Gordon Pask – 28 June 1928 to 28 March 1996

Pask Present

An exhibition of art and design inspired by
the work of Gordon Pask
(28 June 1928 to 28 March 1996),
cybernetician and artist

Edited by
Ranulph Glanville | Albert Müller

edition echoraum

Pask Present – the exhibition

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e d i t i o n e c h o r a u m

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– originated by Ranulph Glanville and curated by Richard Brown, Stephen Gage and Ranulph Glanville.
– designed by Professor Stephen Gage and built by students of the Bartlett Interactive Architecture Workshop
– associated with the 19th European Meeting on Cybernetics and Systems Research
– presented by Dr. Albert Müller on behalf of the Heinz von Foerster Society

Gordon-Pask-Archive
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Ranulph Glanville

Introduction

Vienna in 2008 provides a fortuitous time and ideal location to be the scaffold for an exhibition of art and design inspired by Gordon Pask. Pask, a major cybernetician and educator and the creator of interactive machines and environments that were sometimes educational, sometimes artistic, sometimes both – but always cybernetic – had a particular attachment to Vienna. Although himself one of the early cyberneticians, he looked to Heinz von Foerster as his mentor.
Foerster, of course, was Viennese, his family well known for constructing, amongst other things, the Vienna Ring. In his book of calculator games (things for people who bought calculators without any use for them, to do with them), "Calculator Saturnalia",[1] Pask weaves a story around the games that features the fabulous Dr. Hermann von Pfaff, Heinz von Foerster in thin disguise, leading the way through Vienna, City of Keys.
Dr. Robert Trappl, president of the Austrian Society for Cybernetic Studies (ÖSGK) and founding chair of the European Meetings on Cybernetics and Systems Research (EMCSR) has told me of his surprised delight when Pask (along with Stafford Beer) accepted an invitation to one of the earliest meetings. Pask became the regular chair of a symposium that changed its name but remained concerned to discuss and question the "basic" concepts of cybernetics. For him, his symposium at EMCSR, and his biennial visit to Vienna, was a matter of great personal importance, and his award of an Ehrenmitglied

(honorary membership) by the ÖSGK was a matter of great pride. The certificate hung, framed, in a prominent position on his study wall in Richmond and, later, in Clapham.

Pask's sessions were, as he was, deeply theatrical. He brought to the conference and to Vienna his academic theatricality which somehow seems appropriately at home. His art works were also theatrical. The most famous, most viewed piece was Colloquy of Mobiles,[2] created for Jasia Reichardt's Cybernetic Serendipity exhibition[3] that was shown at London's Institute for Contemporary Arts between 2 August 1968 and 20 October 1968. Our exhibition, Pask Present, celebrates the 40th anniversary of Cybernetic Serendipity: an exhibition that is totemic, giving the seal of approval to a new art medium. This anniversary is the second factor in the appropriateness of our exhibition.

A third factor that makes timely a celebration of Pask's art as a source for work by others is the opening in November last year of the Pask Archive at the Department for Contemporary History (Institut für Zeitgeschichte) at the University of Vienna. Pask left an archive with his daughter Amanda Heitler which was much too big for a family to maintain. After considerable consideration, I introduced the Heinz von Foerster Society to Amanda (who, of course, grew up with Heinz), and the option of Gordon's archive being installed in Vienna and next the Heinz's proved irresistible. The quality of the care taken by Albert Mueller of the Foerster Archive clinched what was, in actuality, already clinched!

So there is an timely appropriateness, a serendipity, in holding an exhibition based around the influence of Gordon Pask's cybernetic art in Vienna in 2008, as an adjunct to the European Meeting on

Cybernetics and Systems Research that mattered so much to him, in the 40th anniversary year of Cybernetic Serendipity.

Our exhibition, Pask Present, does not claim to be authoritative or even a balanced representative selection. It grows directly out of the Maverick Machines exhibition shown in Edinburgh last summer. In the section of Studies, Richard Brown – who curated Maverick Machines – tells us of that show and of his discovery of Pask. This show contains some of the same works, but some are omitted and others (and other artists/designers) are added. Our purpose in making the show is to show a way forward, as I argue in my study. Pask's contribution, and indeed the value of cybernetics itself, is not as historical curiosity, no matter how much we may gain from looking at it in the historian's light. Nevertheless, we are specially fortunate to be able to reproduce Margit Rosen's essay on the significance of Pask's art and Cybernetic Serendipity. Pask approached problems that others are still only on the edge of. In particular, Pask's notion of interaction is far more sophisticated that the general notion employed in the arts, design and architecture – and, for that matter, computing – where the term is usually used to indicate little more that an action and reaction response. Usman Haque's paper argues this point. For Pask, interaction could be demonstrated in the special case of conversation (his opus magnum is "Conversation Theory"). In conversation, participants find themselves discussing topics that they'd never thought of, when they began, and they may find radical, new ideas in and through the conversation.

The art and design works cover a range from the practical to the bizarre, from the slow to the fast, and from student work to that of

established artists and academics. Each piece, and each artist/designer, is described in the catalogue of exhibits. Some of these works strongly resemble Paskian pieces, others are far removed from the sort of work that Pask produced. You will not see any actual work by Pask on show – it does not survive, and anyhow, this exhibition is aimed to look forward. In this anniversary year of Cybernetic Serendipity it is much more worthwhile to see how we can progress than remain trapped in admiration of earlier achievements. There is a reawakening of interest in cybernetics in the arts, but somehow this interest is generally in the cybernetics of 1968, the year of Cybernetic Serendipity, rather than in cybernetics as it has been developed to the cybernetics of today. But here, in this show, you can see work that is not trapped in 1968, rather moving forwards as Gordon Pask would have hoped, and benefitting form the work he, Foerster and others did as they moved the frontiers of cybernetics, in particular transporting it to be at the very frontier of an epistemological debate which itself is visible in many of the works on display.

I would not want to conclude this introduction without giving my thanks to many who have made this exhibition. Firstly, I thank those who have sponsored us through their funding, and Dr Robert Trappl for allowing us to make this unusual extension to a scientific conference. (A complete list can be seen on page 6)
Special thanks go to the Austrian Ministry of Science and Reseach (Dr Peter Kowalski, Mag Martina Hartl), to the Ministry of Education, Arts, and Culture (Mag Andrea Ecker, Mag Bettina Müller-Jeschko), to the Austrian Society for Cybernetic Studies, the American Society of the Cybernetics, The Bartlett, University College London, and to the University of Edinburgh.
Secondly, I thank my colleagues Richard Brown and Stephen Gage, without whose support and efforts as co-curators this exhibition would not exist. Thirdly, I must thank the students of the Bartlett School of Architecture who drove most of the exhibits to Vienna, and who built the exhibition Stephen had designed.
Fourthly, I thank the artists, from many backgrounds and corners of the world, and the gallery owners. And last, I thank especially Dr Albert Müller for his tireless efforts in acting as our Viennese agent, in promoting our cause, chasing funding and bringing in Werner Korn and edition echoraum, who have made the catalogue, accommodating a very difficult time frame.
This exhibition owes its inspiration to two people. The first is Gordon Pask, about whom I have written above. The second in Jasia Reichardt, who had the vision to see the connection and the value and who somehow managed to make the Cybernetic Serendipity, telling us that there is an area here. Without their inspiration, there would be no exhibition.

29 February 2008

1 Pask, G.; Glanville, R. and Robinson, M. (1980) Calculator Saturnalia, London, Wildwood House.
2 See: http://www.medienkunstnetz.de/works/colloquy-of-mobiles/
3 See: http://www.medienkunstnetz.de/exhibitions/serendipity/

Ranulph Glanville[1]

A Cybernetic Serendipity

I first came across that delicious word, serendipity (the occurrence and development of events by chance in a happy or beneficial way),[2] at the Cybernetic Serendipity Exhibition curated by Jascia Reichardt at the ICA in 1968.[3] This exhibition is the stuff of legend: art and cybernetics, artists and cyberneticians, meeting together in a symbiotic feast. It marked both the high point and, contrarily, the beginning of the rapid descent of cybernetics in the arts, for virtualy from that date cybernetics began to be an almost unusable term, much of its thinking being appropriated by other subjects that had more attraction though, I could argue, less coherence and less honour. That particularly specific and limited cybernetic machine, the computer and its theoretical adjuncts artificial intelligence, cognitive science and artificial life, took over and the generous generality of cybernetics vanished from view. It was far from dead (as some claimed), but it went through an internal revolution and has still not managed to return itself to even a bit part on stage!

Roll on nearly 40 years and something strange is happening: Leviathan, it seems, may be emerging from the deep. Over the past couple of years there has been a resurgence in interest in cybernetics by artists. Not, it must be admitted, cybernetics in its current state, but right back, where Cybernetic Serendipity marked its progress as that progress turned into almost freefall.

So how appropriate, how warming and how timely it is to be able to present this exhibition, "Pask Present" in the Atelier Färbergasse in Vienna. This exhibition, a development from the Maverick Machines Exhibition curated by Richard Brown in Edinburgh in August 2007, has been grown (sometimes literally) out of one of the seminal figures of cybernetics, Gordon Pask. Pask was an extraordinary and exceptional man who, although he liked to call himself a cybernetician, was active in many fields including drawing, writing lyrics, and the construction of performative art machines, many of which were so radically advanced that it is perhaps not surprising that his work is becoming current so long after he did it.

For the Cybernetic Serendipity Exhibition he constructed Colloquy of Mobiles,[4] a collection of five large, fibre-glass robots that danced with each other and any member of the public who entered their space. Many years before that (1953), he constructed MusiColour,[5] a light system to accompany the combos of the day. Unlike the light shows since, however, MusiColour joined the combo as if one of the players, modelling the performance of the others and joining in until it became bored and suggested variations of its own (which the musicians would respond to). In a later book ("Calculator Saturnalia", written with Mike Robinson and myself[6]) Pask wrote a fantasy story set in Vienna around a collection of games explicating cybernetic principles, illustrated with his fantastic drawings. He was responsible for the naming and defining of the Maverick Machine.

But the work of Pask's that is most relevant, as far as Pask Present is concerned, comes from two sources. The first is his experimentation with chemical computers and with the way that you could grow computations as crystalline (quasi-dendritic) forms in solutions, influenced by varying electrical charges. This thread is perhaps best presented in our exhibition by Richard Brown's Electrochemical Glasses, showing three glasses (Paskian chemical computers) powered by currents from electrodes that are wired together and so that the dendrites which appear in the crystalline solution compete for the available electrical resource. What is bizarre is that Brown did not, when he made this piece, know of Pask's work. The work of Roman Kirschner, show on video, is also built on Paskian chemical themes (this time knowingly), with a different embodying medium that includes sound. Equally amazingly (and bringing to mind Goldfinger's statement to James Bond "One is happenstance. Twice is coincidence. Three times is enemy action."), Axon Technologies has been developing Paskian chemical computational elements (for use as computer memory) at the nano scale, also without, they say, having heard of Pask at all: a wonderful example of the serendipitous leakage of ideas through the community – and of how cybernetic work so often appears, unacknowledged, in other fields.

The second source is demonstrated in more architectural work that derives from Pask's notion of interactivity and of conversation as the archetypical vehicle of interaction – which may be seen embodied in Colloquy and Musicolour. It is important to note, here, that Pask's interaction was not the trivialised interaction made such a fuss of by the computer industry but involves the generation of novelty which moves the relationship of the participants to new areas, as happens in (everyday) conversation. Pask's main theoretical work was called "Conversation Theory" and developed around concepts of learning

that are still considerably ahead of the field, today. Pask's views of interaction are drivers behind the work of The Bartlett Interactive Architecture Workshop which has been developing its programme over the past 15 years under the direction of Stephen Gage, and Usman Haque, formerly student and now one of the tutors in the Workshop.[7]

The work of Usman Haque with Robert Davis, is a sample of a sound installation in which analogue oscillators interact not only with each other, but are affected in this interaction by the acoustics of the space they are in, and the presence and movement of people. It plays very consciously on the active participation of the observer in the performance, a central concept of the more recent form of cybernetics that developed following the Cybernetic Serendipity Exhibition, generally called second order cybernetics. The work of the Bartlett Interactive Architecture Workshop is represented by two pieces of computational hardware by Ruiari Glynn and Richard Roberts (who are currently studying for higher degrees) and videos of 3 current projects by students working on their thesis projects, Paula Friar, Harry Parr and Rion Willard, as well as research work by the director of the Workshop, Stephen Gage, in colaboration with Chris Leung. The work shows a wide range of objects that respond to the presence of humans and a physical environment, often playfully, in a manner that helps change our understanding of what architecture might be.

An important aspect of this work is the quality of craftsmanship in making the objects: these are polished and finished items, cared for by their makers, sometimes almost furniture, and they contrast nicely with many of the other exhibits that have about them the Heath

Robinson aesthetic of space travel in the Edwardian era – itself appropriate given Pask's personal style, often likened to an Edwardian Dandy's, such as the Time Machine that switches on only in the presence of an observer (raising the sort of philosophical question about what exists when not observed that perhaps inspires Haque and even Pask, himself, in Colloquy); and the Framed Static Machine, which flutters like butterflies and cascades upwards with flickering lights. Both these are works by Richard Brown.

