Machine Culture.

Simon Penny
Electronic Intermedia at the University of Florida

ABSTRACT: This paper is about the relationship between technological change and socio-cultural change. In particular it is about the position of the artist with respect to these types of change. The origin of the Art/Science schism, the history of the technophilia of the art community and the contemporary signs of reconvergence are examined. In conclusion the paper speculates on appropriate activities for art and artists in the post industrial context.

The technology of a culture and its world view are bound to each other in an isomorphic symbiosis (a 'chicken and egg' analysis is beside the point). This was true in Plato's day: the contemporary technologies of potting and weaving structure Platos' images; and in Descartes': the idea of mechanical clockwork informs Descartes' view of the world. It is true now. (1,2). Since the Industrial revolution, technological development has been the major force for change in Western society. New machines like the steam locomotive became icons and images of power. The standardization of industrial mass production became a new structuring reality (...you can have any colour as long as it's black.).

In the sixties, electronics, particularly logic electronics, supplanted the brute machine as the image of 'progress'. The product of technology became ephemeral and information was commodified. The computer became the paradigmatic technology. By the early 1960's it became commonplace for people to speak not only of their genes but of their minds and private psyches as being 'programmed'"

The premises of this paper are: 1. That the machine has been and remains a major force in our culture, both literally and metaphorically. 2. That although art is a product of culture, and our culture is shaped by the machine, art practice has avoided considering 'the machine' as a cultural force. 3. Both art and industry are concerned with the production of objects. It is of crucial importance for contemporary esthetics that the implications of the ephemeralization of the machine are considered.

Modern Times

Some new technologies are eagerly embraced by society while some are resisted. Elting Morison contends that new technologies will be resisted if they promise to distort the fabric of society. His case study of the steamship Wampanoag is an illustration of this phenomenon of societal inertia. (3) However, in many cases the distorting potential of a technology is not forseen. The early inventors of the "horseless carriage" could not have predicted the way in which the automobile would radically change the design of our cities or the form of social relations. On the other hand, some new technologies are eagerly embraced. A very clear example is the pharmaceutical industry. The ready availability of antibiotics has altered our attitudes to pain, to illness and debility, indeed about the occurence of death. The availability of reliable chemical contraception has altered the position of women in the workforce, sexual morality and the institution of marriage.

Every niche and corner of our lives is inhabited by machines. Our lives flow and wrap around them. Our behavior is qualified by them and accomodates them: telephones, cars, airplanes, television, electric light and electronic banking. We are integrally bound to the logic of machines, they permeate our lives.

An immense mythology has built up around the machine since it began to radically change the face of the planet and the relationship of people to their work. This has as much to do with the machine being a convenient focus for an examination of the change in power relations between the nobles and the serfs, as any quality of the machine itself. The industrial revolution spawned two new neuroses: technophobia and technophilia, each debilitating. A history of the trumpeting of new technological developments as 'quick-fixes' for global problems would be an appalling catalog of human folly, from the locomotive to the green revolution and

beyond. Technological utopianism is a pernicious virus.

Dark Satanic Mills

Before the industrial revolution, in the day of Francis Bacon, the arts and the sciences were united. Hamlet says: "....What a piece of work is man, how noble in reason, how infinite in faculty..."(4) Reason and faculty are undivided. In the development of industry and engineering, 'science' came to serve 'commerce', and 'art' (along with religion) was left to define itself in opposition to 'science'. Thus arose the classic schism: the rational/scientific vs the romantic/mystical. This schism persists as a major polarity in our culture to this day. 'Humanity' came to be defined exactly in terms of those qualities that differentiated it from the machine: passion, creativity, even fecklessness.(5)

Jacob Bronowski reconciles these antagonisms with his eminently sensible observation that Blake and Coleridge were contemporaries of Arkwright and James Watt, that the Industrial revolution and the Romantic revival were precisely contemporary. "It was the engine, it was the horsepower which created consideration for the horse: and the industrial revolution which created our sensibility." (6) So Impressionism could not exist without photography, the idea of the 'original' only makes sense in the context of mechanical reproduction. (7) Each new wave of technology allows us to re-evaluate our culture, to find new value in old things.

Artists and Machines

Why is it that while literature and cinema have become technologised, there has been a notable reticence on the part of visual artists? Perhaps it threatens their mode of production. Painters and sculptors are after all, artisans. At the advent of the Industrial revolution, William Morris made a claim for the 'craft' process, and saw a threat to the liberty of artisans in the processes of mechanical mass production. Since that point (with the occasional exception) art practice has defended the validity of the unique hand crafted item. Mass production of text occured with Gutenberg; writers made a sucessful adjustment to the condition centuries ago. The cinema was born of the industrial revolution. It was in its time, the technological medium 'par excellance'.

