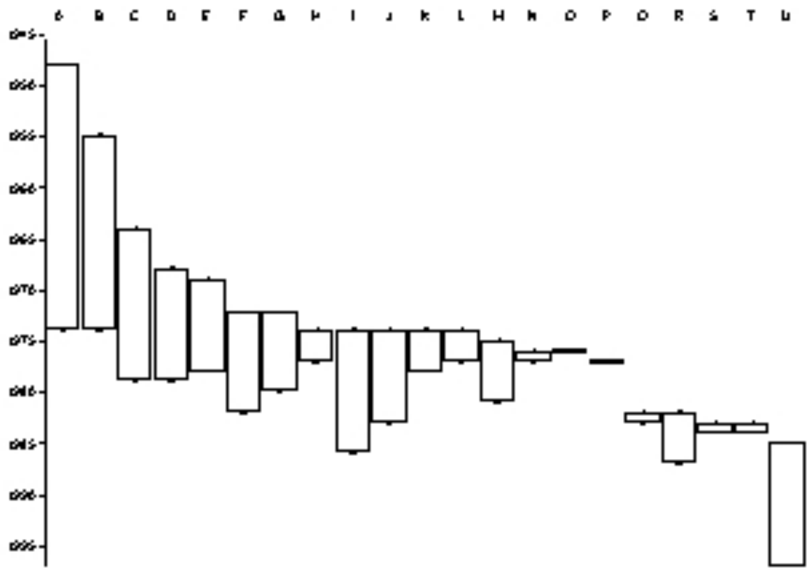

Fig 10 - Duration of Different Forms

The interesting aspect to note here was that by placing these 21 groups into a time-based column chart, (Fig. 10) a clear picture could be seen of the longevity or persistence of each form compared to the others.
It could be shown that early forms of the computer, when there were few varieties of form, remained valid for many years with the duration of any form becoming shorter as time went on and a multitude of forms were in use at the same time - until, that is, the appearance of the 'final' form of the office computer which exists today.This suggests that a position of equilibrium or stasis has been reached where all new developments occur within the same physical form.

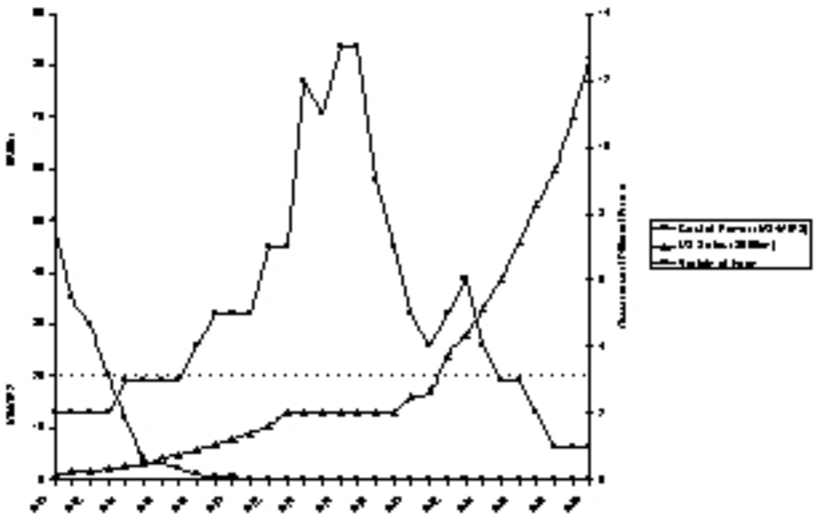

Fig 11 - Sales/Cost of Power/Variety

The possible reasons for this increasing diversity of form were many, and understandable (Fig. 11). To begin with, the cost of computing technology was extremely high, sales low, and the rate of obsolescence unpredictable. Over the years the cost of the technology reduced and sales in new markets increased exponentially - a competitive situation almost certain to lead to a large variety of forms.

Perhaps more difficult to understand is how quickly the variety disappeared as the cost of the technology became almost negligible and sales figures reached the stage where the computer becomes a commodity item.

