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The Mechanisation of Art

Paul Brown
Artist and Writer
Centre for Computational Neuroscience and Robotics, University of Sussex
paul@paul-brown.com

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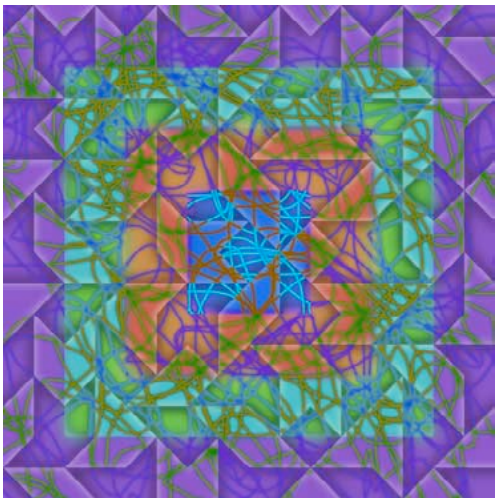

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"Sorry miss, I was giving myself an oil-job" –
Robby the Robot in "Forbidden Planet"

"I'm sorry Dave, I can't do that" –
HAL 9000 in "2001: a Space Odyssey"

What follows is an idiosyncratic account of the development of "the mechanisation of art". I am an artisan, a maker of art, and neither an historian nor a scholar and so it describes only those parts of the narrative with which I am familiar. As the German Dadaist Kurt Schwitters – the architect of Merz – once claimed: "I am the meaning of the coincidence". I have also chosen to end my account in the late 1970's. By then the personal computer had arrived and the world was changed forever. The ensuing proliferation of artworks and ideas are still difficult, for me at least, to record and contextualise.

A comprehensive overview of the historical developments that led to the flowering of the mechanisation of art in the 20th century is beyond the scope of this essay. However a few examples are worthy of note since they give a context and demonstrate that this pursuit of knowledge has a long and intriguing pedigree that stretches back even into pre-history. The Chinese "I Ching" or "Book of Changes" is believed to have first taken form about 1800BCE and is attributed to the legendary "founder" of China – Fu Hsi. The book was restructured and derived its modern format in the early Chou dynasty following revisions attributed to King Wen and his son Tan – the Duke of Chou – around 1100 BCE. Further commentaries were added by Confucius (511-479 BCE) and his school and are known as the Ten Wings. Although the book has been perceived in the West as a divination system or oracle Joseph Needham[1] and later scholars emphasise its importance in the history of Chinese scientific thought and philosophy and describe its method as "coordinative" or "associative" in contrast to the European "subordinate" form of inquiry. The book may be interpreted as a cosmology where the unitary "one" first divides into the binary principles – the yin and the yang represented by either a broken or whole line – which are then permutated to form the eight trigrams. These, as the name suggests, are three-line structures that may also be interpreted as the vertices of a unit cube – the three dimensions of the material world. The trigrams then permutate with each other to form the 64 hexagrams (or archetypes) and then each (any and all) of the six lines that make up the hexagram can flip into its opposite (yin to yang, broken to whole, and vice versa) which enables any hexagram to change to any other and so give the final 4096 changes to which the title

refers. The book may be “consulted” by a process of chance operations – flipping coins or dividing groups of yarrow stalks – a process which identifies the unique “time” of the consultation. Jesuit missionaries sent a copy of the book to Leibniz who introduced the binary mathematical notation system to Europe and it has had an ongoing effect on Western scientific and artistic thought ever since. This gained momentum after a scholarly translation by Richard Wilhelm and Cary F Baynes with an introduction by Carl Jung was published in 1968[2] coinciding with the cognitive experimentation of the psychedelic movement.

During the first century CE the Greek engineer Hero of Alexandria designed and constructed sophisticated automata that were powered by water, gravity, air, and steam. As the Christian Dark Ages closed in over Europe the ancient Greek and Egyptian knowledge was preserved and developed in the Arab world. Al Jaziri's “Al Jami' Bain Al 'Ilm Wal 'Amal Al Nafi Fi Sina'at Al Hiyal” or "The Book of Knowledge of Ingenious Mechanical Devices" (about 1206) describes many of the author’s automata and has been recently placed in the context of art/science histories by Gunalan Nadarajan[3]. Amongst the devices that al Jaziri describes is an automatic wine server that was used at royal parties at the Urtuq court of Diyar-Bakir who were his patrons. It randomly selected guests to serve so some got very intoxicated whilst others remained completely sober – much to amusement of all.