Why the values of the Craft Movement remained stained onto the art community is more problematic. My suspicion is that as the machine became more sophisticated, it began to encroach further into territory which was regarded as definingly human. For a machine to spin yarn or pump water is one thing. It is another thing entirely for it to create images (ie photography) and thereby threaten painting, one of those activites regarded as a crowning glory of the species. The response was to find something else for painting to do: thereupon hangs modernism. The suggestion that technological innovations made traditional art practices redundant, and thus prompted the explorations that resulted in modernism is one that is rarely entertained among art historians, but I believe that it is difficult to refute.

As photography 'perfected' painting, so the machine 'perfected' the production of goods. No artisans could compete with the precision- in- multiplicity of even the simplest thread cutting lathe. Only relatively recently with the multiples of Les Levine, Marcel Broodthaers and others, have artists addressed the process of mass production, but without major effect on the art market, which as yet clings doggedly to the idea of the unique precious object.

The relationship of the artist to the machine is problematic. In attempting to engage the science/technology complex; (which owns the dominant paradigm of our culture); the artist is presented with a powerful paradigm which is at odds with the artists' conventional procedures. This is the epistemological dimension of the schism outlined above. Its axes are: induction vs. deduction; holistic thinking vs. the scientific method of reduction of variables in controlled systems. I doubt whether anyone in this room has not at some time noted with horror the evaporation of their artistic vision in the process of resolving it to numerical variables.

We are at a curious historical cusp when the ultra- rapid calculation afforded by

computers (these devices which are the epitome of the 'machine' project) allows scientists the opportunity to employ induction in simulatory research. The point at which information so derived is allowable as 'knowledge' in the scientific world signals a revolutionary point. At this point also, the same technology offers itself as an artists' tool, for much the same reasons. But it requires on the part of artists the engagement of values of the other side of the schism in order to exploit it. I shall discuss this convergence further, below.

Bachelor Machines

Why did it take so long for the machine to be brought in from the cold? Perhaps because the spirit of Cezannes' dictum: "Art is harmony parallel to nature" got confused with a pastoral/romantic mindset allied with the anti-industrialist sentiments of the craft movement.

There have been movements in modernism that have atempted to embrace industry, industrialization and mass production. Russian constructivism placed industrialization in a clear political agenda. Art history has found it possible to downplay the significance of industrialization in Russian constructivism in the same way that it downplays the significance of Marxism in the movement. Indeed, industrialization and Marxism are integrally related in this context.

Italian Futurism paradoxically clad industrialization in the garb of the political opposite, the extreme right. By and large they discussed it within the traditional media, with Russolo standing as an innovator among them. Bugatti, on the other hand, seemingly embraced the expostulations of Marinetti (after his baptism in industrial waste), so literally that he abandoned the gallery object completely and opted for motor car production. The association by the Futurists of machines with Fascism and a glorification of war no doubt reinforced the generally luddite stance of the art community; the futurists gave the machine a bad name.

The Dadaists saw WW1 as a war of the machine, as the logical outcome of rationalism and industrialization. In rejecting both, they simultaneously rejected the Futurist position for the more traditional romantic one which had its roots with William Morris.

The Bauhaus made an attempt to reconcile traditional artistic sensibilities with the new industrial production, but seems to have been sucessfully marginalized as being more properly a design movement.

As in so many other ways, Marcel Duchamp pinpointed the issues here, in his attempts to engage the machine as both icon and medium. As Jack Burnham reminds us, when Duchamp employed the bicycle wheel in a readymade, it was not a technologically nostalgist gesture, but state of the art technology: "From a practical standpoint, the Readymade bicycle wheel was an apt choice. Only a few years before Duchamp's appropriation it had been mechanically perfected. The ball bearing mounted axle and tension wire spokes made the bicycle wheel one of the lightest and most elegant devices then in common use.... The lightweight wheel, the chain drive, the tubular frame construction made the bicycle, along with the automobile, revolutionary forms of personal transportation." (8)