Also in the interactive camp is the work of Omar Khan. Khan spent some time working in association with Gordon Pask, as a student at the Architectural Association in London. On show in Pask Present is a model of a large physical interactive environment, his Open Columns Homeostat.

A bridge is built between the two sources (chemical and interactive) by the work of ArtStation. These are the only artists (apart from the author) to have worked with Pask. They built animated visualisations of Pask's concepts, and, learning from that, an unfolding program and robot in support of a collective plant generation processes.

Finally, there is my own piece, Slow. This piece changes at such a slow rate that the observer is left questioning wether and when it changes, and, in making the decision, becomes, explicitly, not only the involved observer of second order cybernetics, but also, because the decision is unpredictable, in, I would argue, an interactive manner.

There remain, I believe, two questions that need at least to be raised even if I cannot answer them.

The first is the familiar one of what exactly constitutes a piece of art? Ever since Duchamp exhibited his urinal as a "Fountain" we have been

able to argue that something is art because someone who claims the title artist says so. This exhibition, like many others involved in the making of machines and computing environments, brings this question to the fore. How do these exhibits differ from the records a scientist might produce? And does this matter? Some will argue the job of art is to raise, time and again, the question as to whether this is art: that raising the question qualifies the work as art work. Isn't this the basis of much work since cubism?

The second is, does this take us forward? Here I would like to write of cybernetics rather than art. With the supposed death of cybernetics shortly after the Cybernetic Serendipity Exhibition, it seems that cybernetics is caught in a timewarp. Even those who work in that approach to cybernetics which has been developed since 1968, so called "second order cybernetics"[8] are inclined to look backwards, eulogising the dead old men (including Pask). These men made wonderful contributions, but it is surely time to seek out the workers who are creating new understandings. We are fighting the danger, in an exhibition such as this, of becoming nostalgic: and, indeed, some of the pieces do hark back in their form, and sometimes their mechanism and technologies, to earlier times. This looking backwards is a serious matter, but fortunately, in this exhibition, as well as the nostalgia there is a sense of extension that moves the thinking, at least at the junction of cybernetics and art, onwards. In this respect, the show is, we believe, a cybernetic serendipity and serendipitously cybernetic.

1 Developed from a review of the the predecessor of this exhibition, the *Maverick Machines Exhibition*, http://maverickmachines.com/WordPress/

2 The origin of the word lies with Horace Walpole, who coined it in 1754 from the fairy tale "*The Three Princes of Serendip*".
See: http://livingheritage.org/three_princes.htm

3 See: http://www.medienkunstnetz.de/exhibitions/serendipity/

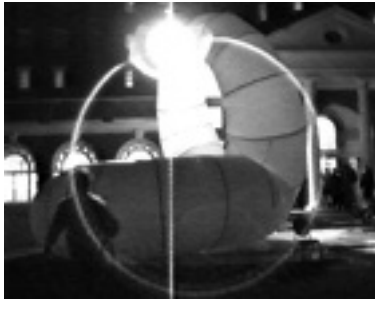
4 See: http://www.medienkunstnetz.de/works/colloquy-of-mobiles/

5 Pask, G. (1971) A Comment, a Case History and a Plan, in Reichardt, J. (ed.), *Cybernetics, Art and Ideas*, London, Studio Vista

6 Pask, G, Glanville, R and Robinson, M (1980) Calculator Saturnalia, London, Wildwood House

7 For more information on the *Bartlett Interactive Architecture Workshop* see Stephen Gage's introduction to the Workshop in this section of the catalogue

8 Second order cybernetics is the outcome of a cybernetic critique of cybernetics. In 1968 Margaret Mead (in her paper, Mead, M. (1968) The Cybernetics of Cybernetics, in von Foerster, H. et al (eds) *Purposive Systems*, New York, Spartan Books) wondered why a cybernetic society (the American Society for Cybernetics) did not try to organise itself according to the principles the subject espoused. In cybernetic systems, the sensor (observer) is within the system, for the system is circular. One inconsistency that comes to mind is the manner in which, in classical (first order) cybernetics we talk about the systems we examine as though we were divorced from them, without the circularity of feedback. Second order cybernetics is, thus, concerned with the cybernetics of observing (as opposed to observed) systems, or with observers IN a system rather than observers OF a system.



Gordon with a physical Conversation Theory model in our Amsterdam studio, 1988

(Still) Travelling inside a Conversation Theory animation, CAD 3D, Atari ST, 1988

Paper Installations

ArtStation (Anne E. Hayes / Glenn Davidson) (Wales)

On Conversation 1988
Splicer and Hare 1989–92

On Conversation

The video documents the artists' early experiments with Pask, programming animation on an Atari computer. These were some the first moving images Pask saw of the topological carapaces implied by his Conversation Theory (CT). They are attempts to model emergent bifurcations, within the dynamic process product complementarity of CT. Working together, Pask and the artists established the architectural metaphor of the theory using a moving viewpoint. The viewer is placed within events themselves providing a window on the motion and execution of the model. The video documents the Bitori installation, created for Virginia Beach American Society for Cybernetics conference in 1989 which placed Pask physically within an architecture drawn directly from CT's minimal form; bifurcating tori. Built from paper and inflated by air, the architectural installation formed an emblematic presence at the conference. The video features Pask and Davidson emerging in reflective conversation on revelations released by their meeting within, and continues at the artists' studio in Amsterdam showing a tensegrity model of CT being constructed by Pask and mathematician Joachim Mowitz. The artists international works are in part contemplation, illustration and evocation of Pask's ideas on conversation.

Splicer and Hare

During 1988 the artists created their "Splicer" topological computer aided design (CAD) software with Mowitz. Splicer is software for splicing into three dimensional surfaces, flattening the net to reveal the inner surfaces. This act was analogous to cutting into the architecture of CT to provide views of the inside. It also expressed curiosity in the corporal body: during this period the artists studied hospital microscopy operations where cameras were inserted into the digestive system of patients. Operating on the live processes within CT, Hayes and Davidson began to externalize their thoughts through the use of industrial waste paper. A mouse driven Interface was added later that year by a young games programmer, Markus Te. Optimized for building in paper the software now helped produce the distinctive paper works. It has also provided a collaborative working process known in Artstation as human CAD CAM (computer aided design – computer aided manufacture). Splicer produces data lists describing sections of the installations as large numbers of points. Public installations require a team to measure and plot the points by hand.
In 1991/92 a robotic "Hare", seen in the exhibition, was created with physicist Richard Noble. The idea built upon the work of Seymour Papert and the Logo computing environment widely adopted in schools. Output from Splicer was scaled up and rapidly plotted out using the Hare. A wide range of architectural and educational works became possible. The video documents a Schools Town Planning project through which Hayes and Davidson were invited to be studio guests on BBC 1's Blue Peter programme, accompanied by a small number of students from the 7 schools who came together to design, build and organise their own town.

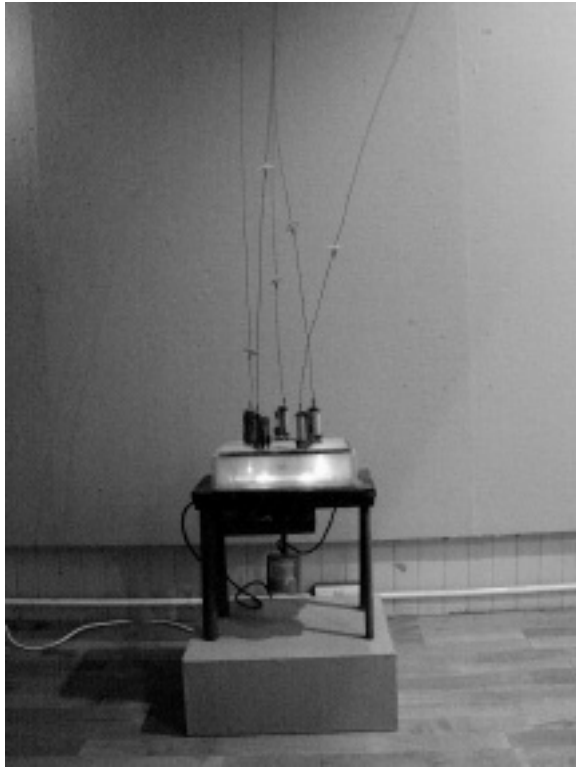
Artists **Anne E Hayes** and **Glenn Davidson** (aka **ArtStation**), were introduced by Ranulph Glanville to the Research Programme "Support, Survival and Culture", based at the University of Amsterdam under the direction of Gerard de Zeeuw and Glanville, in which Gordon Pask was a professor. They spent much time working with Pask during their invited fellowship in 1988.
Their creative partnership had formed in 1979. Hayes and Davidson Trained in Fine Art in Cardiff/Wales as well as with Pask and his Cybernetics in Amsterdam. Their work as Artstation has been seen in Japan, USA, Canada, Australia, India, Germany, France, Holland, Belgium, UK and Northern Ireland. Each year Davidson presents a lecture at the University of Cardiff Business School. As a result of their work in Amsterdam with de Zeeuw and Pask, in 1989 they presented (at the American Society for Cybernetics conference in Virginia Beach) Bitori.
A year later they helped organise and presented "Thistle", a new work reflecting co-operative working methods and the conversational principle at the ASC conference in Montreal. The experience of this period and, Pask's work in particular, continues to inform Hayes and Davidson's "socially engaged" practice in installation, writing, filmmaking, media work to the present day.

Richard Brown (UK)

Various (1983–2008):
Electromagnetic Time Machine 1983.
Static Machine 2007
Electrochemical Glass 1997–2007
Electrochemical System 2008
Axon Memory Device 2007
Electrochemical Synthesiser 2007

Electromagnetic Time Machine 1983

An electromagnetic kinetic sculpture using the cybernetic principle of regulatory feedback to generate complex oscillatory behaviour. Each electromagnetic relay is physically coupled to a vertical pendulum and electrically influenced by its immediate neighbour. When a relay closes it causes the relay in front to close only if the relay behind is open, thus creating a regulatory feedback loop with unstable oscillations due to the differing physical weightings of the vertical pendulums. A simple PIR sensor activates the work, the pulsing lights indicating the closing and opening of each relay.
Cybernetics concerns itself with any type of system that involves sensing and feedback, biological, ecological, mechanical and chemical. Gordon Pask created cybernetic feedback mechanisms using electromechanical and analogue components in his works, such as "Colloquy of Mobiles" in the same vein, Time Machine represents an alternative paradigm to the digital.



Static Machine 2007

An electrostatic kinetic sculpture.
The movement of the copper tongues is generated by the attraction and repulsion of induced static electrical charge. A high voltage ioniser circuit generates the static charge at the base of the sculpture. Energy flows around the sculpture via the oscillating copper tongues causing the neons to glow as the machine attempts to dissipate electrical energy. The tongues act as capacitors, accumulating and moving the charge upwards with excess energy being spent via the spark gap.
The machine can be viewed as an analogue computer constantly trying to balance charge dissipation over charge accumulation through the physical movement of electrical charge.
Though apparently a simple kinetic device, a digital simulation of the complex behaviour of static machine would probably be well nigh impossible due to the many interacting complex processes and parameters – the changing humidity and ionisation gradients in the air within the work, the varying mechanical properties of the copper tongues, the varying and complex interdependencies of charge induction in time and space, the electrical characteristics of the neon. Pask would have appreciated the fact that these complex interactions could only be realised as a physical machine and perhaps used it to justify his view one the digital computer as a "kinematic magic lantern".