Without realising it, the column chart I had produced to describe the variety of different forms of computer and their duration over time contained two of the three axes used in 'dynamic systems theory'. By laying that diagram down as the base plane of a three-dimensional chart and adding 'fitness' (or to put it crudely, popularity) as the vertical dimension, a comprehensive image of the development of different forms could apparently be displayed. While this would be extremely desirable, I feel the difficulties associated with collating accurate sales figures for the different types would be insurmountable.

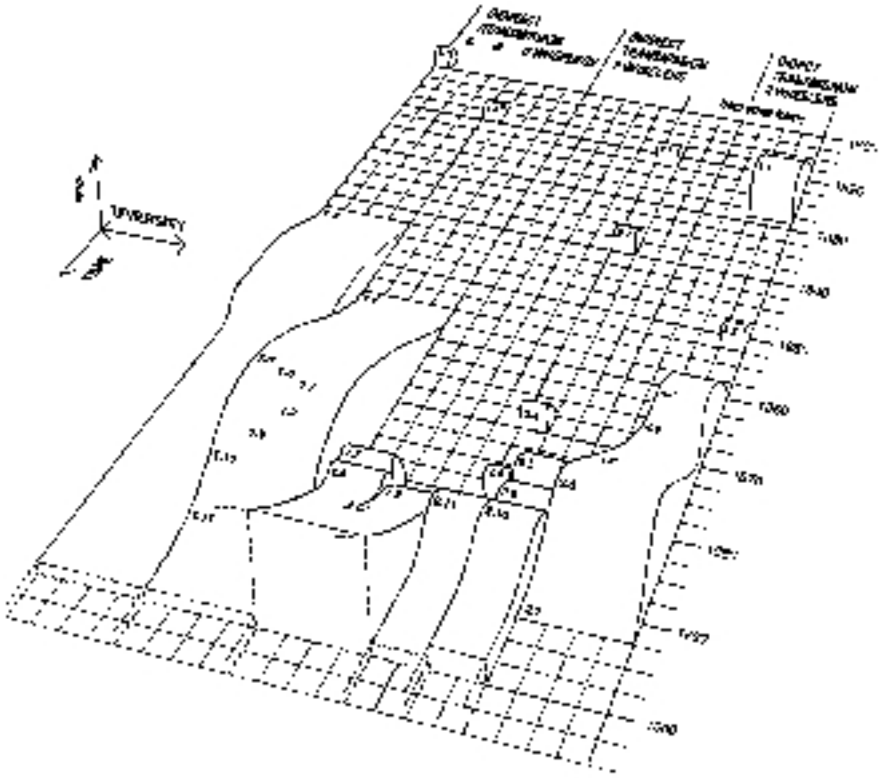

Fig. 12 - Dynamic Systems Theory Fitness Landscape showing 'the Evolution of the Bicycle'

van Nierop, Blankendaal and Overbeeke employed this analytical technique (previously used in a variety of scientific and social disciplines) in their case study of the 'evolution' of the bicycle (a favourite subject for technological determinists everywhere). (Fig. 12) While the diagram appears to give a comprehensive account of the development of different types of bicycle, the analysis of each type's development is only discussed in technological terms, and while not simplistic, it remains deterministic.

In this particular case study there is also the question of accuracy around some of the information used about the bicycle's history. The result is a somewhat subjective analysis which, presented in this manner, takes on the appearance of scientific fact. The authors acknowledge sociological constraints as no less important than technological ones, but felt "the global process of diversity generation and extinction requires no other explanation than a dynamic one" [18]. I would beg to differ. This model of development shows clearly that the history of a product is not inevitably linear, yet dynamic systems theory recognises only three different types of 'fitness landscape' - simple, chaotic and complex. Simple landscapes have no variety, only one optimal product producing a single plateau; chaotic landscapes have a large number of types creating a rugged image of peaks and troughs; while complex landscapes display a balance of neither too few or too many variations. The theory predicts that any adaptive system will always achieve a 'complex' state with an optimal number of varieties to ensure continuation and adaptability in the face of changing circumstances. Clearly, this is not the case with the personal computer as one design largely fills all the roles a computer undertakes. As a truly multi-functional product (a situation incidentally which may not last) it acts as a word processor, calculator, financial planner, desktop publisher, communicator, information retriever, image creator, solid modeller, and so on, and so on. The adaptability required within the system is in the domain of the software running on the computer, not the hardware itself. One can, perhaps, only assume that other factors are at play which are not covered by this methodology.