Burnham later goes on to say: "More than any artist previously, Duchamp confronted the psychic and practical difficulties of realizing a viable motorized art. A Kinetic art, somehow, presented a contradiction in terms. As a sculptural totem, the machine was unassailable. Yet to function in actuality, and artistically, it had to be injected with imprecision and irrationality. Then, perhaps, it could begin to live, in doubt and indecision, as human beings do..." (Significantly, here Burnham reinforces the old dualism, allowing humans the qualities of 'imprecision and irrationality'. Once again we define ourselves in terms of; in opposition to; our technology) "...Most revealing is the fact that Duchamp, according to Lebel, regarded himself as an "unfrocked artist " after his art became centred around the Rotoreliefs. No longer dealing with the gentle illusionism of painting, nor even the leverage of Dada's tools,(irony, fallibility, and repitition), Duchamp realized that he had placed himself on the brink of raw technology. Such a situation demanded that one either draw back or plunge into a rational world of impersonally controlled effects. He chose to do the former."(9)

The Mechanical Bride

Although conventional wisdom defines Kinetic art in terms of the exploration of 'motion' as an aesthetic element, I see two distinct projects. On the one hand was the mechanization of Op art. On the other was an attempt to examine the condition of 'machineness'. As such it was the first time artists consistently engaged the 'aesthetics' of industrial production. The project was problematised by Cezannes' dictum [quoted above] because the machine was not part of 'nature'. Although it was 'designed' it was also not part of (high) 'culture'. To utilise machines as models or physical components was thus to engage in a second order creative act, or more accurately, a one and a halfth order creative act. In many cases the confontation with 'raw technology' led to the work devolving to either the more traditionally aesthetic [Op art], or the merely 'machine'.

Two of the most significant solutions to these problems came from Tinguely and Takis. Jean Tinguely managed to build into his works a profound critique of machine culture and man-machine relationships, veiled by a ludicrous sense of humour. His 'drawing machines' incisively question the creative human vs. repetitive machine schism, over a decade before it became a central theme of the Artificial Intelligence debate. His machines however, remain ludricrous by virtue of investing the machine with representations of the 'romantic' definitions of humanity. They are haphazard and surprising. They are unproductive, clamourous, self defeating and self destroying. They are ultimately anti-machine.

The works of Takis, on the other hand, are silent. They exude a mysticism which is grounded in the mysteries of basic physics, of the interrelationship of the electrical and the magnetic. They possess a quiet profundity which is easily overlooked due to their unfamiliar frame of reference.

Cyborg art

In 1950, Alan Turing asserted that machine intelligence was possible and would be a reality by the year 2000. He also proposed what is now referred to as the Turing Test. This was the industry standard, as it were, in thought experiments. Its function was to assess whether the device can be said to possess 'intelligence'. It is the essence of simplicity: connect a person and a computer by teletype to a human examiner. If the examiner cannot tell the difference after a series of questions on any subject, the computer has achieved the goal. This test in fact, would prove that the machine was more intelligent than the person, for it would have to mimic human error and slowness at calculation.(10) The Turing test is now outdated, for much the same reasons that the IQ measurement is also outdated: they are both one dimensional. We are now comfortable with the fact that a computer can play chess with grand masters but can't find its shoes in the morning.

At this same time, almost precisely mid-century, two other major theories became public: Claude Shannons' Communication theory and Norbert Wiener's Cybernetics. Cybernetics was concerned with communication between systems. It made no implicit distinction between organic-organic communication, electronic-electronic or electronic-organic. This radical formulation was confirmed by Wieners' cybernetic diagnosis of the neurological condition 'ataxia' as being a disruption of feedback loops.

Shannons' paper "A Mathematical Theory of Communication" defines information in entirely mathematical terms, and is concerned with the way an encoded message may be corrupted by noise and entropy in its passage between transmitter and receiver. His is a technical definition of information and disregards semantic content. It must be emphasized here that 'successful data transfer' and 'mutual understanding' are both definitions of communication, but they mean wildly different things. This is one of many cases when a specialized scientific definition has been 'ported' into the humanities with disastrous consequences.

The work of Turing, Shannon and Weiner laid the a theoretical base for the

explosion of computing and telecommunication as ideas as well as physical realities. Their work was the beginning of information technology, of the information industry and of a new chapter in mans' relationship to his tools. For the first time they were extensions of his mind rather than of his arm. Roszak distinguishes between 'strong' and 'smart' machines: "Strong machines (the steam engine, dynamo, airplane) have had their share of public appreciation; but smart machines have elicited a very different response, a self effacing awe that has more than a touch of the pathological about it." (11) The transition from arm to mind is full of import for artists, who have long straddled the gap between philosophy and 'craft'. It evokes an identity crisis which can indeed have a touch of the pathological about it.