reference: http://en.wikipedia.org/wiki/Gordon_Pask

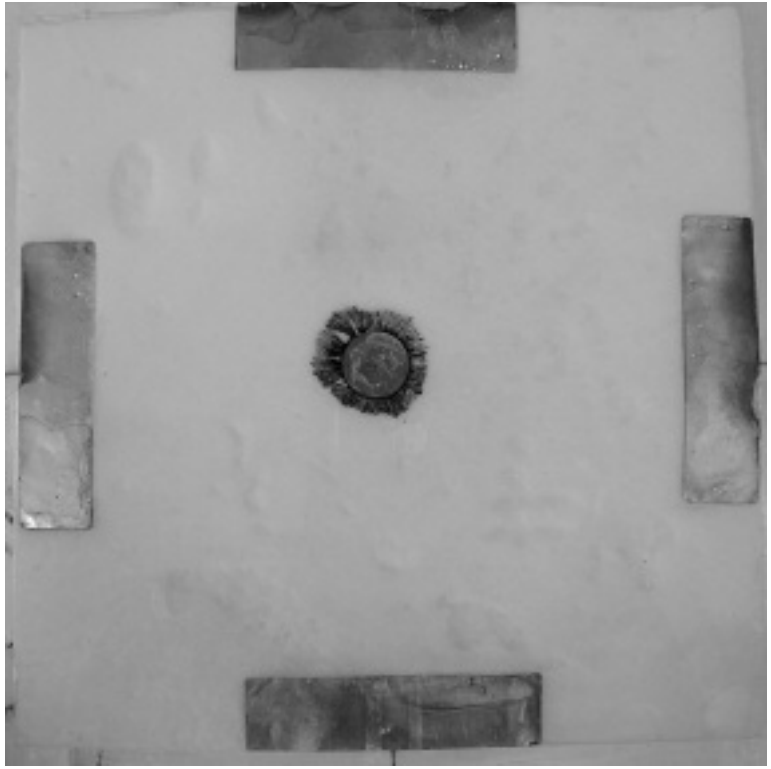
Electrochemical Glass 1997–2007

In 1997, three metals, copper, aluminium and iron were set on a cotton wool base immersed in a conductive solution and sandwiched between glass. The three metals act as a primitive battery, causing ionic migration of the metals and associated electrochemical reactions. The interaction between the metals, the chemicals and the resultant potential difference is a complex system of cybernetic feedback, which is visually represented by the traces and deposits. The startling tentacle-like growth of the iron dendrites grew forth over a period of months in 2005, eight years after the works inception.
The Electrochemical Glass can be viewed as an extremely slow "electrochemical computer", the potential difference between the three metals as input, the electrochemical processes as program and the tendrils as output, representing changes of energy as the work evolved over time. Pask experimented with electrochemical dendrites, training them to respond to external stimuli as learning devices, the most famous being knows as Pask's ear.

reference: http://homepage.mac.com/cariani/CarianiWebsite/PaskPaper.html

Electrochemical System 2008

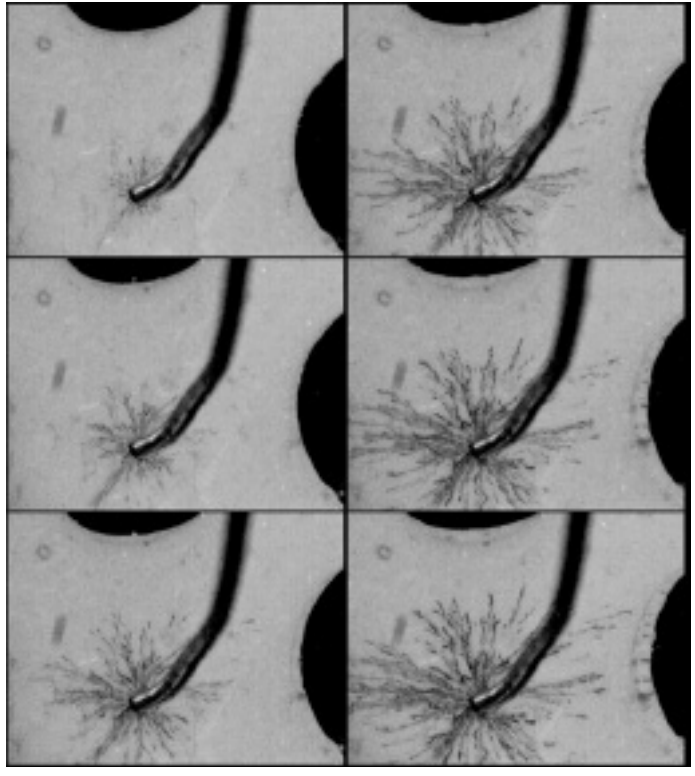
The Electrochemical System is inspired by Gordon Pask's early experiments with electrochemistry. The central negatively charged copper electrode of each glass is surrounded by four positively charged copper electrodes. Copper dendrites grow from the central electrode reaching out to the outer electrodes. The plates are connected so that each glass is in competition with the other, more charge being consumed by the fastest growing dendrite. Each outer electrode is connected via an LED whose colour and brightness indicates the voltage difference.
This work represents an experiment in using dendritic growth as self regulating switching mechanisms, as a dendrite grows, it consumes more potential in competition with other dendrites trying to grow from the same power source.
Pask describes the possibilities of chemical computing, the energy systems involved and illustrates a number of circuit possibilities for dendritic circuits on pp 105–108 in his book "An Approach to Cybernetics", Pask 1961.



Axon Memory Device 2007

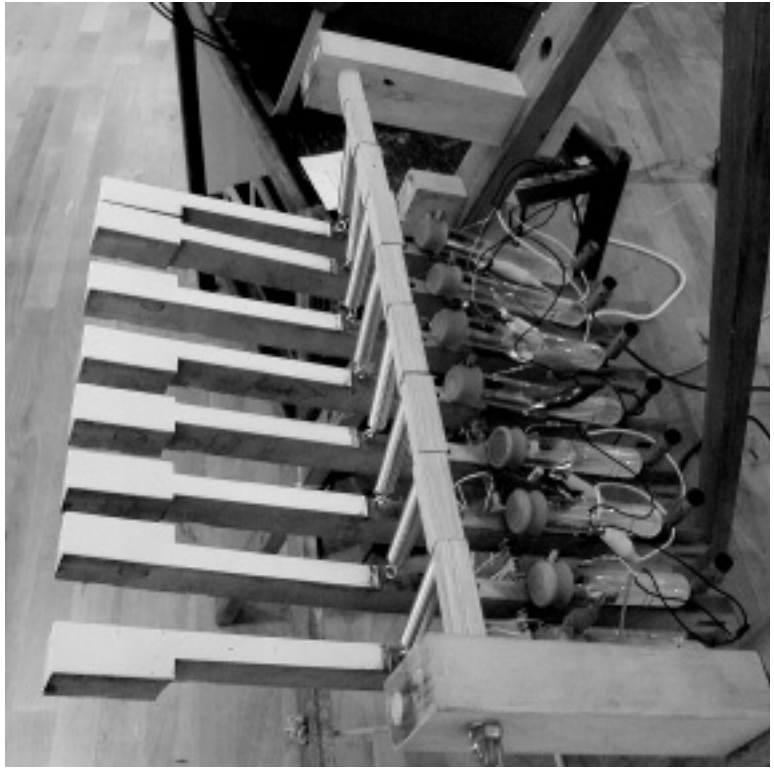
Axon Technologies have produced a new memory technology that is based on electrochemical deposition of metal, similar in principle to the electrochemical experiments conducted by Gordon Pask. The device on show consists of a microscope viewing an Axon demonstrator slide, a much larger version of their nanoionic memory system. The slide consists of a number of circular silver electrodes deposited on an electrochemical substrate. The control panel enables a positive or negative potential to be applied to the central wire electrode between the two circular electrodes. When the memory switch is set to remember/grow, by pressing the left or right button (or both) buttons) a dendrite can be made to grow and make a connection indicated by the LED. Setting the memory switch to forget/decay the dendrite can be made to recede and break the connection. This demonstrates at a larger and much slower scale the principle employed in Axons memory device, which operates on the nanoscale where connections can be made or broken in nanoseconds rather than minutes.

Electrochemical Slide courtesy of Axon Technologies: www.axontc.com



Electrochemical Synthesiser 2007

Through the audio amplification of low level electrical activity, this work demonstrates the highly complex electrochemical activity occurring between copper and aluminium in salt (Sodium Chloride) solution. The sounds give an indication of the many invisible oscillating electrochemical processes occurring between the two metals. The work serves to illustrate the natural complexity available through simple materials contrasting the amount of electronics or software programming that would be needed to realise the synthesis of equivalent sound effects.
The inspiration for this work was from a previous installation monitoring electrochemical activity between dissimilar metals, "The Preservation of Entropy" and the web page, "Peculiar sound from Aluminium" by Nyle Steiner,
http://home.earthlink.net/~lenyr/alsounds.htm
The electrochemical synthesiser demonstrates once again the incredible complex properties possible with non-digital systems. The formulae that might describe the oscillatory electrical activities that are heard are likely to be esoteric and difficult to understand, however the rendering into sound serves to communicate the complexity in an aural manner, giving us an immediate sense of what we cannot see, or visualise, but we hear. Gordon Pask dramatised many of his complex ideas, referring to theatre and mechanical visualisations as a means of conveying his theories. This work attempts to do something similar: it provides a means of engagement with what are essentially complex theories of electrochemistry.



Richard Brown has a BSc in Computers & Cybernetics and an MA in Fine Art and works as a hybrid artist, inventor and entrepreneur creating interactive and mimetic experiences using a wide variety of media, including the digital, the analogue and the chemical. His work explores the perception of space, time and energy encompassing ideas from cybernetics, artificial life, interaction design, emergence, complexity and alchemy.

Between 1995 and 2001 Richard was a Research Fellow at the Royal College of Art where he created and exhibited three major interactive works Alembic (ICA 1998), Biotica (Siggraph 2000) and the Neural Net Starfish (Millennium Dome 2000). Whist at the RCA, Richard also published the book "Biotica: Art, Emergence and Artificial-Life".

Richard has funded his work with awards and grants from Intel, The Arts Council, Sci-Art Wellcome Trust and in 2002 was awarded a two-year fellowship grant from NESTA (the National Endowment of Science Technology and the Arts) to enable him to pursue an independent research career.

Between 2002 and 2003 Richard was based in Australia as an Honorary Senior Research Fellow at the Victorian College of Art, Melbourne University, and artist-in-residence at CEMA (Centre for Electronic Media Arts), Monash University.

In 2004 Richard moved to Edinburgh and joined EPIS, the Edinburgh Pre-Incubator Scheme to combine entrepreneurship, art and research. In 2005, with an award from Ideasmart, Richard developed and patented a unique gesture controlled lighting system.

In 2006 Richard was invited by Edinburgh Informatics to be their first Research Artist in Residence. In this role, he has developed projects combining art, informatics and communications research. The culmination of this research was an exhibition inspired by Gordon Pask, entitled "Maverick Machines" showing in Edinburgh in August 2007. Video and documentation of this exhibition can be found on the website maverickmachines.com.

For further details of Richard's work, please visit www.mimetics.com

Rob Davis | Usman Haque (England/Pakistan)

Evolving Sonic Environment IV 2007

Evolving Sonic Environment IV is an acoustically-coupled analog neural network, consisting of a society of devices whose behaviour collectively changes in response to the pitch ascendancy or descendency that each one detects. In contrast to earlier versions of the project (which operated at much higher frequencies), humans will be able to participate more directly in the adaptation process by making sounds of their own.
Drawing on the work of Gordon Pask, Donald Hebb and Andrew Adamatzky, the project is an architectural experiment to investigate how one might construct an interactive environment that builds up an internal representation of its occupants through a network of autonomous but communicative sensors.
Each device can output at any one time a rising and/or descending tone: however, if a device hears too much of one type of tone it may get 'bored' and slowly modify its behaviour. On the other hand, they may all coalesce in an equilibrium where they are all 'content' with the state of pitches in the room. This 'contentedness' may get disrupted when humans enter and start making their own sounds, thus perpetuating the evolving acoustic characteristics of the space.

Robert Davis is Systems Developer in the Psychology Department, Goldsmiths University of London, has an extensive background in both digital and analog electronics and has developed a number of electronic and computer based systems, mainly for research including: software/hardware for virtual reality based research; polygraphs for presence research; systems for precision colour and temperature measurement and generation; infrasonic/ultrasonic acoustical devices; random signal generation and processing for anomalistic psychology research; and a number of eye tracking systems for research in relation to addiction and schizotypy.
Usman Haque, Director, Haque Design + Research, specialises in responsive environments, interactive installations, digital interface devices and mass-participation performances. His skills include the design of both physical spaces and the software and systems that bring them to life. He is recipient of a Wellcome Trust Sciart Award, a grant from the Daniel Langlois Foundation for Art, Science and Technology, the Japan Media Arts Festival Excellence prize and the Grand Prize Asia Digital Art Award. His work has been exhibited at the Institute of Contemporary Arts (London), Ars Electronica, Transmediale, The National Maritime Museum Greenwich, the Tokyo Metropolitan Museum of Photography, Itau Cultural, Sao Paulo, NTT Inter-Communication Centre, Tokyo and the Singapore Bieniale.