Not long after this Ramon Lull (1235-1315) was born in Palma, Majorca. He was a Christian writer and philosopher living in Spain when it was part of the Islamic Moorish Empire (which included Portugal and parts of North Africa). Unlike his Northern European contemporaries, who were still living under the repressive Catholic rule appropriately named the Dark Ages, Lull had access to Arab knowledge dating back to Greece and culled from around the rapidly expanding Islamic sphere of influence. Although his contribution to knowledge was broad, of particular interest here are his Lullian Circles. These are described in his *Ars Generalis Ultima* or *Ars Magna* published in 1305 and they consist of a number of concentric disks that can be rotated independently on a common spindle. Each disk is scribed with symbols representing attributes – or archetypes – that can be permutated together to form compound expressions. The system forms a combinatorial logic that is remarkably similar in concept (though not in implementation) to the generative method employed by the much earlier I Ching. Two centuries later Gottfried Leibniz (who, as mentioned above, knew about the I Ching) developed Lull’s idea for his investigations into the philosophy of science. Leibniz named the method *Ars Combinatoria*. Machines like Lull’s appear in literature: in *Gulliver's Travels* (1721) Jonathan Swift describes a system that creates knowledge by combining words at random – a passage that is believed to be a parody of Lull’s work. More recent fictional combinatorial knowledge machines appear in books like Herman Hesse’s *The Glass Bead Game*[4] and Umberto Eco’s *The Island of the Day Before*[5].

The Christian re-conquest of Spain during the 15th century enabled the European rediscovery of the long-suppressed knowledge preserved by Islam and this was a major cause of the flowering of the Renaissance (literally the rebirth). The polymath Leonardo da Vinci (1452-1519) is known for his lateral and experimental approach to both art and science. Amongst his prolific

output around 1495 he recorded in his sketchbooks a design for an anatomically correct humanoid automaton although there is no record that Leonardo's Robot, as it is now known, was ever built. The German Albrecht Dürer (1471-1528) was another polymath who made significant contributions to both mathematics and the visual arts. In his Treatise on Measurement (1525) he included several woodcut prints of perspective-drawing systems that can be retrospectively acknowledged as early precursors of analogue computing machines.

By the 17th century the French mathematician and philosopher René Descartes (1596-1650) proposed that animals were nothing more than complex machines. By suggesting a correspondence between the mechanical and the organic Descartes laid the groundwork for a more formal study of autonomy. The production of automata flourished with ever more complex and sophisticated examples. The Jesuit alchemist Athanasius Kircher is reputed to have made a statue that could carry on a conversation via a speaking tube (he's also credited with building a perpetuum mobile!). However it was in 1737 that the French engineer and inventor Jacques de Vaucanson (1709-1782) made what is considered the first major automaton of the modern age. His Flute Player was not only intended to entertain but was also a serious investigation into human respiration. As such it stands as an early precursor of the art/science collaborations that developed in the 20th century. Vaucanson's automated loom of 1744 rejected the punch cards proposed by Falcon in 1728 to build on the paper tape control system invented by Basile Bouchon in 1725. By 1801 Joseph Marie Jacquard created a robust card driven loom – a design that was still in use in the late 20th century. Jacquard's card system had another major and arguable more influential outcome when Charles Babbage (1791-1871) selected it as the control and storage mechanism for his Analytical Engine. Later Herman Hollerith (1860-1929) took up the idea and went on to found the company known today as IBM. It's an early and excellent example of how research in the arts can have a profound effect on science and technology and demonstrates how the modern science of computing has clearly defined roots in the art of weaving which, after all, is an ancient system for the codification, manipulation, storage and reproduction of pattern.

Religious warnings about human intervention in the work of God accompanied many of these developments and emerged in literature. The archetypical text is Mary Shelley's wonderful "Frankenstein"[6] (1818). Similar concerns continue to this day in many of the detractors and critics of Artificial Intelligence and Artificial Life (as well as many other aspects of science and technology like, for example, evolution, nanotechnology and stem cell research).

Developments continued throughout the 19th century. The paper tape and punch card control systems developed for weaving were adapted for use in other applications. Orchestral machines like steam organs toured the fairs and pianolas and music boxes were mass-produced. Paper pianola scrolls enabled people to hear performances by contemporary virtuosi, as well as forming a now-valuable historical record, and they created a demand for pre-programmed music that would later be satisfied by shellac and vinyl

gramophone recordings and contemporary compact disks and MP3 players. In the visual arts and sciences the invention of photographic recording by Joseph Niépce in 1827 was improved by Louis Daguerre and followed in 1835 when William Henry Fox Talbot devised a method to duplicate images by printing multiple positives from a unique negative. The Renaissance experiments into perspective, Dürer's drawing systems and other devices like the camera obscura were automated – image making was now a mechanical process. By 1888 Kodak-founder George Eastman could coin the slogan: "you press the button, we do the rest". During the same decades French post-impressionist artists such as Paul Cézanne (1839-1906) and Georges Seurat (1859-1891) challenged the role of painting as representation, a function that had in any case been usurped by photography, and emphasised instead its role as analysis. Both artists were concerned with a proto-semiological exploration of the relationship between the flat plane of the canvas – the representation – and the three-dimensional world – the represented. Neither would break completely with the figurative. That would happen early in the 20th century when the Russian artist and theosophist Wassily Kandinsky (1866-1944) recalled some illustrations he had seen in a book called "Thought Forms" by Annie Besant and C. W. Leadbeater[7] (1888) and painted what he amazingly (in retrospect) titled "First Abstract Watercolour" in 1910. The visual arts had been freed from their anchor in "the real" and a colossal explosion in creativity, with ripples throughout the artworld, ensued.