In 1952, UNIVAC, the first stored programme computer, was loaned to CBS to predict the result of the Eisenhower presidential election, which it did within 1% accuracy, using a 7% sample. To a large public, this was shocking 'proof' of the arrival of the 'intelligent' machine.

These developments, combined with the introduction of the transistor as a consumer item, stimulated exploration into the relationship between electronic technology and art making. Landmarks in this enquiry were the publication of Jack Burnham's "Beyond modern sculpture" and the Cyberntetic Serendipity exhibition curated by Jasia Riechart.(12) The works in the Cybernetic Serendipity exhibition were hampered by a complete lack of historical context and comparatively primitive tools. They are characterized by an arduous scientism and a mindset that found 'artness' in the more or less arbitrary translation/transduction of one phenomena into another, (music into image etc.) and the utilisation of mechanized chance operation regulated by rigid and simple structuring algorithms. It was a pioneer event and was limited by shortfalls in both media and critique.

In "Beyond modern sculpture" Burnham embraces Cybernetic theory and builds around it a new model of art practice. He argues that inasmuch as mimesis has always been the concern of sculpture, from the caveman to early modernism, anthropormorphic robotry is the logical sucessor to that tradition in sculpture and argues that the 18th century clockwork automata of Vaucanson and Jaquet Drosz are significant predecessors of this trend. (13)

Conceptual art is most often critiqued as the logical end point of the modernist project. This may well be the case. What is seldom acknowledged is its contemporaneity with the growth of the Information Revolution and the idea of 'software'. Though it did not utilise the technology, conceptual art is philosophically related insamuch as it insisted on the 'artness' as residing in the idea and being separate from any physical realization of the work. One may correctly refer to this art as 'cultural software'. Once again it was Jack Burnham who drew attention to this parallelism in his essay 'Systems Aesthetics' and his exhibition "Software".(14)

This development created something of a crisis in the institutions of the art world. The livelihoods (and fetishistic predilections?) of people in those institutions depended on a reliable supply of new art in the form of objects. The program 'History of Modernism' had hit a bug. It was sucessfully debugged (at least temporarily) by the addition of a new line, a loop instruction: If< no new art objects> goto <expressionism>. Thus was the engine of history 'jump started' again.

Reconvergence

For all the touted schism between the humanities and the sciences, the disciplines seem to be converging. This may well have to do with conditions imposed by the technology now common to both. Digital manipulation of data seems to result in a fragmenting of information; dissociation and decontextualization; on a psychological as well as a technical level. Texts break up into sections and versions, and are placed in any order. No version maintains greater authority than any other. Hypertext erodes the linearity characteristic of written argument. This fragmentation is akin to the errosion of the Empirical method by such events as the 'proof' by iterative testing of the 'four color theorum' and other proofs by computer simulation.

Euclidean and Newtonian systems are also weakening under the influence of

fractal theory and chaos physics. On a more general level, the destruction of the idea of 'authority' of texts by post-modern literary criticism is paralleled by the questioning of the authority of the scientific method by writers such as Feyerabend.

Is it purely coincidental that the examination of the position of the 'author' and the 'authority' of texts by Barthes et al. is roughly contemporary with the development of word processors and personal computers? Is there no more than a lexical similarity between the Baudrillardian notion of the 'simulacrum' and the explosion of digital simulation in laboratories, amusement arcades and 'virtual reality' research?

Consumer electronics and cultural redundancy

The technology has progressed at lightning speed, and its cultural position has changed as rapidly. All the power of a UNIVAC with its 5000 vacuum tubes is now mass produced and hand held, the price has miniaturized along with the size. Sophisticated electronics now appears in consumer goods, digital watches are disposable, free in the bottom of your cornflakes. Electronics has moved out from the research labs into the shopping malls and amusement arcades.

With the advent of "user friendliness" the technology is almost always a "black box", with 'in' and 'out' plugs and variables to adjust. More or less compatible user friendly units. It is no longer necessary, nor is it possible, to understand the mechanics of the device in order to use it. Nor are the mechanics amenable to visual understanding as in the case of the Kinetic work. "Truth to materials" is an outmoded esthetic. Whereas gears, pulleys and levers have a certain accessible visual logic to them, the IC chip does not. We can experience the effects of the technology, but not its structure.