Stephen Gage | Chris Leung

The Mechanical Homunculus 2007–08

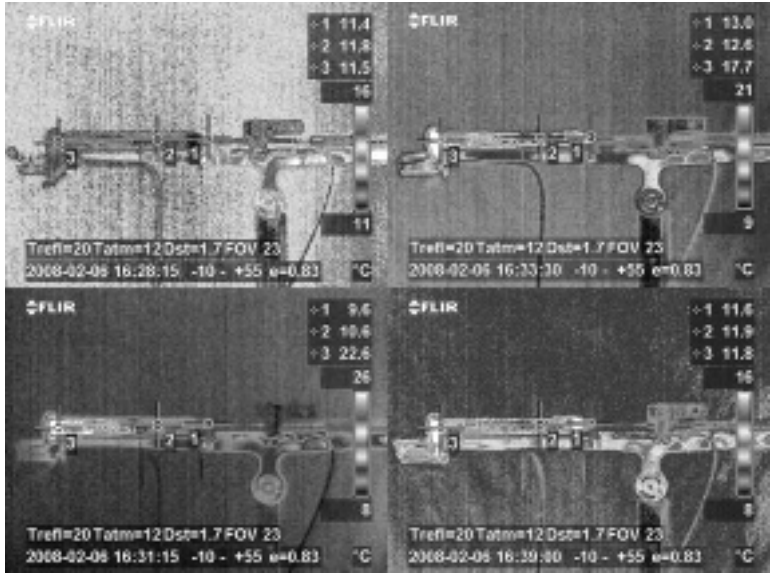
We are interested in devices that become part of the architectural environment and which hover on the border between first order cybernetic responsiveness and second order cybernetic interactivity.
There are some potentially very useful devices that use phase change in wax to drive a piston. The phase change occurs as a result of a change in ambient temperature. These devices are passive. They can be used to drive site and climate specific sculptures, for example, the "Kielder Project" by Phil Ayres, Chris Leung and Bob Shiel. They can also be used to modify the climate inside buildings. We are examining the possibility of placing this type of device outside buildings in order to do this. We have worked out ways of communicating with them through heat, the only language that they understand, and of observing their actions.
This gives us an overall picture of an environment being modified by homunculi placed outside it which in some ways resemble the subsumption (robotic) architecture proposed by Rodney Brooks. The homunculi contain a physical model of the unmodified internal environmental conditions that need to be modified in the environment that is being served.
This base line operates autonomously and without any additional formal self-representation. The base line is accessible both on its output side and on its input side. Local communication allows for object/

object and user/object interaction. Global observation by a vision system allows for a system observer/object interaction. It is possible in this context that anticipatory behaviour can be constructed through multiple routes each incorporating their own mode of representation.

Stephen Gage's professional career spans the design and construction of buildings, academic teaching and research in government, private practice and academic contexts.
He currently co-ordinates the technical aspects of design research at the Bartlett, UCL where he is professor of innovative technology and a founder member of the Bartlett Interactive Architecture Workshop His many published buildings are recognised as leaders in their field. He describes his current research as follows:
"During my long experience as a designer I have sustained an interest in the way that the technology of building can subtly modify the internal environment. My other area of research comes from a long-standing interest in the time-based aspects of architecture that relate to human occupation and building use: it takes forward an early interest in cybernetics and building brief writing."

Chris Leung is a research engineer at the Bartlett, UCL in London. He trained as an architect at the Bartlett and qualified in 2003. He is an alumnus of the Interactive Architecture Workshop founded by Professor Stephen Gage and was awarded a distinction in 1998 for his diploma project "Fibre Light-field", an installation of nine human-

machine-environment responsive systems. He worked for nine years at YRM Architects as an architect and developed bespoke software tools to support large-scale healthcare projects.
He is a member of the Sixteen*(makers) group of Designers, Fabricators and Researchers, its philosophy of "design through making" is being exercised in the Kielder Forest project in the North of England, the first "Architect's Residency" in the UK. His work and that of Sixteen*(makers) have been exhibited and published internationally including in editions of Architectural Design and Blueprint. He is a candidate for an Engineering Doctorate at UCL for his current research into integrating computer-vision techniques and physical computing to develop innovative building technology for passive environmental systems. His industry sponsor for the EngD is Haque and Design + Research Limited.



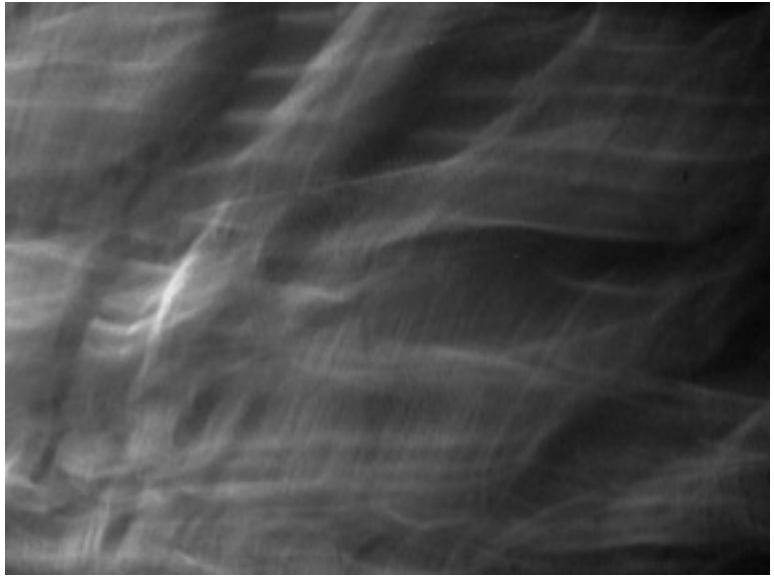
Four thermographs showing drive system electro-thermally heated in climate chamber, Bartlett UCL (February 6th 2008)
© Chris Leung, Bartlett EngD Research 2008

Ranulph Glanville (England/Australia)

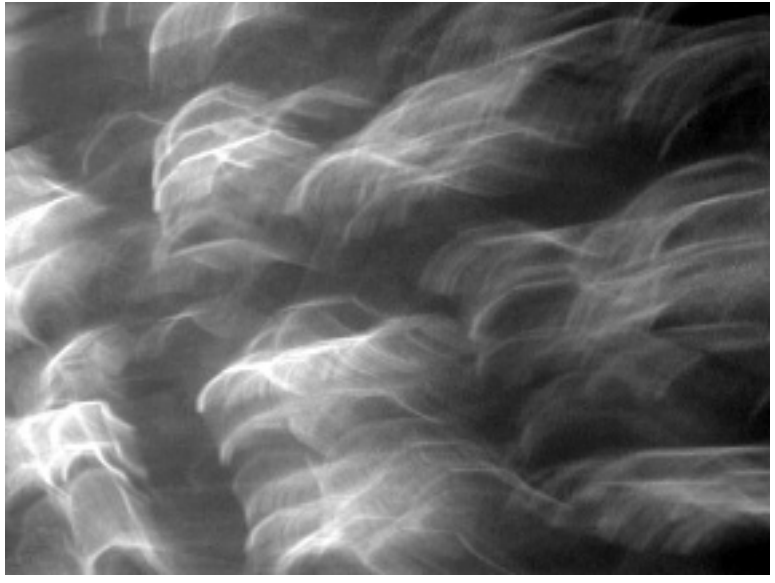
Slow 2005

Slow sits at the edge of the (im)perceptible. It consists of a set of abstract images that slowly transform one into another in a scarcely perceptible manner. The question is whether change can be sensed, and if so, how? The effect is to produce a tension between the wish to notice and the hypnotic effect of the slow change. This leads to a new consideration of interaction as a shared outcome, and it places the (participant) observer's presence and understanding at the centre of the experience.
Slow explores my interest in creating experiences that are, explicitly and publicly, ambiguous and meaningless so that the presence of observer is clearly seen and understood as essential. This is the position that was developed in second order cybernetics, especially in the conversational cybernetics of Gordon Pask. As Heinz von Foerster said:"Objectivity is the delusion that observations could be made without an observer."

Slow was coded by Usman Haque.



Ranulph Glanville studied architecture but spent most of his student life involved in early electronic music creation, and live electronic performance. He took a PhD in cybernetics (studying with Gordon Pask) and a second in human learning. He has worked as a teacher and researcher, but has continued and recently increased an involvement with the arts. He has performed as a musician in several major concert halls, and has placed art works internationally, most recently (2007) his sound and vision piece "Still" at the Biennial of Electronic Arts, Perth. He was recently awarded a higher doctorate (DSc) in cybernetics and design, and is professor or architecture and cybernetics at UCL. He also holds professorial posts at RMIT, Melbourne and Sint Lucas, Brussels and Ghent; and has been invited to act as visiting research professor at the Royal College of Art, London. He is vice president and president elect of the American Society for Cybernetics and regularly gives keynotes at conferences, including the Heinz von Foerster Conferences in Vienna. He was instrumental in bringing the Gordon Pask Archive to Vienna, and has attended the EMCSR conferences in Vienna since 1976.

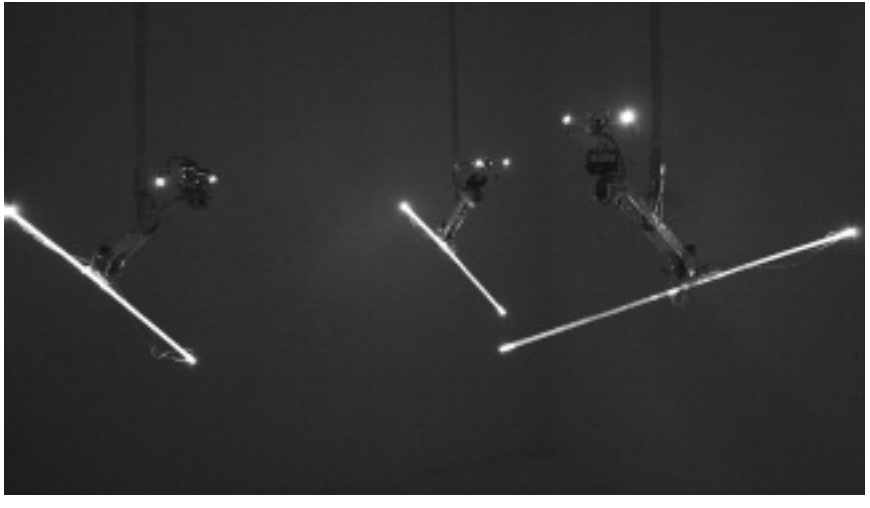


Ruairi Glynn (Ireland)

Performative Ecologies 2007–08

Three autonomous, but very sociable, performative robotic sculptures search and orientate to face human inhabitants of their environment. When performing for their audience, they learn which of their performances are most successful, using facial recognition to assess attention levels. Using a Genetic algorithm they assess the 'fitness' of their performances, disregarding less effective dances and testing and developing more effective alternatives. As well as developing their performative techniques, they are able to teach each other their most successful performances and then negotiate new performances together.

As an ecology (together with human inhabitants) they construct an intertwining of networks rich in circularities of reciprocal communication and adaption – where individual participants, both human and synthetic, operate within a larger ecology of agents, each performing independently, but continually negotiating their actions with each other. This social system revisits some of the concepts first considered in Gordon Pask's art work, the 'Colloquy of Mobiles', exhibited at Cybernetic Serendipity (ICA 1968). Like the Colloquy of Mobiles, it is an environment of active conversational participants, a physically constructed embodiment of Pask's Conversation Theory. Unlike Colloquy, this work uses new technologies unavailable to Pask and explores how Pask's ideas can be extended using contemporary digital technologies.



Installation Artist **Ruairi Glynn** explores the effects and opportunities that responsive technologies provide for participatory and performative spatial experiences. He is a graduate of the Bartlett School of Architecture where he studied under Prof. Stephen Gage & Prof. Ranulph Glanville, and is a member of the Institute of Digital Art & Technology, founded by Roy Ascot. His work crosses artistic and scientific disciplines from sculpture, architecture and dance to artificial intelligence, computer vision and robotics following a cybernetic approach inspired in particular by Gordon Pask's experimental machines and theoretical developments. He is a multi award winning artist most recently receiving the 'European Top Talent Award for Digital Media' in the category of 'Installation Art', at Europrix 2007 held in Graz, Austria.
As well as a practising artist, he is the editor of 'Interactive Architecture', a leading online resource dedicated to emerging artistic and architectural explorations of responsive technologies. He is a tutor on the Textile Futures programme at the University of Arts, London. He acts as a visiting critic at leading Architecture and Digital Arts Faculties in the UK and Holland. He has also organized a number of international events including the "Interactive Architecture & Media" symposium held in January 2007 at the Eyebeam Gallery in New York, and 'Rip Mix Burn: Cultural Industries Redefined' conference held at the Plymouth Arts Centre, UK.

Omar Khan (USA)

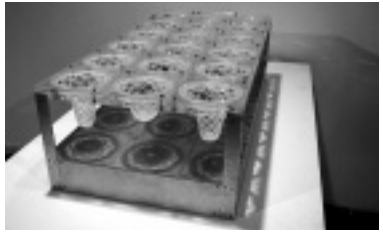
Open Columns Homeostat 2007

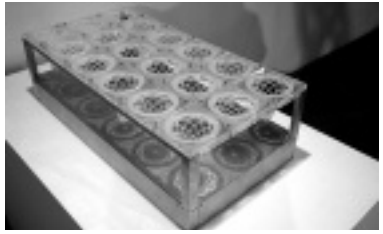
The piece is a self organizing environment for exploring spatial configurations using cellular automata. It is a scaled model (1"= 1'-0") for a larger project which envisions a distributed system of collapsible "columns" that, through their deployment, can reconfigure the space of inhabitation. It was inspired by Ashby's legendary cybernetic machine, The Homeostat, and Pask's interactive environment, the Colloquy of Mobiles. Like the former, it is a demonstrative model of an idea, in this case a means to study an evolving environment based on different heuristics. Like the latter, it imagines a space of interaction between people and their environment where the architecture has subjectivity and can adapt to changing conditions.