A decade later Karel Capek (1890-1938) wrote "Rossum's Universal Robots" or R.U.R. The play was first performed in Prague in 1921 then in New York in 1922. His brother Josef had coined the term – robota is Czech for "drudgery" or "servitude" and a robotnik is a peasant or serf. The play is either a utopia or dystopia depending on your point of view. Robots are created as cheap labour then revolt and kill all the humans except one. The robots learn to replicate themselves and the play closes when two of them, Helena and Primus, fall in love and are dubbed Adam and Eve by Alquist – the last human. Responding to criticism by G. B. Shaw and G. K. Chesterton amongst others Capek stated that he was much more interested in men than in robots. He predicts the sentiments of William Gibson who, over 60 years later, would express his concern when he discovered that computer graphics enthusiasts at the annual SIGGRAPH Conference were busy implementing the dystopian virtual reality he created for his Orwellian-style Cyberspace trilogy – Neuromancer, Count Zero and Mona Lisa Overdrive[8]. Five years after R.U.R. in 1927, Fritz Lang (1890-1976) wrote and directed his legendary film "Metropolis" (restored 2002). Based on the novel by his wife Thea von Harbou it's a parable of socialist class struggle where the Lord of Metropolis – Johhan Fredersen – wants to replace his human workers with robots. Their leader Maria is cloned by the evil scientist Rotwang into a robot "femme fatale" – part of a plot to incite a revolution that Johhan hopes will give him the excuse to eliminate the workers and replace them with Rotwang's machines. A decade later, in 1936, the German Marxist historian and cultural theorist Walter Benjamin (1892-1940) published his essay "The Work of Art in the Age of Mechanical Reproduction"[9] where he argued that the artwork is democratised by mass production technology but by the same token its unique intrinsic value is threatened. The essay was influential, particularly in

the latter half of the 20th century when the concept of the art object gave way to art as process.

The French artist Marcel Duchamp (1887-1968) is recognized as one of the major intellects of 20th century art. As a key member of the Dada movement he questioned the entire nature of the artwork when he introduced his Readymades with Roue de Bicyclette (Bicycle Wheel) in 1913. During the 1920's Duchamp worked on a number of Rotoreliefs and some were recorded in his film 'Anémic Cinéma' (1925-1926). The rotating disks produced 3-D illusions and progressed Duchamp's interest in both art-as-machine and as cognitive process. László Moholy-Nagy (1895-1946) realised his Light-Space modulator in 1930 after some years of experimentation. It's a kinetic sculpture that he described as an "apparatus for the demonstration of the effects of light and movement". These effects are recorded in his film "Lichtspiel, schwarz-weiss-grau," ("Light-play, black-white-grey") made the same year. The original Light-Space modulator is preserved in the collection of the Busch-Reisinger-Museum in Cambridge, USA and a number of working reconstructions have been made. Alexander "Sandy" Calder (1898-1976) was a Parisian-based American sculptor best known for his kinetic sculptures, dubbed Mobiles by Duchamp, that date from 1931 onwards. Though his early experiments were motorised he soon developed the graceful wind and gravity-powered Mobiles by which he is now known best.

The Swiss artist Jean Tinguely (1925-1991) belonged to a later generation of artists who were influenced by both Dada and these early kinetic experiments. In 1944 he began making his Metamechanics – or Metamatics – eccentric machines that often expended high energy doing nothing. Although his early work is playful and entertaining there is always a dark undercurrent present. By the 1960s the early whimsy had evaporated to be replaced by a more somber mood reflective of the times. Amongst the best-known work of this period is "Homage to New York" (1960) an ambitious auto-destructive installation in the courtyard of New York's Museum of Modern Art – MoMA – which was documented in Robert Breer's film 'Homage to Jean Tinguely's *Homage to New York*' and is further notable because it was the first artist collaboration by Bell Telephone Lab-based engineer Billy Kluver (1927-2004) who went on to co-found the influential EAT – Experiments in Art and Technology. Takis (1925-) was born in Athens but, like Tinguely, based himself in Paris and began making his illuminated Signaux – Signals – in 1955. They become kinetic in 1956 and Takis integrated electromagnetic elements that gave his works chaotic dynamics in 1958. Frank Malina (1912-1981) was a USA aerospace engineer who did pioneering work on rocketry and was a co-founder and the first director of Caltech/NASA's Jet Propulsion Lab in Pasadena. Disillusioned with the increasing military application of his research he left in 1947 to join UNESCO before committing himself full-time to his art practice in 1953. He based himself in Paris where many of the European kinetic artists were congregated. His son, Roger, has recently commented that he … "was amazed that artists created so little artwork depicting the new landscapes we now see, thanks to telescopes, microscopes and robots that explore the ocean and space"[10]. In 1954 Malina introduced electric lights into his work and began his kinetic paintings in 1955. In 1968 he

founded the influential publication Leonardo, as the journal of the International Society for Arts, Science and Technology, ISAST[11].