As the physical operation of the new technology is occluded, so is its political/philosophical agenda. Roszak notes: "Information smacks of safe neutrality; it is the simple, helpful heaping up of unassailable facts. In that guise, it is the perfect starting point for a technocratic political agenda that wants as little exposure for its objectives as possible." (15) Although we avail ourselves of data bases, computer banking and the like, the spectre of databases which cross reference police, taxation department, medical and welfare records is indeed a frightening prospect. The information revolution is the realization of the megalomanic civil servants dream.

Models: new and pre-owned

The exercise of art practice in the realm of digital electronics is thus a thorny task, socio-politically and also methodologically. The logic employed is abstract, mathematical; truths do not necessarily correspond to observed sensory data. The logic of conventional art practice is directly sensorial, experiential, 'suck it and see'. The art object loses its objecthood, its singularity, in the mire of digital permutations. In fact almost every defining aspect of traditional art practice is brought into question in the application of this new media.

It may be that traditional art practice is so concerned with the visible and the tangible that it has no relevance to this intangible realm. Perhaps a new discipline, unrecognizable in terms of traditional art practice, will evolve to suit the new medium.

There are models for art practice which incorporates the electronic. One of the strategies of Nam June Paik was to orchestrate the symbolic defeat of the technocracy by transmuting its tools, defeating its image. Paiks procedure is remarkably shamanistic, reminiscent of sticking pins in voodoo dolls. This kind of approach remains symbolic and naive.

Another approach is that of the Australian artist Stelarc, whose work focuses on the idea of the obsolete body. In a recent interview he summed up his position in two statements: "What's philosophically and physiologically interesting for me is that technology seems to be welcomed by the body. In other words, if technology is miniaturized, and packaged in an inert material, the body acts as if the technology is not even there, ...technology at this point is merely a tool in the process of post-evolutionary development." (16) This program is familiar from the

Sci-Fi tradition. What makes Stelarcs work compelling is his dedicated illustration of the potential of this union, on and in his own body, in performance. His use of medical electronic devices in performance exposes a technology not generally publicly accessible, whose very existence goes some way to proving his point. The cumbersome control interface of his robotic third arm has recently been outdated by the development of nerve signal interface chips which, when implanted into the body, interpret nerve impulses to drive robotic prostheses. This trend towards finer and finer interpenetration of the organic and the electronic is evident also in the development of miniature retina scanning lasers to replace cathode ray and liquid crystal screens.

These two artists demonstrate a procedure for actually utilising technological items in art production, whilst avoiding technological fetishism. They have made some important distinctions: Firstly, it is important to distuinguish beween an attitude to technology per se, and a strategy for utilisation of technology in art practice. Secondly, there is a difference between devising new tools and ways of manipulating a new medium; and the work of producing artwork with those tools. Even now, in such events as the SIGGRAPH conferences, tool development is confused with artwork, esthetics takes a backseat to engineering. Twenty years ago James Seawright offered some esthetic / methodological advice on art practice in a technological context. His words remain valid : "If you start with a conventional definition or concept of an effect or phenomenon and design back from that towards the means necessary to get it, all too often you end up with a machine or a device which produces effects. You may be able to distort or deform the thing into some structural or visual sugestion of sculpture, but the integration of form and behavior, if present, will be sheer accident." (17)

I contend that the computer has only just 'become itself', in the way that the horseless carriage became the automobile. Until recently most computer activities were simulations of analog tools: typewriter, drafting board, keyboard, paintbox. Simulation, interactivity, hypermedia and 'virtual reality' are the core of the entirely new range of potential art modes that the computer opens up.

There is a growing number of 'second generation' electronics artist who are exploring these areas, among them Jeffrey Shaw and Robert Edgar. Shaws' project for the 200th anniversary of the French revolution, "An Imaginary Museum of Revolution" was described as: "A game in space, time and ideology played on interactive videodisc installations... a conjunction of library, museum and amusement arcade."(18) Although the project is too complex to describe fully here, it is clear that this is a creative practice which has internalized the lessons of the interactive arcade game and information retrieval systems, which has integrated software design as an aspect of art practice.