Consumption of Computers

In my research and analysis on this subject [19], these other factors were explored by examining the images of computers and the accompanying text from the brochures within each of the forms identified and analysing them to determine how different forms of the office computer had been received by consumers. Although the object of analysis here fluctuates between the analysis of a representation and associated biased authoring, the brochures have to be viewed as a form of advertisement. The analysis is not, therefore, of documented reality, but of the construct of the manufacturer's imagination. As these brochures are designed to appeal to a target audience in the same way as an advert, their analysis in semiotic terms is seen to remain valid.

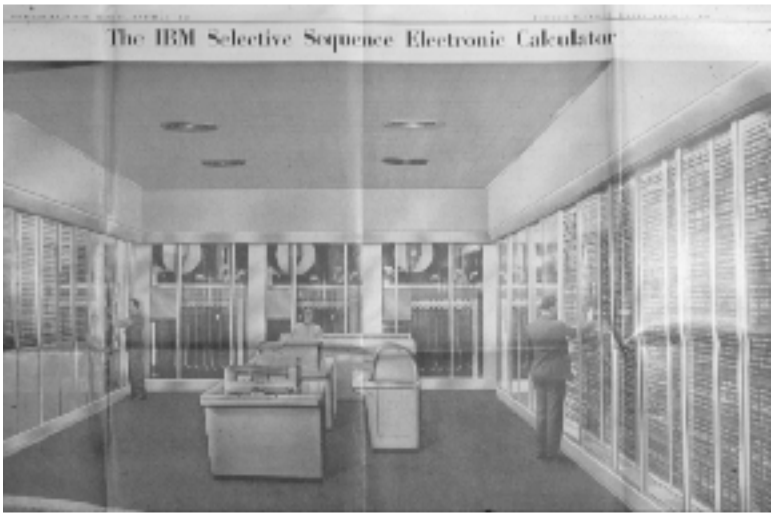

Fig. 13 - IBM SSEC, 1948

The results showed how over the years the office computer was represented and received at different periods and to different audiences, and how those forms had been influenced by a variety of social factors.
These representations ranged from the computer as a frighteningly new or alien technology (Fig. 13)…

Fig. 14 - Burroughs E101, 1955

… to a familiar piece of office equipment..

Fig. 15 - Hewlett Packard HP250, 1979

They have reflected general stylistic trends in design such as integration…

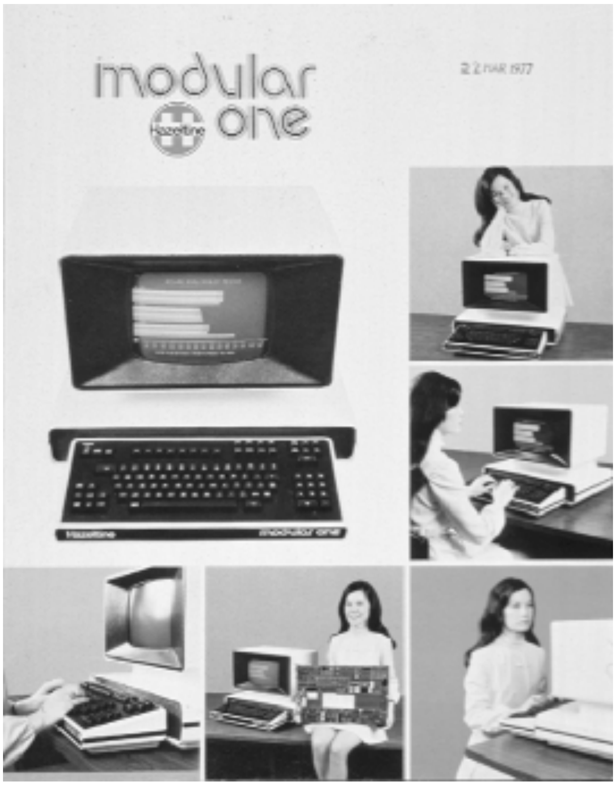

Fig. 16 - Modular One, 1977

… and modularisation..