It was in Paris, in the 1950's, that the artist Nicolas Schöffer (1912-1992) formulated his idea of a kinetic art that was not only active and re-active, like the work of his contemporaries, but also autonomous and pro-active. He developed sculptural concepts he called: Spatiodynamism (1948), Luminodynamism (1957) and Chronodynamism (1959) and was influenced by the new ideas that had been popularised by Norbert Wiener[12] and Ross Ashby[13]. His CYSP 1 (1956, fig. 1) is accepted as the first autonomous cybernetic sculpture. Its name is formed from CYbernetic SPatiodynamism 1. It was controlled by an "electronic brain" (almost certainly an analogue circuit) that was provided by the Dutch electronics company Philips. In addition to its internal movement CYSP 1 was mounted on a mobile base that contained the actuators and control system. Photosensitive cells and a microphone sampled variations in colour, light and sound and so it was…

> *"…excited by the colour blue, which means that it moves forward, retreats or makes a quick turn, and makes its plates turn fast; it becomes calm with red, but at the same time it is excited by silence and calmed by noise. It is also excited in the dark and becomes calm in intense light."*

figure 1

Nicolas Schöffer, CYSP 1, 1956
credits as per ADAGP

On its second outing CYSP 1 performed with Maurice Béjart's ballet, on the roof of Le Corbusier's Cité Radieuse, as part of the Avant-Garde Art Festival, held in Marseille. Schöffer said of his work:

> *"Spatiodynamic sculpture, for the first time, makes it possible to replace man with a work of abstract art, acting on its own initiative, which introduces into the show world a new being whose behaviour and career are capable of ample developments".*[14]

Schöffer worked closely with composers and choreographers including Pierre Henry and Alwin Nikolais – they created KYLDEX together, the first experimental cybernetic show, at Hamburg Opera House in 1973. He is also credited with making the first video production in the history of television: "Variations Luminodynamiques 1" for Télévision Française in 1960 and so in addition to his considerable contribution to the world of kinetics and autonomous arts he is also remembered as the "father" of video art.

The same year that CYSP 1 danced in Marseille across the channel in the United Kingdom the Independent Group put together a show at London's Whitechapel Gallery called "This is Tomorrow" which has become an

influential landmark in the history of the contemporary arts in the UK. Charlie Gere has pointed out that the catalogue contains what is possibly the first reference to punch cards and paper tape as artistic media[15]. Robby the Robot, star of the recently released film Forbidden Planet, attended the opening and the show received a high popular profile in the British press. Fred Wilcox' film Forbidden Planet (1956) bucks the trend of most USA sci-fi movies of the time (where communists disguised as aliens are taught that freedom and democracy come out of the barrel of a gun) with a thoughtful script that's loosely based on Shakespeare's "The Tempest". But here the spirit world is a product of cybernetic amplification of the human subconscious and the film was influenced by the popular science and psychology of the day together with echoes of Shelley's "Frankenstein". However the mood of the time was strongly pro-science and the public action of the Campaign for Nuclear Disarmament (CND, founded 1958) and televised atrocities of the Vietnam War that would alienate people from science's perceived military agenda didn't emerge for another decade. "Eagle" was a popular middle-class boy's comic of the day and one issue featured a car powered by a small nuclear power pack that would never need refuelling and was expected on Britain's roads before the turn of the century! In 1963 Labour Prime Minster Harold Wilson promised that the "white heat of technology" would solve the country's problems and a golden age of plenty, delivered by science and its machines, seemed immanent.

In Germany Herbert Franke produced his first Oszillogramms in 1956. The mathematician, physicist and philosopher Max Bense (1910-1990) proposed his concept of Information Aesthetics[16] the next year when he brought together aspects of information theory, cybernetics and aesthetics. About the same time French theorist Abraham Moles (1920-1992) published his work in the area[17]. A decade later in 1965 Bense curated what is believed to be the first public exhibition of computer art in the world when he invited Georg Nees to show his work at the Studiengalerie der Techischen Hochschule in Stuttgart. The exhibition ran from 5-19 February. This encouraged Frieder Nake to show his work, along with Nees later that year from 5-26 November at Stuttgart's Galerie Wendelin Niedlich (fig. 2). Many of the European artists working in the new field congregated in Zagreb in August 1968 for a colloquy called "Computers and Visual Research" run as part of the New Tendencies Movement and leading to a major exhibition called "Tendencies 4" which ran 5 May – 30 August 1969. Christoph Klütsch[18] quotes Rainer Usselmann[19] and suggests that these meetings confronted socio-political

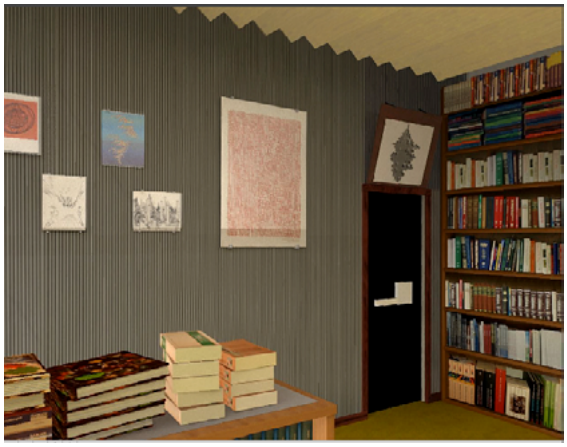

figure 2

Galerie Wendelin Niedlich, Stuttgart. Screenshot of virtual reconstruction of the gallery room with exhibition of computer art by Frieder Nake and Georg Nees, Nov. 1965. Courtesy Yan Lin-Olthoff

issues associated with the new technologies (and especially the military agendas) that were absent from the more playful British debate and especially the event which has come to epitomise the period.