Assisted by: Dennis Cook, Nick Bruscia, Mike Wychosanski and Brian Podleski

Omar Khan is an architect and educator whose work spans the disciplines of architecture, installation / performance art and digital media. His research and interests deal with responsiveness and performativity in architecture. He is principal of Liminal Projects, a practice that has developed performance spaces, interactive and responsive installations, domestic interiors and award winning competitions. His work has been exhibited at The Kitchen, NYC; The Whitney Annex, NYC; The Storefront for Art and Architecture, NYC; The National Building Museum, Washington DC; ZeroOne San Jose, among others. He was a winner of the Architectural League of New York's Young Architects Forum, 1999.

Omar is an assistant professor in the Department of Architecture at the university in Buffalo (SUNY) where he co-directs the Center for Virtual Architecture. His current research projects include Machine Vision for Responsive Architecture and Variable Materials: Composite Elastomers. Omar received his Bachelor of Architecture (BArch) from Cornell University and Master of Science in Architecture (SMArch) from MIT where he was a member of the Aesthetics and Computation Group at the MIT Media Lab. He studied with Gordon Pask at the AA as part of Raoul Bunschoten's Diploma Unit 2 from 1990–91.



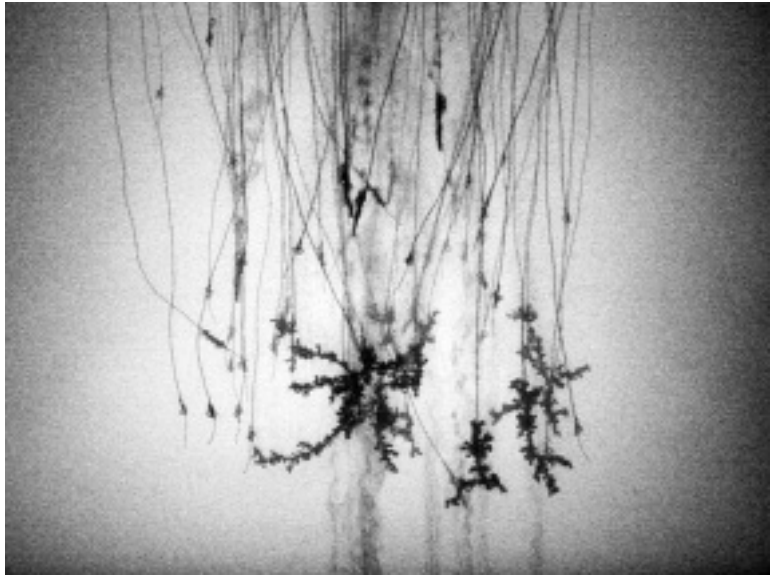


Silicon rubber columns actuated by servos model a hypostyle space where their configurations can change based uponenvironmental sensing.

Roman Kirschner (Austria/Germany)

Roots 2005–06

Roots is a dreamlike screen that follows an old persian image: a bush growing heads. – In a green and brownish fluid iron crystals grow steadily ... Bubbles ascend like jellyfish. Branches break off and sink to the dark ground. They start to dissolve and become thick clouds hovering over the scene. The sculpture works in a cyclic way. Two thirds of the cycle it is active: a cystal object is growing and strechting in space which creates a more and more tense sound. The sculpture composes itself. The following passive dreamphase makes up one third of the cycle. The object dissolves and falls apart while the tension slowly fades. The cycle of growth and decay restarts on the ruins of the decomposition. One cycle lasts around 3 hours.
Electricity is pulsed through the whole Sculpture. It is the key to the constant transformation. Growth changes the flow of the current. The modified flow changes the growth. Software and Hardware leave the next step to the material. The voltages at each wire are put through a resonance filter and thus transformed into sound. The 4/4 pulse results in a sublime rhythm.
Utopian Screen: The installation is based on the model of a chemical computer by Gordon Pask in the early 1950s. It was open to the environment and it managed to grow to a configuration which was able to distinguish between different frequencies. Roots refers to a time when the big synthesis and simulation of image, sound, thinking and memory was soon to be started.



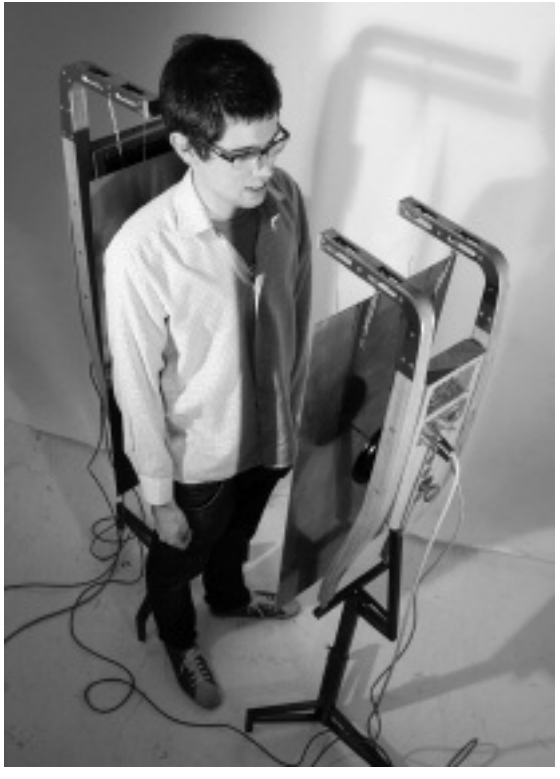
Roman Kirschner (born in Vienna 1975) lives and works in Cologne. He studied philosophy and art history in Vienna and attended the Academy of Media Arts in Cologne. In 2001 he co-founded the art group "fur", specializing in multisensory interfaces in a games context. In his latest works he explores the animation of matter in visual and acoustic ways, while glimpsing at the emotional implications of turbocapitalism. During his studies in Vienna he was introduced to the concepts of cybernetics. At the crossover of experimental informatics and arts he found the work of Gordon Pask whose focus on working with raw matter and its dynamic qualities was used in Roots, Kirschner's latest work. Kirschner's work has been shown in Europe, Asia and North and South America. Together with the group "fur" he has won prizes in Germany and Japan. [mail@romankirschner.net]

Richard Roberts (England)

Hearing a Reality 2007–08

Hearing a Reality is an electro-acoustic system developed to explore the sonic properties of an environment, and reveal the way in which sound and space co-habit with one another and co-inhabit each other. The title of the work is a pun taken from the title of Heinz von Foerster's 1973 Paper 'On Constructing a Reality'.
The system uses speakers and panels of resonating metal and gains its input and mode of operation through the cyclical feedback of sound waves from the environment in which it is placed. It is extremely reactive and capable of changing in real-time to anything that alters the acoustic properties of the environment that it exists within.
Through this work the artist discovered that sound is an effective method with which one can explore first and second order cybernetic principles. The necessary inclusion of an observer / participant within the system parallels the work of, amongst others, Gordon Pask, as the observer / participant has the opportunity to appreciate that they are an integral and inescapable part of their own acoustic space.
In creating the piece and reflecting upon the making process, the artist has come to understand the parallels that can be drawn between the central activity of designing and the principles of second order cybernetics.

Richard Roberts is a recent Diploma graduate of the Bartlett School of Architecture, where he is currently studying Cybernetics at Masters Level. The Work of Heinz von Foerster and Gordon Pask cast a strong influence on his work, which is often at 1:1 and refined through an iterative process involving many prototypes, experimental models, digital animations and drawings. He has lectured and exhibited internationally, and recent installations include The Eyebeam Institute in New York, The ICA in London and the Matthew Gallery in Edinburgh (in the Maverick Machines Exhibition curated by Richard Brown). In addition he practices architecture in London.



Hearing a Reality
in Action

The Bartlett Interactive Workshop

Stephen Gage,
Professor of Innovative Technology,
Bartlett School of Architecture, UCL

The School of Architecture in the Bartlett Faculty, a constituent faculty of University College London, is arguably the UK's premier architecture school. The Bartlett Interactive Architecture Workshop has been in place for over a decade. We have been working with Postgraduate architectural students and more recently with stand alone Masters students from other disciplines, as well as with PhD students.
The Workshop has been greatly influenced by the work of first and second order cyberneticians, notably Heinz von Foerster and Gordon Pask. This has resulted in a considerable body of work from a large number of students; I have been reflecting on this in a series of recent papers, one of which can be found in the proceedings of the EMCSR conference the exhibition Pask Present parallels.
Cybernetics and Architecture were early bedfellows. The works of Nick Negroponte[1] at MIT in the USA and, even earlier, Cedric Price[2] in his London practice in the UK are both very significant. More recently seminal work has been produced by John Frazer[3] and Ranulph Glanville.[4] The relationship has been strong for almost 50 years.
However, it is curious that this relationship has not generated in architecture an easily identified stream of output in the form of "cybernetic" buildings or artefacts. Instead we find a much more diffuse collection of influenced work which ranges from urban planning through buildings, installations and into conceptual drawing and painting. I put this down to the wide-ranging nature of cybernetic theory and the wide-ranging nature of architectural practice. When these are overlaid the result is a very large number of possible approaches and theoretical positions.
In this short paper I attempts to distinguish between two classes of approach in the context of Pask's work and the work of the students at the Bartlett.

1 Constructing and Intervening in "Natural" Systems

Many aspects of the built environment now incorporate feedback controllers that modify devices to maintain set point conditions, for example temperature levels, ventilation levels, lighting levels etc …, As we seek to achieve more with less energy input these devices will become increasingly delicate. They have the possibility of being perceived as delightful in the way that we find some aspects of "nature" (for instance the opening of a flower in response to the sun) delightful. The delicacy and charm of these devices, coupled with the technical challenge of making them, has attracted this author and many students – some of whom have attempted analogue activation and control systems. But this is only part of the story.

2 **Performative Systems and Maverick Machines**

Paul Pangaro argues that many of Pask's strengths derive from the fact that he was both a director of and a performer in theatrical entertainments. Pask is the only cybernetician who could have produced the following description of the properties of an "aesthetically potent environment".[5]

a It must offer sufficient variety to provide the potentially controllable novelty required by a man (however, it must not swamp him with variety – if it did, the environment would merely be unintelligible).
b It must contain forms that a man can interpret or learn to interpret at various levels of abstraction.
c It must provide cues or tacitly stated instructions to guide the learning and abstractive process.
d It may, in addition, respond to a man, engage him in conversation and adapt its characteristics to the prevailing mode of discourse.

Pask's own performative pieces were designed to entertain. They had the observer in mind and held the observer in a conversation.
It is this aspect of Pask's work that makes him extremely relevant to today's Architects. Architects have traditionally constructed static objects and it is salutary to realise that these can only be learnt and appreciated by a viewer over time. Pask's underlying message is to remind us that Architecture is a time-based art.
Pask also reminds us that viewers can get bored and will look for novelty.[6]

They will become active participants in what they see as they look to construct an interpretation of it. Pask, the originator of Conversation Theory, suggests that architecture might respond and engage an observer in a conversation.
This is a challenge that remains to be met. In the last 40 years, we have not gone much beyond Pask's "Musicolour" machine and his "Colloquy of Mobiles" (installation at the ICA in 1968).[7] Both used sophisticated non-verbal communication modes, the former music and light, the latter light and physical movement. The students at the Bartlett who have taken on this challenge have examined a number of different approaches. Some have developed architectures that are static or incorporate automata that are not responsive on the principle that Pask's points a), b) and c) are as far as physical architecture can reasonably go.
Others have developed architectures that incorporate responsive objects and projections which attempt to converse with each other and with their observers. More recently some students have taken Glanville's view (derived from cybernetic studies of where intelligence might be situated and embodied in his piece, "Slow", in this exhibition[8]) that Pask's argument does not require the interactive elements in an architecture should be machines, and that it is possible to construct worlds where the interactivity is driven by people who are conceived of as being an essential part of the interactive structure. As Glanville puts it, they are "observers in" rather than "observers of" the system,[9] and the behaviours they account for are behaviours that arise between themselves and that which they observe.

In the Pask Present exhibition, the Bartlett Interactive Architecture Workshop is represented by video records of the work to date of 3 final year architecture students:

a Paula Friar's Sound Vessels
b Harry Parr's Warwick Castle Victorian Breakfast
c Rion Willard's Hypnotic Spaces: Creating an Architectural Rapport

Friar's and Willard's projects are embedded in this second position. Parr's explores the performative through the sort of drama Pask was so interested in.
In addition, the Bartlett Interactive Architecture Workshop is represented by 4 other projects, produced by those with a more mature, and possibly more distant, relation with the Workshop:

i Rob Davis and Usman Haque's Evolving Sonic Environment IV
ii Stephen Gage and Chris Leung's The Mechanical Homunculus
iii Ruairi Glynn's Performative Ecologies
iv Richard Robert's Hearing a Reality

Haque was an early student in the Workshop and has developed a number of interactive environments. His and Davis's Evolving Sonic Environment IV also belongs to the second approach, as do recent graduate Glynn's robots in his Performative Ecologies. Glynn's colleague, Robert's work is positioned at the cusp where the first approach becomes the second. My own work with Leung illustrates an argument that the second approach can be seen as arising in the first, when there are many simple systems working in concert.