Fig. 17 - Sanders 720, 1974

In terms of acting as markers of gender and status, they have reflected feminine work production…

Fig. 18 - GEC Datacom 30, 1978

… and masculine managerial control (note how women operating the computer are presented as only ever having to type - whereas whenever a man operates a computer, he still has to be shown as needing to write).

Fig. 19 - ITT 3280, 1978

They have taken on the appearance of being little more than an advanced typewriter,

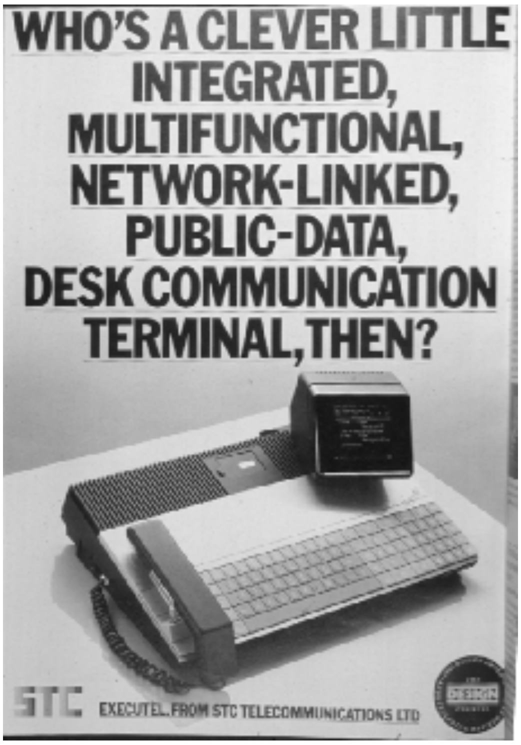

Fig. 20 - STC Executel, 1984

an advanced telephone,

Fig. 21 - IBM 5100, 1976

to being an advanced piece of scientific equipment.

Fig. 22 - Data Dynamics ADM-2, 1975

They have reflected the aspirations of a society immersed in the space age..

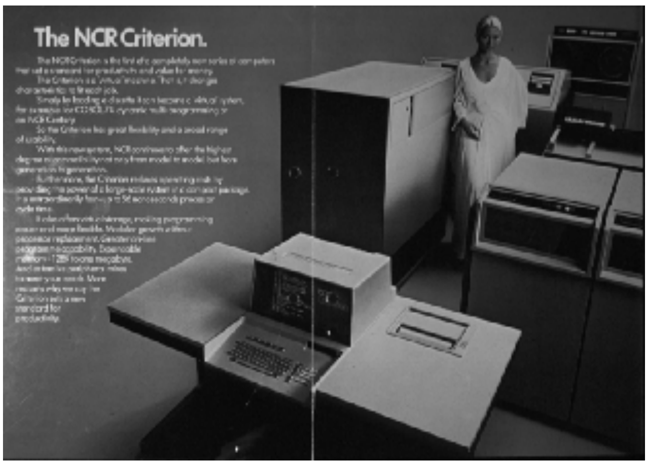

Fig. 23 - NCR Criterion, 1976

… and been a representation of our hopes for the future.