It was a suggestion from Max Bense in 1965 that inspired Jasia Reichardt[20] to curate the exhibition that now stands as a defining moment of the computational arts. Cybernetic Serendipity[21] opened at London's Institute of Contemporary Art (ICA) on 2 August and ran until 20 October 1968. Reichardt recently described it as:

> *…" the first exhibition to attempt to demonstrate all aspects of computer-aided creative activity: art, music, poetry, dance, sculpture, animation. The principal idea was to examine the role of cybernetics in contemporary arts. The exhibition included robots, poetry, music and painting machines, as well as all sorts of works where chance was an important ingredient."*[22]

The show coincided with and complemented the release of one of the major cultural artefacts of the period. Stanley Kubrick's enigmatic film "2001: A Space Odyssey" features a self-aware artificial intelligence – HAL 9000 – that has a psychotic breakdown when it is unable to resolve conflicting data. Amongst work by over 300 scientists and artists at Cybernetic Serendipity was a piece by the British cybernetician Gordon Pask (1928-1996). The Colloquy of Mobiles (fig. 3) consisted of five ceiling mounted kinetic systems – two "males" and three "females". Using light and sound they could communicate with each other in order to achieve "mutual satisfaction". The system could learn and the mobiles optimised their behaviour so that their goal could be achieved with the least expenditure of energy. However members of the public could interact with the mobiles using flashlights and mirrors and influence the process[23]. Pask also worked together with John Frazer, Roy Ascott and others as an advisor to The Fun Palace Project conceived by Archigram's Cedric Price[24] and the socialist theatrical entrepreneur Joan Littlewood. Although it was never built, the Fun Palace – a dynamically reconfigurable interactive building – had a wide influence and inspired, for example, Richard Rogers and Renzo Piano's Centre Georges Pompidou in Paris. The architect John Frazer later worked closely with Pask at the Architectural Association in the 1970's and is notable for his concept of the Intelligent Building[25].

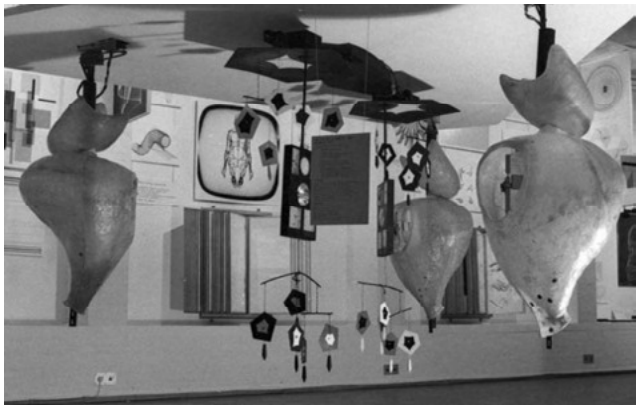

figure 3

Gordon Pask, Colloquy of Mobiles, installation shot from Cybernetic Serendipity (1968).
Courtesy Jasia Reichardt

Cybernetic Serendipity also included Edward Ihnatowicz' (1926-1988) Sound Activated Mobile or SAM. Ihnatowicz would later describe himself as a Cybernetic Sculptor[26]. SAM consisted of four parabolic reflectors, shaped like the petals of a flower on an articulating neck. Each reflector focussed sound on its own microphone and an analogue circuit could then compare inputs and operate hydraulics that positioned the flower so it pointed towards the dominant sound. SAM would track moving sounds and gave visitors the eerie feeling that they were being observed. Not long after Ihnatowicz was commissioned by Philips to create the Senster (fig. 4) for their Evoluon science centre in Eindhoven. It was a large (4 m) and ambitious minicomputer controlled interactive sculpture that responded to sound and movement and was exhibited from 1970-74 when it was dismantled due to high maintenance costs. Its behaviour was exceptionally life-like[27] and Ihnatowicz was an early proponent of a "bottom up" approach to artificial intelligence or what we would now call artificial life. He was inspired by his reading of the developmental psychologist Jean Piaget to suggest that machines would never attain intelligence until they learned to interact with their environment[28].