We can also appropriate to the Workshop "Slow", the piece by my colleague of many years, Ranulph Glanville, in which his argument about the involved observer, noted above, is apparent: interaction, in his sense, comes about through the uncertainty (ambiguity) of the almost imperceptibly changing, visual image requiring the observer to resolve it: the resolution being the constantly generated outcome of this form of interaction.
To all of us who have been or are part of the Bartlett Interactive Architecture Workshop, the architectural and artistic insights of Gordon Pask and those around and following him are both examples and inspirations. They give us a springboard from which to launch ourselves towards new worlds and new possibilities.
This is an exciting time to look forwards rather than drifting back nostalgically into the past.

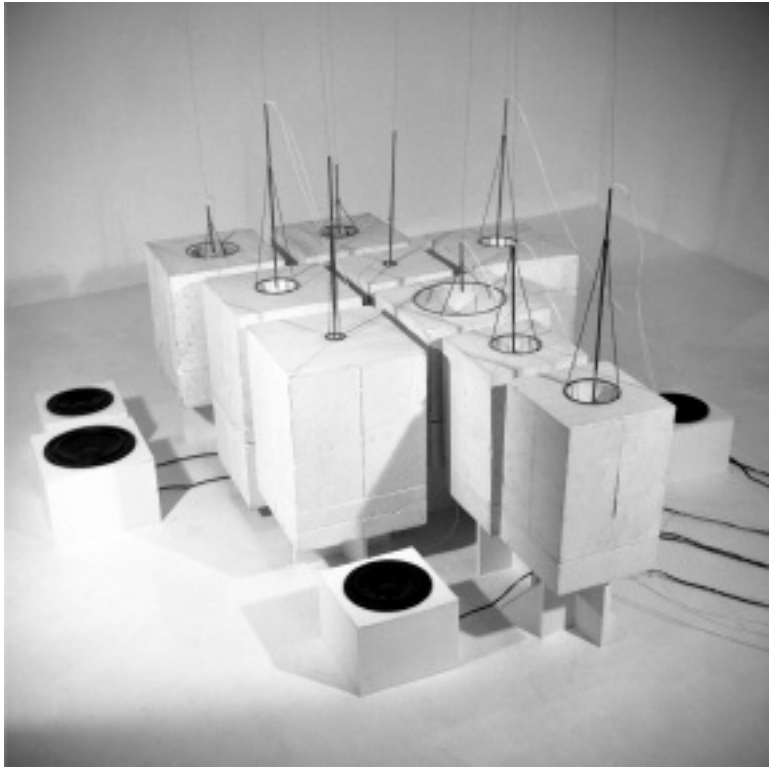
1 See, for instance, Negroponte, N. (1970) *The Architecture Machine*, Cambridge Mass, MIT Press
2 See the Fun Palace and Generator projects, reported in, for instance, Matthews, S. (2007) *From Agit-Prop to Free Space: The Architecture of Cedric Price*, London, Black Dog; and the web site: http://www.metamute.org/en/In-the-Bowels-of-the-Fun-Palace
3 See Frazer, J. (1995) *An Evolutionary Architecture*, London, Architectural Association: available as free download from: http://www.aaschool.ac.uk/publications/ea/intro.html
4 See the recent collection in Glanville, R. (ed.) (2007) *Cybernetics and Design*, special double issue of Kybernetes vol 10 nos 9–10, specially the lead paper Glanville, R. (2007) *Try again. Fail again. Fail better. The cybernetics in design and the design in cybernetics.*
5 Pask, G. (1971) *A Comment, a Case History and a Plan*, in Reichardt J. (ed.), *Cybernetics, Art and Ideas*, London, Studio Vista
6 Pask, G. (1971) *A Comment, a Case History and a Plan*, in Reichardt J. (ed.), *Cybernetics, Art and Ideas*, London, Studio Vista
7 See: http://www.medienkunstnetz.de/works/colloquy-of-mobiles/
8 See Glanville, R. (2007) *Grounding Difference*, in Mueller, A. and Mueller, K.H. (eds) (2007) *An Unfinished Revolution?*, Vienna, edition echoraum
9 See Glanville, R. (2007) *Try again. Fail again. Fail better. The cybernetics in design and the design in cybernetics*, in Glanville, R. (ed.) (2007) *Cybernetics and Design*, special double issue of Kybernetes vol 10 nos 9–10

Paula Friar

Feedback Vessels 2008

This work explores the operation of feedback in the environment. The phenomenon of audio feedback is exploited as binding sound and space to one another. Its malleable properties allow a soundscape consisting of stands of feedback to be sculpted by disturbance, interference and destabilisation.
A set of plaster-cast vessels offer a potentially rich variety of acoustic environments, with differing cavity volumes, aperture sizes, neck forms and internal profiles. These environments help make an instrument, defined as all the parts included in the audio feedback loop: the collection of vessels, microphones, amplifiers, loudspeakers, mechanical devices, as well as the room and its occupiers.
By inserting a microphone (connected through an amplifier to a loudspeaker) into the mouth of each vessel, the presence of a set of invisible vertical thresholds within each void is revealed; at specific depths tones emerge, shift pitch or interfere with others, creating audible beating, rhythmic shifts, momentary silences and other acoustic effects. The soundscape of the room can be manipulated by occupation, movement, speech, singing or changes in air pressure (for example opening a door or letting in a draft of air).

sonograph of vessel with output wave frequency variations



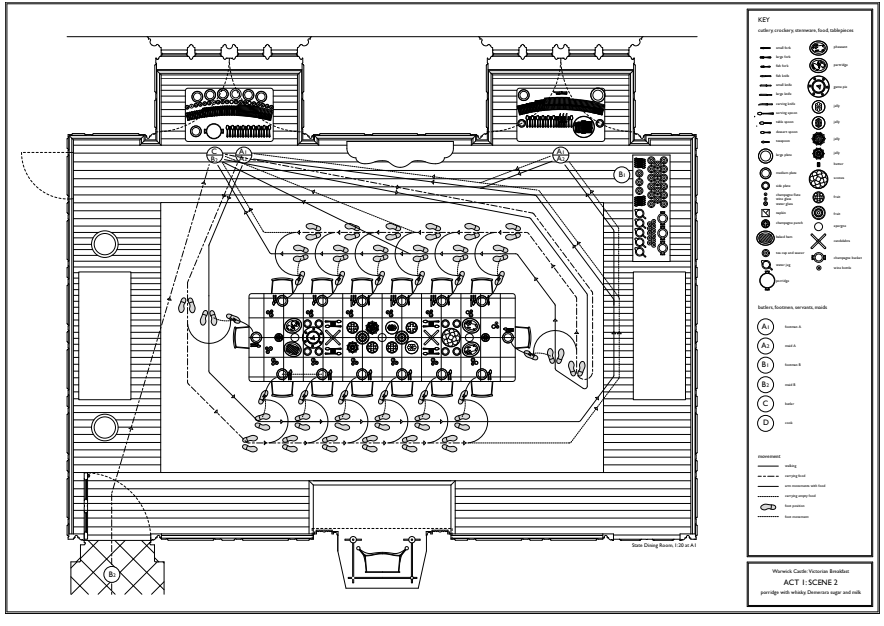
feedback vessel installation

Paula Friar: I am exploring my interest in sound and space, through time-based physical installations in the Bartlett Interactive Workshop.
Having completed my undergraduate BSc. Architecture degree also at the Bartlett, I worked for a number of years with Surface Architects on several high profile projects, including a Film Studies Centre and Graduate Centre. A series of conceptual drawings I completed at Surface have been exhibited and published in a number of architectural magazines, including the RIBA journal.
To gain inspiration for further study, I have taken time to travel, in particular through India and South East Asia, experiencing new cultures and exploring the role architecture has within a broader cultural context. I spent a year in Indonesia studying traditional Balinese Gamelan music at the State College of Arts, Denpasar in Bali. I continue to regularly perform music with several London based Gamelan groups and enjoy learning new, fiendish and complex drum patterns.

Harry Parr

Warwick Castle Victorian Breakfast 2007

One feature of cybernetic systems that interests me is the concern for process rather than objects. This makes cybernetics a valuable way of looking at performative systems and the added value performance can bring. It interests me that so many cyberneticians, paramount amongst them Gordon Pask, are performers and interested in performance.
My breakfast project explores how the Victorians added taste to their meals through the performance of servants and through visual-taste synaesthesia. The breakfast was held in Warwick Castle's state dining room. I designed a system of serving food to the diners, which amplified the experience of eating in such magnificent surroundings. The banquet table was laid with a landscape of food, which created the main site for visual-taste synaesthesia. The performers, acting as Victorian servants, were choreographed to remove the food from the table, deconstruct it on one of the side tables, and to serve it back to individual diners. For one course the diners became performers themselves by carving meat. After twelve lavish courses and three hours, the diners had, aided by the performers, consumed the food landscape. Ultimately the main flavour of the breakfast came from the performance, as a signifier of occasion, rather than from the food itself.



Act 1 Scene 2: choreography for serving the porridge

Act 1 Scene 2: the porridge is served

Harry Parr is a member of the Bartlett Interactive Architecture Workshop, having previously studied architecture in Glasgow. He has recently founded his own practice, Bompas and Parr, which works in the space between food and architecture. The practice's research currently focuses on jelly due to its uniquely plastic form and the historic role it has played in exploring notions of taste.

Projects include:

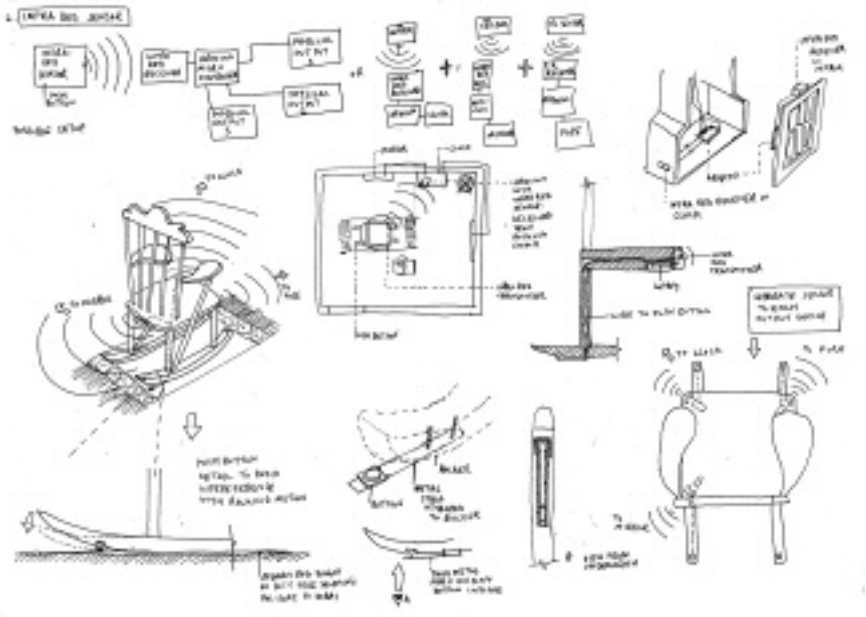
2008 Architectural Jelly for the London Festival of Architecture: project exploring the relationship between jelly and architecture. A jelly mould design competition and workshops will lead to the creation of 2000 jellies which will form part of a jelly banquet to be held in UCL's grand portico. Choreographed performers will destabilise the observer's perception of the space and create a wobbling, and consumable, jelly world.