Conclusions

Having looked at a variety of methodologies and perspectives used to construct histories of the computer and finding a number of shortfalls in each, where do we go from here? Historians of technology, writing as technological determinists, have provided a somewhat blinkered and causal account of the computer's development. The history of the computer cannot be moulded to fit a simple, convenient evolutionary model. It is too complex or inscrutable an object, subject to too many diverse factors - technological, yes; economic, yes; but also semiological, sociological, cultural and political. The great benefit of their work, though is that as specialists in their field it is mostly a highly detailed and in-depth, accurate factual contribution. Social constructionists, on the other hand, have opened up the area to consider a host of implicit meanings around the consumption of the computer. While this is useful in that it denies determinism, the writing of the history of the computer through this kind of analysis often falls short in having a lack of detailed knowledge of the technology involved and of the economic, business and political influences which cannot be denied as important factors. Consequently (as my own work shows) semiological and structural analysis tends to be forced to make certain assumptions and generalisations in order to construct history.

I am not suggesting that this should apply to all objects, but certainly in the case of the computer, theories of production **and** consumption, covering technological, economic **and** social perspectives need to be considered. The history of technology is needed because the technology behind the computer is complex, and has such an involved history which is not easily understood by a non-specialist. Economic and business history is needed because of the convoluted nature of the industry. Companies involved range from people working on their own in garages to global or multi-national corporations, both of which have been subject to a potentially confusing series of bankruptcies, mergers and takeovers often within a framework of political interventions.

Social constructionist approaches are important because of the complexity of the ways in which computers are consumed by people across the whole range of hierarchies within organisations from the Chief Executives down to the secretaries, sometimes for very different reasons, and sometimes for identical purposes. The same object is also, of course, consumed in a domestic context as well as in the workplace. Due to the unique multi-functional nature of the personal computer, a single object has a host of different meanings to different people.

Finally, the psychology and sociology of science - a discipline only touched upon at the start of this paper - has a valid point to make in the case of the computer as it raises a question of binary opposites which historians of design have to address. Are we dealing with the object itself or the ideas contained within it? Are we discussing hardware or software? Is our analysis to be framed within the real world, or the virtual world?

Perhaps more than any other technological artefact, the computer requires an integration of all of the above perspectives. To be successful this approach will require more than mere multidisciplinarity. A complete and effective history of the personal computer will not be achieved without the adoption of truly interdisciplinary methodology.

Notes

1 Bolter, J. D (1984) Turing's Man, pp. 225/226.

2 Turkle, S. (1995) Life on the Screen, pg. 47.

3 Ibid. pg. 49.

4 As a matter of interest, in 1994 William Aspray wrote "To simplify, three professions have undertaken research and writing on the history of computing: computer professionals, historians of technology and science, and journalists". Design historians are conspicuous by their absence! (See Aspray, W. 'The History of Computing within the History of Information Technology', History and Technology, Vol. 11 (1994), pp. 7-19).

5 Misa, T. J. 'How Machines Make History, and How Historians (and Others) Help Them to Do So', Science, Technology, & Human Values. Vol. 13 Nos. 3 & 4, 1988, pg. 308.

6 Hughes, T. P. 'The Evolution of Large Technological Systems' in Bijker, Hughes and Pinch (Ed.)(1987) The Social Construction of Technological Systems, pp. 51-82.

7 Steadman, P. (1979) The evolution of designs, pgs. 14,15.
8 Ibid. pg. 109.
9 Gould, S.J. (1989) Wonderful Life, pg. 31.
10 Ibid. pg. 35.
11 Ibid. pg. 36.
12 Ibid. pg. 43.
13 Misa, T. Op. Cit. Pg. 322.
14 Ibid.
15 Aspray, W. Op. Cit. pg. 9.
16 Ibid. pg. 10.
17 See Atkinson, P. 'Computer Memories: The History of Computer Form', History and Technology, Vol. 15 (1998), pp. 89-120
18 van Nierop, O. A., Blankendaal, A. C. M. and Overbeeke, C. J. 'The Evolution of the Bicycle: A Dynamic Systems Approach', Journal of Design History, Vol. 10, No.3 (1997) pg. 267.
19 See Atkinson, P. (Op.Cit.) and 'The (In)Difference Engine: Explaining the Disappearance of Diversity in the Design of the Personal Computer', Journal of Design History, Vol. 13, No. 1 (2000) pp. 59-72.

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