"Memory theatre one" by Robert Edgar (1987) allows the 'player' to navigate a multi dimensional virtual architecture in which image icons are integrated with quotations from Levi Strauss, Frances Yates, Roland Barthes and the New York Times, among others. Most rewarding is the way that the work metaphorically discusses the topology of memory, which is directly referencing the special qualities of the machine itself. The work, the nature of its architecture and its title also reference Dame Frances Yates' work "The Art of Memory". This adds a profound historical dimension to the work, tying the notion of the computer as artificial memory to a tradition of memory training dating back to the ancient Greeks.(19)

Interactivity has yet to be explored in any depth but it is clearly a very rich field. It is a powerful tool for inculcation of responses in the 'player' as is evidenced in childrens relationship to arcade games. The arrival of software porn and interactive games which impose fascistic values is as predictable as it is lamentable. The inevitable commercialization of "virtual reality" technology can only heighten the affectiveness of this interactivity. I am unaware of any case anywhere, when a new enpowering technology was not appropriated by the power elite to enhance its power and exploit the powerless. We have no reason to imagine the game will change now. Technological utopianism is indefensible.

Conclusion

In examining the possibility of art practice using micro-electronics, basic precepts about the nature of art and art production are brought into question; one is confronted with a series of conflated oppositions such as the rationality vs romanticism, and the science vs art opposition. The two systems of operational logic are at odds. If these and related philosphical problems were not in themselves enough; any artist engaging these media must also consider the socio-political implications of working with it.

To avoid embracing contemporary technology is to opt for voluntary cultural fossilisation, for an art practice that becomes quaint and irrelevant to all but a 'cultured' few. To embrace the technology is to live and work in the real world, to grapple with the forces that are shaping it. This to me is the responsibility of the artist.

Simon Penny.

Notes and references

1 J.D. Bolter 'Turing's man.' Pelican 1986. xvi : "... technology is as much a part of classical and western culture as philosophy and science and that these "high " and "lowly" expressions of culture are closely related. It makes sense to examine Plato and pottery *together* in order to understand the Greek World. Descartes and the mechanical clock together to understand Europe in the C17th +18th. In the same way it makes sense to regard the computer as a technological paradigm for the science, the philosophy, even the art of the coming generation."

2 Theodor Roszak. The Cult of Information. Pantheon 1986. p18: "In the seventeenth century, at the very beginning of modern science, astronomers and physicists appropriated the model of the clock to explain the mechanics of the solar system and soon taught their society to see the entire universe as a clockwork instrument."

3 Elting Morison. Men, Machines and Modern Times. MIT Press 1984 Chapter 6: Men and Machinery. pp98-122

4 William Shakespeare. Hamlet. Act 2 scene 2.

5 These issues are discussed further in my essays: "New Territory, Art practice in the digital environment" Artlink magazine March/May 1988 and 'Charlie Chaplin, Stelarc and the future of humanity'Artlink magazine March/May 1989

6 Jacob Bronowski "The common sense of science" Vintage/Random House (undated) p12. Conrad Atkinson, in a lecture at Carnegie Mellon University in 1990, and elsewhere, has shown that the 'Romantics' are often misrepresented in cultural history writing. He demonstrates that, far from having their dreamy heads in the clouds, these people were, like William Morris, intensely motivated socio-political activists. see also: 'The country and the city'. Raymond Williams. Oxford 1973

7 It was Walter Benjamin who pioneered the analysis of the history of modernism in terms of this new industrial environment. cf. Walter Benjamin. The work of Art in the age of Mechanical Reproduction. in Illuminations. Harcourt Brace + World. New York 1968

8 Jack Burnham, 'Beyond Modern Sculpture' George Brazilier 1968, p227

9 Jack Burnham. ibid p230

10 This test is telling in its anthropcentricity, the implication being that human intelligence is the epitome of possible intelligences, which belies its ultimate grounding in Christian theology. This test also implicitly asserts that intelligence is a linear phenomenon, that degree of intelligence can be measured like a test of strength, the hammer and bell game at old country fairs. But intelligence is demonstrably a vector phenomenon and machine intelligence already far exceeds human ability in some fields.

11 Theodor Roszak. ibid p40

12 "Cybernetic Serendipity" a Studio International special issue, ed Jasia Reichart, 1968

13 I examine the theme of anthropomorphism more fully in The Intelligent Machine as Anti-Christ, S.Penny1990

14 Jack Burnham Systems Aesthetics. Artforum V viii #1 September 1968.

15 The Cult of Information. p19

16 Eyeline magazine (Brisbane, Australia) nov 1987, p8

17 Beyond Modern Sculpture p359

18 An Imaginary Museum of Revolution. Jeffrey Shaw and Tjebbe van Tijen. Editions De Struikrover, Amsterdam. 1988

19 see: Musings on an interactive postmodern metaphor. Fred Truck. High Performance #37, 1987.