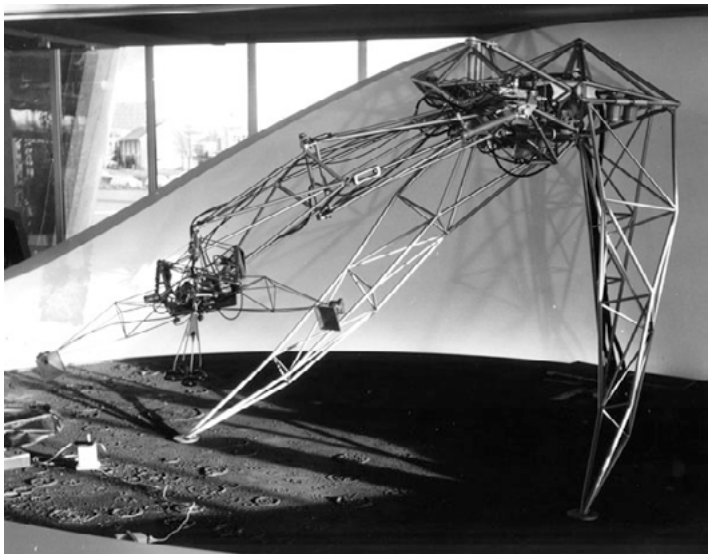

figure 4

Edward Ihnatowicz, The Senster, 1970

Courtesy Olga Ihnatowicz

The socialist techno-utopian vision that played a major role in European politics and culture of the period was less influential in the communist-phobic United States. In consequence developments there were less centralized, more sporadic and often linked to artists' initiatives or the commercial artworld rather than state patronised social agendas. In 1950 Ben Laposky (1914-2000) began to make his analogue Oscillons the same year that composer John Cage (1912-1992) discovered the I Ching. This profoundly changed his career, which increasingly involved technology and chance elements. Coin flips were used to determine pitch, rhythm, dynamics, and duration of his Music of Changes written in 1951 and he created the masterpiece 4' 33" the year after. The performer stands still on stage and the audience listen to the ambient sounds and silence. In 1952 Cage began working with electronic music and in 1967, with Lejaren Hiller, he produced the ambitious computer-assisted HPSCHD. The name reflects the contemporary use of FORTRAN (FORmula TRANslation) a "high level" programming language that only allowed 6-character names in uppercase and where vowels were often omitted. The year before in 1966 Cage was one of many artists who contributed to the defining event of art/technology collaborations in the USA.

9 Evenings: Theatre and Engineering was produced by the Experiments in Art and Technology group – EAT[29] – set up by Billy Klüver and Fred Waldhauer with the artists Robert Rauschenberg and Robert Whitman.

The journal Computers and Automation sponsored a Computer Art competition from 1963. That year and the next the winning entry was for visualisations from the US Ballistics Research Lab at the Aberdeen Proving Ground in Maryland. Michael Noll won in 1965 and Frieder Nake in 1966 (fig. 5). Noll had produced the first computer graphics artwork in 1962 – a year before Charles "Chuck" Csuri. The USA's first computer art exhibition "Computer Generated Pictures" was held 6-24 April 1965 at the Howard Wise Gallery in New York just three months after the pioneering Stuttgart show (above) and featured work by Noll and Bela Julesz (1928-2003). Csuri, a sculptor, established a pioneering computer arts lab at the Ohio State University where Tom Defanti completed his PhD before collaborating with the artist/engineer and video art pioneer Dan Sandin. Together in 1974 they established the Electronic Visualisation Lab – EVL – at the University of Illinois, Chicago Circle and later the world's first MFA in computer arts. It's believed that Copper Gilloth was the first graduate. A year earlier Myron Kruger who had collaborated with Sandin coined the term "Artificial Reality" to describe his interactive immersive computer-based art installations.

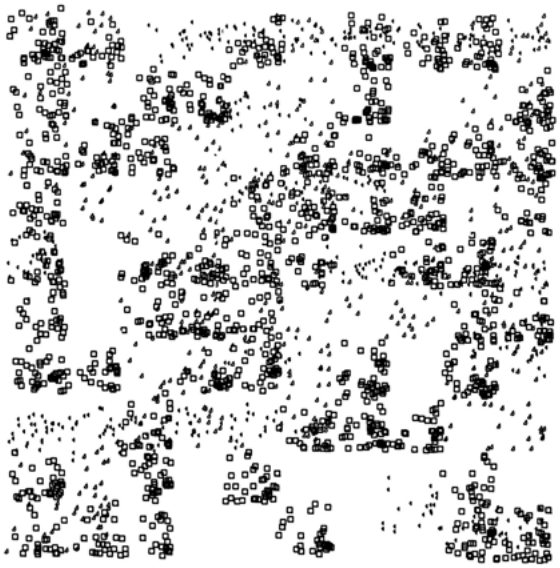

Figure 5

Frieder Nake: 13/9/65 Nr. 5, "Random distributions of elementary signs", China ink on paper, 51 x 51 cm, 1965. Possession of Sammlung Etzold, Museum Abteiberg, Mönchengladbach. First prize Computer Art Contest 1966, Computers and Automation