2007 Warwick Castle Victorian Breakfast.

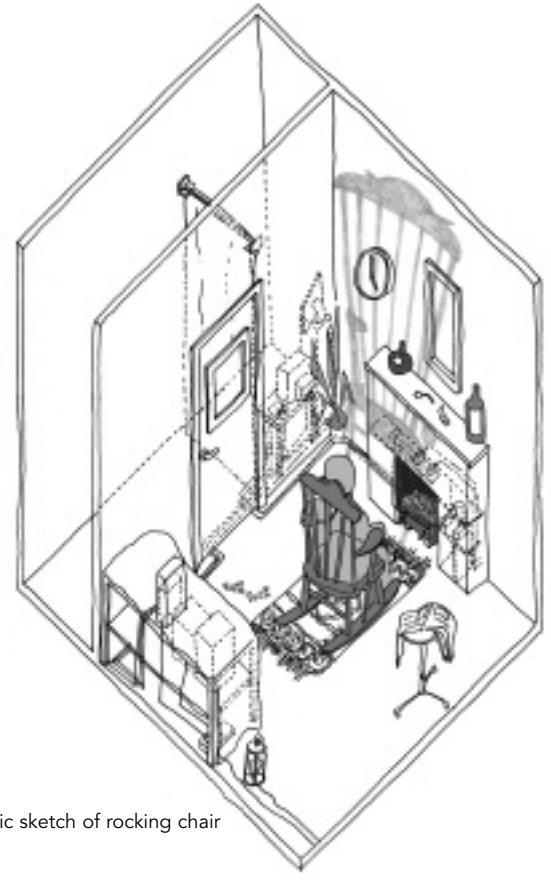
Rion Willard

Hypnotic Spaces: Creating an Architectural Rapport 2008

I am interested in the experience of trance-like states, particularly hypnosis (in the sense of Milton Erickson), and in exploring how architectural actions might assist us entering into them. In Hypnotic Spaces I explore the possibility of the action of a cybernetic feedback look in modifying human behaviour and experience to encourage hypnotic trance. This involves the establishment of an equivalent of the hypnotist's rapport through the comfort of the familiar – the oscillations of rocking in a rocking chair. The pattern of oscillation is analysed and other environmental elements are brought into action, synchronising with the rocking at first and then gradually slowing down, dragging the speed of rocking with them as the observer moves towards a more trance-based experience.
Hypnotic Spaces is the outcome of a series of time based spatial investigations that are more concerned with the observer's construction of experience than in the object that presents the opportunity. In this respect, my work is deeply embedded in a second order cybernetic appreciation.



Sketch details of Infra red switch on rocking chair



Axonometric sketch of rocking chair

Rion Elliott Willard took a foundation year in Art and Design at Chelsea College of Art before studying Architecture at the Bartlett School, UCL, where he is completing his thesis design in the Bartlett Interactive Architecture Workshop with Stephen Gage, and his theoretical study with Ranulph Glanville. He has worked for a number of architectural practices in London, and in sales, where he developed his interest in human communication. He is a keen musician and performer, a member of of the experimental and theatrical electro art rock group Myernark. He has made a personal study of NeuroLinguistic Programming.

Ranulph Glanville[1]

All the 8's

Introduction[2]

In recent years, I have found an unexpected revival of interest in cybernetics amongst artists and designers. However, the cybernetics they are aware of seems to be the pre-1968 variety brought to public attention in the Cybernetic Serendipity Exhibition. I have been wondering how to capitalise on this interest, to bring an updated cybernetics to artists and designers. One move to this end was compiling and editing a double issue of Kybernetes on "Cybernetics and Design".[3]

Meanwhile, preparing for the 50th anniversary of the founding (in 1958) of the Biological Computer Laboratory at the May conference of the American Society for Cybernetics,[4] I came to realise the importance of the 9th year of each decade in the story of cybernetics.

We can form the history of cybernetics around years ending in 8 – until cybernetics more or less disappeared from popular awareness. The history is, of course, familiar, but the familiar is re-formed by re-centring its focus.

More importantly, we can propose a way forward for cybernetics in 2008: develop our association with artists and designers, in such a manner that we can introduce our more recent, and relevant, insights. The serendipitous launch in Vienna in November 2007 of the Gordon Pask archive provides further impetus. Pask's work is the subject of

considerable scrutiny in art and design, in part because of his own performance and output as an artist. Thus, even though history contains no predictive causal mechanisms, we may take a lesson from history in order to move forward.
I hope you find it helpful to read this text against this background.

1968

My own background is in the arts, although I studied sciences as a schoolboy. At University, I studied architecture but spent most of my time composing – electronic and instrumental, notated, taped and improvised music. I founded an early live electronic performance group, and promoted concerts.
I came across cybernetics (in the form of Gordon Pask) when designing an automated supermarket (what is now internet shopping): an epiphany. Pask was a polymath. As well as cybernetics, he had a more than passing interest in the arts. As a wedding present, he bought his wife a theatre.
At that time, Pask was preoccupied with a revolutionary art work, Colloquy of Mobiles. This followed other, earlier machines, particularly MusiColour. Colloquy[5] was shown at an epoch marking exhibition, Jasia Reichardt's "Cybernetic Serendipity", at London's Institute of Contemporary Arts (ICA), from August 2 to October 20, 1968. It was a collection of mobiles sending light signals to each other, which turned to capture and engage these signals in a dance. The audience could walk between the different mobiles, modifying the behaviour, joining the dance. The result was a performance that derived from the machinery's interaction with the environment, specifically with the ambulant viewers. The interaction belonged to all participants, human and mechanical. This understanding of interaction goes back, as do so many current cybernetic concepts, to Pask's very early work.[6]
Cybernetic Serendipity was the ICA's most visited exhibition, its opening extended because of public demand. It was totemic. It remains in the consciousness, and can be said to mark a moment in which cybernetic ideas, computation and the arts came together seriously. A new art medium, and area of cybernetic action was affirmed, its significance confirmed by the founding in 1969, of the Computer Arts Society.

1948

As noted, early cybernetics can be articulated by decade. I believe recognition of the significance of events clustered around "8 years" offers insights for 2008.
In 1948, Norbert Wiener published "Cybernetics". With it, he founded a new subject described by the subtitle "control and communication in the animal and the machine".[7] Appreciation of the (modern) history of cybernetics has become clearer recently, in part because of two books, Steve Joshua Heims's "The Cybernetics Group: Constructing a Social Science for Post-War America",[8] and Flo Conway and Jim Siegelman's "Dark Hero of the Information Age".[9] There were two separate, yet linked, streams. The first is based in the dinner parties Wiener held during the 1940s with distinguished, mainly phy-

sical scientists, particularly the Mexican neurophysiologist, Arturo Rosenblueth. These dinners were built on the growing conviction that there were common structures behind apparently distinct fields – if we could but find them – and find a language in which to discuss them. The most obvious example is feedback. The first expression of these insights was, I believe, Rosenblueth, Bigelow and Wiener's 1943 paper, "Behavior, Purpose and Teleology",[10] which lead to Wiener's book, where he named the field. As he said:

> Until recently, there was no existing word for this complex of ideas and … I felt constrained to invent one ...

Slightly earlier, another group (from social and biological sciences) formed, including Warren McCulloch, Margaret Mead, Gregory Bateson, as well as Wiener and others. This group, supported by the Josiah Macy Junior Foundation in New York, first meet in 1942. It continued after the Second World War, describing its concern as "circular causal and feedback mechanisms". In 1948, McCulloch brought in Heinz von Foerster, visiting the USA to promote his Quantum Mechanical Theory of Memory. Margaret Mead insisted he become secretary of the group and editor of the Proceedings in order to improve his "execrable English" (his words). It was Foerster who united the two groups, proposing the Macy group adopt the name Cybernetics.

Heims' book refocussed us on the Macy meetings as equi-significant in forming cybernetics. Republication of the proceedings, edited by Claus Pias,[11] confirms their importance. I argue several of this group

already understood cybernetics in a manner later identified as second order cybernetics.

1958

Fifty years ago, following a historic meeting at Dartmouth University in 1956,[12] Foerster took time to study neurosciences, and founded the Biological Computer Laboratory at the University of Illinois, Champaign/Urbana. Although cybernetics was fashionable, there were few university departments and most were driven by the mechanical aspect of Wiener's description: the biological (animal) was underrepresented. Foerster was interested in new possibilities, including the development of non-standard computer architectures.

One of Foerster's greatest abilities was as a ring master (typically modest, he claimed this as his main ability). Foerster built a faculty of researchers, teachers, students and visitors whose work was critical to the development of cybernetics.[13] Where most research groups accepted the (hidden) epistemological assumptions of early cybernetics (for instance, that cybernetic systems should be determined by the laws of physics, as Wiener asserted), Foerster's group questioned them. The BCL explored cybernetics as offering its own, unique epistemological approach. This enquiry eventually found form in the demands of Margaret Mead's 1968 paper "Cybernetics of Cybernetics"[14] and subsequent publication of the course book (also "Cybernetics of Cybernetics"[15]) Foerster and his students assembled in 1974 consisting in the main of selected cybernetic texts subjected to cybernetic analyses. These are generally taken to be origins of

second order cybernetics. Autopoiesis may also be said to have an origin in work done at the BCL (see below).
The BCL was formally dissolved in 1975 (although many associated with it continued working, and Foerster maintained a shadow BCL in his Californian home), but the recent work by Albert and Karl H. Mueller,[16] based in the Foerster Archive, suggests that there is "An Unfinished Revolution". The Muellers, instrumental in installing the archive in Vienna, have forced a revival of concern in the BCL and what its legacy might be. Its 50th anniversary is being celebrated in a joint event shared between the conferences of the American Society for Cybernetics (ASC) and the Department of Electrical Engineering at the University of Illinois, Urbana/Champaign (the BCL's academic host). It is appropriate the ASC is involved, since Foerster was also responsible for its founding, and it has provided a home for second order cybernetics since earliest days. This is now extended through the link with the journal Cybernetics and Human Knowing, explicitly promoting second order cybernetics, which Foerster saw as an important element in the life of the ASC, and, hence, cybernetics in general.

1968

I started with 1968. Mead's paper was published in 1968. Cybernetic Serendipity was on shown in 1968. The year of student revolt, Kent State and Vietnam (and flower power) was also an important year for cybernetics. But while a peak moment, it was also the beginning of the trough. Stuart Umpleby[17] points out the effect of the Mansfield Amendment, passed by Congress in 1968, denying US military funding to speculative areas, at just that moment cybernetics was about to become its most speculative.[18] This was a terrible blow to U.S. cybernetics, from which it has not recovered.
It is also the year of publication of Lars Loefgren's "An Axiomatic Explanation of Complete Self-Reproduction",[19] which Pask cited as the origin of second order cybernetics. This process was, effectively, completed by 1978, by when the basic understandings and concepts had been clarified.
It may be that there is no longer any need to distinguish orders of cybernetics. But the revolution lead and orchestrated by Foerster was critical helping us understand inconsistencies in how we were talking about our circular systems, and the subconscious precedence given to the mechanical over the animal. Foerster's (second order) cybernetics reverses the preferred metaphor to the animal metaphor from the mechanical, without which autopoiesis might not have been thinkable. In conversation, Dirk Baecker (who studied philosophy in Paris) remarked that deconstruction and post modernism deal with many of the same questions and come to similar conclusions as second order cybernetics does, but whereas the former lead to the despair of structureless nihilism, second order cybernetics leaves us with a structure and a way forward. I have recently understood how this works in the case of the Black Box, a conceptual device I have explored for years.
There may be much to be explored in the influence cybernetics has had on continental philosophers and philosophy.

1978

1978 is marked by the conference "Applied General Systems Research, Recent Development and Trends"[20] which George Klir organised with the support of NATO, to my knowledge the last time that cybernetics/systems research received serious funding for a meeting. In our story, the conference is of interest as the first large-scale public parading of work on and in autopoiesis.[21]
1978 also marks a new, associated approach, for around this time Glasersfeld began publishing in earnest on radical constructivism,[22] which many believe is closely related to second order cybernetics. Radical constructivism may have stolen some of the thunder of cybernetics in spite of Glasersfeld referring to himself as a cybernetician and embedding his work in the cybernetic tradition. Nevertheless, the fields have remained closely allied.[23]

1988, 1998

After this, nothing. I know of nothing to place under the year headings 1988 or 1998. The decline of cybernetics, and public interest in and valuing of its offerings, is virtually non-existent and we cyberneticians learn to take a small place in an apparently insignificant corner of what should be history – insignificant to almost everyone but us. This can be indicated through a distinguished professor's comment on hearing I was to become a colleague, remarking that cybernetics had died in 1970: in his eyes, therefore cyberneticians are necrophiliacs.[24]

2008

This interpretion would be wholly depressing, were there not something of the moment to add. I am no numerologist, but slicing the stream of experience at regular intervals can help us see changes and developments. If, in 2008, we see new life in cybernetics we might have reason for optimism. If not, perhaps 30 years is enough to qualify for us to declare The Official Death of Cybernetics!
I said at the outset that I have noticed a resurgence of interest in cybernetics among artists and designers. I believe we can build a valuable association with these fields. I do not mean this should exclude other areas of interest: just that there is interesting potential here.
2008 is the 60th anniversary of Wiener's book; the 50th of Foerster's founding of the BCL; and also the 40th anniversary of the Cybernetic Serendipity Exhibition. I believe we should celebrate all three: but at this moment of celebration we should look for renewal particularly in the arts and design. I shall turn to this now.

Why?

From the above, we can see, historically, a mutuality between the practices of cybernetics and art/design. Indeed, I have recently written about how we can find developments in cybernetics in the work of some commentaries on design made by non-cyberneticians.[25] Furthermore, the journal this piece first appeared in intersperses its academic publications with art works.