London in the 1960s was "swinging" and the artworld was fertile anarchistic ground for any and all new ideas. Jim Haynes set up the London Arts Lab on Drury Lane and the London Filmmakers Coop was established. Later the Arts Lab moved to Camden as an artist-run space called the Institute for Research into Art and Technology (IRAT) and from 1969 included the Electronics and Cybernetics Workshop (possibly a single mechanical teletype and a 300-baud modem) that was organised by John Lifton and offered free and exclusive computer access to artists for the first time. At Ealing College in 1961 the recently graduated Roy Ascott[30] was appointed head of Foundation Studies where he developed the influential Groundcourse. He recruited an impressive team of young artists as teachers and visitors included Pask and the linguist Basil Bernstein. Ascott (and others) believed that it was the process, rather than the ensuing object, that provided the essential content of the artwork and

this became a dominant aesthetic of the arts in the latter part of the 20th century[31] influencing the formation of several movements including Art & Language[32], Conceptual Art and Systems Art. Stephen Willats was a student of Ascott who went on to produce some major works linking art and technology with a social agenda and whose contribution has recently been reassessed[33]. A colleague of Ascott – Stroud Cornock – moved to the City of Leicester Polytechnic where he met the artist and mathematician Ernest Edmonds. They co-authored the influential paper "The Creative Process where the Artist is Amplified or Superseded by the Computer "[34] and Edmonds[35] went on to establish the Creativity and Cognition Lab (originally at Leicester, then at Loughborough and now at the University of Technology, Sydney) as well as founding the ACM Creativity and Cognition conference series. Ascott later pioneered the use of communication networks in the arts[36] and more recently has established the Planetary Collegium as a global initiative intended to encourage scholarly research in the field of art, technology and consciousness.

In 1969 the Computer Arts Society (CAS)[37] was co-founded by Alan Sutcliffe[38], John Lansdown and George Mallen. Mallen had worked closely with Gordon Pask at his company Systems Research and, for the CAS launch – Event One, an exhibition at the Royal College of Art – he produced a remarkably sophisticated (especially considering the rudimentary technology of the time) interactive computer artwork called The Ecogame[39] (fig. 6). The CAS bulletin PAGE, originally edited by Gustav Metzger, is still in print and forms a valuable historical record[40]. The same year that CAS was formed, Penguin published a book called "Systems Thinking" edited by the Australian Fred Emery as an inexpensive paperback special[41]. It contained chapters by Ross Ashby and Geoff Summerhoff amongst others and because of its accessibility it was widely influential throughout the artworld in the UK. It was, for example on the recommended book list for many foundation and undergraduate fine art courses in the UK. Two books by the left-wing cybernetician Stafford Beer – "Designing Freedom"[42] and "Platform for Change"[43] were also influential as the 1970's progressed. Although the systems art movement was pan-European, the Systems Group was primarily based in the UK. Malcolm Hughes was a member and was also head of Postgraduate Studies at the Slade School of Fine Art, University College London. He set up what became the Experimental and Computing Dept – or EXP – in 1973 under Chris Briscoe where the systems ethos was transferred into the computer domain. The

figure 6

George Mallen, The Ecogame, 1969
Coutesy the Computer Arts Society

emerging ideas of deterministic chaos, fractals and cellular automata were influences and the output of EXP forms a root of both the computational/generative arts as well as the scientific pursuit of a-life[44] (fig. 7[45] & 8). Edward Ihnatowicz who was then based in the Mechanical Engineering School at UCL was a regular visitor as was Harold Cohen[46] who was working on an early version of his expert drawing system AARON at UC San Diego. From 1974 to 1982 when it closed EXP was a major focus for artists from around Europe who were working in the computational domain.

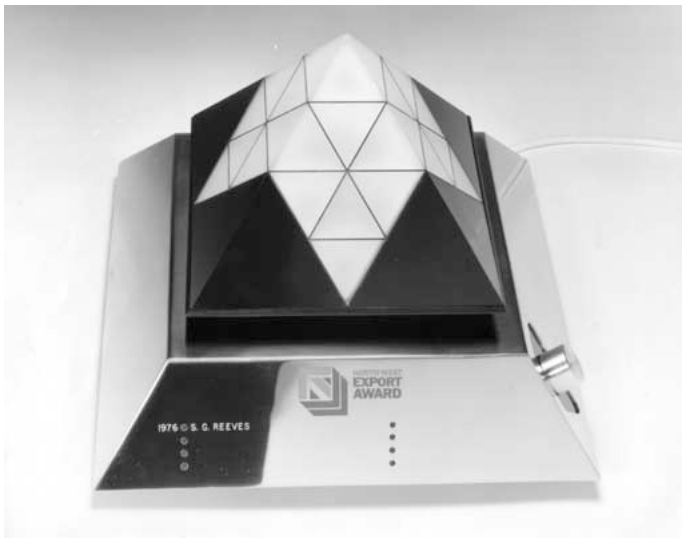

figure 7

Paul Brown, CBI North West Export Award, 1976

An early a-life work by the author that was driven by a dedicated digital circuit.

In 1970 two important exhibitions took place in New York. Kynaston McShine's Information show at MoMA was an eclectic and idiosyncratic mix of conceptual formalism, linguistic & information theories and socio-political activism[47]. Jack Burnham's Software show was held at the Jewish Museum and was intended to draw parallels between conceptual art and theories of information such as cybernetics. The complete name of the show was "Software – Information Technology: Its New Meaning for Art" and it included work by a young architect called Nicholas Negroponte who would later found MIT's Media Lab. In his earlier and influential book "Beyond Modern Sculpture" published in 1968[48] Burnham had suggested that the future for art was the production of "life-simulation systems". Many artists of the time agreed and believed that the world of art would be radically undermined by an imminent revolution and undergo what the philosopher of science Thomas Kuhn had recently described[49] as a "paradigm shift". The artworld did change but not in the radical way these artists and theorists expected – by the 1980's it was being driven by humanities educated graduates who identified more with the eclecticism of McShine than with the focussed analytical vision of Burnham and the systems and conceptual artists. They adopted the emerging theories of postmodernism and tended to be unfamiliar with, and deeply suspicious of, computing and information technology, which they identified with the growth in power of what later became known as the military-industrial-entertainment complex. It is my opinion they made a singular mistake: by identifying the kind of developments I have described above with the absolute narratives of utopian modernism (which, to be fair, is not an altogether unreasonable association) they ignored aspects such as emergence, non-linearity, hyper-mediation, interaction, networking, self-similarity and self regulation etc… that should have been seen as – and have more recently been acknowledged as –

central to the postmodern debate. It was a classic case of throwing out the baby with the bathwater.

The ongoing lack of support from the arts mainstream throughout the latter decades of the 20th century led to the formation of an international "salon des refusés". The Computer Arts Society ran several exhibitions in the unused shells of computer trade shows in the late 1970's and early 80's in the UK and in 1981 in the USA the first SIGGRAPH Art Show[50] was curated by Darcy Gerbarg and Ray Lauzzana who also established the influential bulletin board – fineArt forum – in 1987[51]. The Austrian Ars Electronic convention and Prix[52] was launched in 1979 and in 1988 ISEA – the International Symposium on Electronic Art[53] – series began in Utrecht in The Netherlands. These international opportunities were and most remain important venues for debate and exhibition of work that, until recently, rarely found its way into the established gallery system. Thanks, in major part, to this "patronage" a younger generation of computational and generative artists emerged in the 1980s and early 90s and their ranks include Stelarc, Karl Sims, Yoichiro Kawaguchi, William Latham, the Algorists, Michael Tolson, Simon Penny, Jon McCormack, Troy Innocent, Ken Rinaldo, Richard Brown and many others.

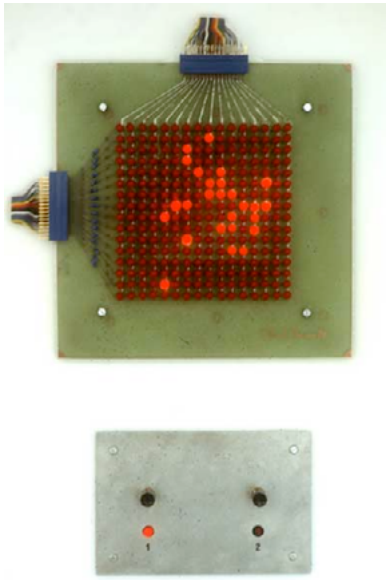

figure 8

Paul Brown, Life/Builder Eater, 1978

An alife work by the author produced at EXP. Believed to be the first artwork to have an embedded microprocessor.

Acknowledgements

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Biography

Paul Brown is an Anglo-Australian artist and writer who has been specialising in art & technology for almost 40 years.

In 1984 he was the founding head of the United Kingdom's National Centre for Computer Aided Art and Design and in 1994 he returned to Australia after a two-year appointment as Professor of Art and Technology at Mississippi State University to head Griffith University's Multimedia Unit. In 1996 was the founding Adjunct Professor of Communication Design at Queensland University of Technology.

From 1997-99 he was Chair of the Management Board of the Australian Network for Art Technology and he is a member of the Editorial Advisory Boards for LEA, the e-journal of the International Society for the Arts, Sciences and Technology (MIT Press), and the journal Digital Creativity (Routledge). From 1992 to 1999 he edited fineArt forum, one of the Internet's longest established art 'zines and he is currently moderator of the DASH (Digital ArtS Histories) and CMCA (Computational Models of Creativity in the Arts) e-lists.

His computer generated artwork has been exhibited internationally since 1967 and is currently on show in Europe, Russia, the USA and Australia

During 2000/2001 he was a New Media Arts Fellow of the Australia Council and he spent 2000 as artist-in-residence at the Centre for Computational Neuroscience and Robotics (CCNR) at the University of Sussex in Brighton, England. From 2002-05 he was a visiting fellow in the School of History of Art, Film and Visual Media at Birkbeck College, University of London, where he worked on the CACHe (Computer Arts, Contexts, Histories, etc...) project and he is currently (2005-08) visiting professor and artist-in-residence at the CCNR, University of Sussex where he is contributing to a project to evolve robot artists.

Examples of his artwork and publications are available on his website at:

http://www.paul-brown.com

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