Why should there be a link between cybernetics and art/design? Is there any structural reason?
There are at least two ways in which cybernetic understandings give insight into aspects of art and design.
First, there is the concern with circularity. At the centre of the act of designing is, I argue, a circular process that can be described through the metaphor of a conversation held with oneself, alternating the acts of mark-making and mark-viewing. This moving between roles involves switching what we might think of as personae, or as Pask calls them, p-individuals.[26] Switching between personae gives rise to novelty, just like the exchange with another in regular conversation. This circular conversation is right at the centre of the creative process and is intensely cybernetic: as a version of a Paskian conversational structure it's necessarily circular. Thus, design may be seen as cybernetic practice while cybernetics can, reciprocally, be seen as design theory.[27]
Secondly, there is variety.[28] In effect, the ability of any one system to control any other is determined by Ashby's Law of Requisite Variety, requiring that the variety of states in the system that will control must equal or exceed that which may be attained in the system to be controlled. The variety of a system made up of several people interacting exceeds that in one person. Similarly, the variety in one person is vastly less than that in the world (using a realist construction as a shorthand). Thus, we live an inherently unmanageable life. This may not be bad: it means there are always states as yet unimagined, if we cease restricting the world to what we already know. Openness can lead to the new, perhaps the main thing (western) artists and designers believe they deal in.

There is a different synchronicity. Although Gordon Pask practised mainly as a cybernetician, his persona and practice as an artist was equally important to him. His art work is being re-evaluated and recognised, no doubt one source of artists' and designers' current interest in cybernetics. These studies are supported and facilitated by the same Muellers who revived interest in Foerster's Unfinished Revolution, following the installation of Pask's Archive alongside Foerster's in Vienna University's Institute for Contemporary History.[29] Pask's archive was formally opened in November 2007, just in time for 2008, our festive year!
Several initiatives are being developed to celebrate Cybernetic Serendipity: not just to look backwards, but rather to provide a springboard from which to launch second order cybernetic questions: not what can the arts and design learn from cybernetics, for instance, but how can they support each other. Can the approach of practitioners in each teach practitioners in the other?
I hope re-acquaintance with Pask's work in art and design will opens a new future for cybernetics in general and Pask's reputation in particular. We saw a beginning in the "Maverick Machines" Exhibition Richard Brown curated in Edinburgh last summer[30]. This is developed in the exhibition, "Pask Present".

Action

I propose that if we look at the history of modern cybernetics, slicing each decade at its 9th year, we find key events each decade from 1948 until 1978, after which there is nothing. I suggest that 2008 is

a good year for a cybernetic celebration, and we should particularly celebrate Cybernetic Serendipity because of the positive and active interest in cybernetics amongst artists and designers, hoping that the exhibition "Pask Present" is a step in this direction. I have suggested analogies between cybernetics and art/design, and indicated the central position of Gordon Pask.

Yet this interest in cybernetics is founded in the cybernetics of 1968, and has scarcely moved on. Thus, for instance, the exploration of Edward Ihnatowicz's sculptures "SAM" (shown at Cybernetic Serendipity) and son-of-SAM, "Senster"[31] sees cybernetics as closely allied to computing, providing a modelling technology allowing a particular artistic aim to be realised; indeed, a lot of art interest in Pask is based in his early experiments with chemical computers. Those I meet at art and design conferences and workshops talk of cybernetics as it was in 1968, with no awareness that it has moved on, that what they are talking about is not current. There is a mission: to bring a more up-to-date understanding to those already interested. This exhibition, "Pask Present", does this, for much of the art and design work on show is inconceivable without second order cybernetics.

The Chinese traditionally view the number 8 as bringing great fortune. Let's hope that the 8 in 2008 will bring that to cybernetics.

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1 *CybernEthics Research*, Southsea, UK, email: ranulph@glanville.co.uk

2 This paper was written for the journal *Cybernetics and Human Knowing*, where it is published in vol 15 no 1. It appears here in a slightly modified form to address an audience not primarily made of those interested in cybernetics with the kind permission of the editor and publisher.

3 Glanville, R. (ed.) (2007) *Cybernetics and Design*, special issue of Kybernetes, vol 36, nos 9–10

4 To be held in Urbana, Illinois, 11 to 15 May:
see http://www.asc-cybernetics.org/news.htm

5 See http://www.medienkunstnetz.de/works/colloquy-of-mobiles/
and http://www.lumen.nu/rekveld/wp/?p=624

6 See, for instance, the early book, Pask, G. (1961) *An Approach to Cybernetics*, London, Hutchinson

7 Notice that this subtitle neither claims to be a definition, nor that cybernetics is a science.

8 Heims, S.J. (1991) *The Cybernetics Group: Constructing a Social Science for Post-War America*, Cambridge MA, MIT Press

9 Conway, F. and Siegelman, J. (2005) *Dark Hero of the Information Age*, New York, Basic Books

10 Rosenblueth, A., Wiener, N. and Bigelow, J. (1943) *Behavior, Purpose and Teleology*, Phil. Sci vol 10, no 1, pp 18–24

11 Pias, C. (ed.) (2003) *Cybernetics – Kybernetik: The Macy conferences 1946–1953*, Diaphanes: Zürich/Berlin

12 Umpleby, S. (2003) *Heinz von Foerster and the Mansfield Agreement*, Cybernetics And Human Knowing. Vol. 10, nos. 3–4, pp. 187–190) tells us that this was the meeting where the (cybernetic) engineers and epistemologists began to part company, perhaps necessitating the founding of the BCL leading eventually to the formulation of the cybernetics of cybernetics as the embodiment of cybernetic epistemology.

13 These included Alex Andrews, Ross Ashby, Stafford Beer, Roger Conant, Gotthard Guenther, Alfred Inselberg, Lars Loefgren, Robert Martin, Humberto Maturana, Gordon Pask, Paul Schroeder, Stuart Umpleby, Francisco Varela and Paul Weston.

14 Mead, M. (1968) *The Cybernetics of Cybernetics*, in von Foerster, H. et al. (eds.) *Purposive Systems*, New York, Spartan Books

15 Foerster, H. von et al. (1974) *The Cybernetics of Cybernetics*, Champaign-Urbana, Biological Computer Laboratory, University of Illinois. Republished (1995) in a second edition, Minneapolis, Future Systems

16 Mueller, A. and Mueller, K.H. (eds.) (2007) *An Unfinished Revolution?* Vienna, edition echoraum

17 Umpleby, S. (2003) *Heinz von Foerster and the Mansfield Agreement*, Cybernetics And Human Knowing. Vol. 10, nos. 3–4, pp. 187–190

18 The Mansfield agreement is one major factor in the demise of Cybernetics, but is not, I believe, solely responsible.

19 Loefgren, L. (1968) *An Axiomatic Explanation of Complete Self-Reproduction*, Bul Math Biophys Vol 38 No 3

20 Klir, G.J. (ed.) (1978) *Applied General Systems Research: Recent Developments and Trends*, New York, Plenum Press

21 It lead to the publication of Zeleny's (1981) Miscellany, "Autopoiesis".

22 My first record of Glasersfeld mentioning Radical Constructivism is "Piaget and the Radical Constructivist Epistemology" (Glasersfeld, E. von (1974) *Piaget and the Radical Constructivist Epistemology*, in Smock C.D. and Glasersfeld, E. von (eds.) *Epistemology and Education*, Athens GA, Follow Through Publications, pp 1–24)

23 For a review of Glasersfeld's work see the festschrift for his 90th birthday (Glanville, R. and Riegler, A. (2007) *Festschrift for Ernst von Glasersfeld*, Constructivist Foundations, vol 2 nos 2–3)

24 The landscape is not completely empty. I am reminded, for instance, that the journal Cybernetics and Human Knowing (in which this paper was first published) was founded.

25 Glanville, R. (2006) *Invisibility and Silence*, Cybernetics and Human Knowing vol 13 no 1

26 Glanville, R. (2007) *Try Again. Fail Again. Fail Better. The Cybernetics in Design and the Design in Cybernetics*. in Glanville, R. (ed.) (2007) Cybernetics and Design, special issue of Kybernetes, vol 36, nos 9–10, pp 1173–1206

27 The paper mentioned appears in a double issue of Kybernetes (devoted to Cybernetics and Design) which I edited. The size and variety of the issue shows that there is something timely to examine. See Glanville, R. (ed) (2007) *Cybernetics and Design*, special issue of Kybernetes, vol 36, nos 9–10

28 See, for instance, Glanville, R. (1998) *Variety and Creativity*, Cybernetics and Human Knowing vol 5 no 3

29 The archive referred to passed through his family to the University. There is a second archive recognised by Pask, his American archive, maintained by Paul Pangaro, which includes some hardware.

30 See http://maverickmachines.com/WordPress/

31 See http://www.senster.com/ihnatowicz/index.htm

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Glanville, R. (1998) *Variety and Creativity, Cybernetics and Human Knowing* vol 5 no 3

Glanville, R. (2006) *Invisibility and Silence, Cybernetics and Human Knowing* vol 13 no 1

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Usman Haque[1]

Architecture, interaction, systems[2]

"I go up", said the elevator, "or down."
"Good," said Zaphod, "We're going up."
"Or down," the elevator reminded him.
"Yeah, OK, up please."
There was a moment of silence.
"Down's very nice," suggested the elevator hopefully.
"Oh yeah?"
"Super."
"Good," said Zaphod, "Now will you take us up?"
"May I ask you," inquired the elevator in its sweetest, most reasonable voice, "if you've considered all the possibilities that down might offer you?"

Conversation with an elevator
designed by the Sirius Cybernetics Corporation
in *The Restaurant at the End of the Universe* by Douglas Adams[3]

The word "interactive" is found everywhere these days. It may be worth considering what "interactive" means and whether things presented to us as "interactive" actually are so, before moving on to consider why we might want our designed objects and spaces to be "interactive".

"Interactive" and "hi-tech" are not interchangeable words; one can create something interactive yet not hi-tech – likewise one can create something hi-tech yet not the slightest bit interactive. Technological advances may, however, make certain aspects of interaction easier to achieve, in part because they compress temporal, spatial or interpersonal scales.
Rather than provide at the outset a fixed definition for "interaction", I would like to discuss it from a few different angles, hoping that the sketched-in boundaries enable us to converge on a particularly useful conception of the word.
In an architectural context, a brick wall crumbles over years under the impact of rain. Is the wall "interacting" with the environment? I would argue that it is merely "reacting" – because the wall does not have an effect on the environment that it is responding to (other than, arguably, in an inconsequential way at the level of molecules). There is no circularity because the environment does not change its behaviour as a result of the wall falling down. Causality is straightforwardly ascribed in this case because the transaction is occurring mostly in a single direction. Similarly, when louvres track the direction of the sun in order to direct sunlight in a building, they are merely responding to given input conditions and as such should not usually be described as "interactive" but rather "reactive".
At its fundamental, interaction concerns transactions of information between two systems (for example between two people, between two machines, or between a person and a machine). The key however is that these transactions should be in some sense circular, otherwise it is merely "reaction".

When you enter an art installation that presents you with a visual effect based on your movements in space then should this be considered "interactive"?
Consider the following example.
When I withdraw money from a cash machine, is that interactive? (I key in some numbers and currency notes are returned – closing a circle). Before answering that question, let us step back even further for a moment and consider what occurs when we actually talk with a live person, inside a bank, for the purpose of withdrawing money. We step up to the desk, provide some identification to the teller, wait a few moments and then receive from the teller the quantity of money that we have requested. Although it is fairly basic, there has been a two-way transaction of information here: we have provided identification and a numerical amount, and we have then received what we had hoped for.

The key here is that we have received what we expected, both ourselves and the teller. There is an interaction, in the sense of a transmission of instruction across a boundary which has resulted in something being returned to us. However, we provided information to the teller that was expected of us (though it had to be distinguished from a large set of other pieces of fixed instruction, namely customer accounts), and we ourselves have received what we expected in the form of a sum of money.
This may be called interactive by some, but it is, to my mind, the least interesting form of interaction, because each of us operated within a predetermined set of boundaries.

The cash machine mirrors this process in that each of us selects from a fixed set of possibilities and responds directly to the other from a fixed set of possible outcomes. It is similar to a thermostatic switch in a building, which enables us to set a dial corresponding to our desired temperature and which returns to us (hopefully!) the spatial temperature we requested. Input and output criteria are predetermined by the designer of the system.
Similarly, in the art installation example given above, although the person entering the space may not have expected particular visual phenomena to be presented in response to particular motions in space, it is quite likely that at least the designer of the system had already determined particular outputs for particular inputs – either knowingly by filtering for only the actual visual aesthetics desired or unknowingly, but just as deterministically, through the complex but unchanging structure of the computer programme.
Let us call this a "single-loop interaction".
Much more profound, I believe, is the interaction in which we actually enter into a "conversation" with the bank teller. This might concern some news item, or a conversation about a particular financial issue that requires further interactions, or a conversation about personal matters (which may occur once we get to know a teller from repeated visits to the bank) – the key is that the domain of our interactions is open, and through conversations we are able to maintain a relationship that is productive and engaging.
We will probably discover new, unexpected information. We may benefit from this information, or we may benefit simply from the cycles of interaction that will encourage related interactions in the future.

It could be argued that it is our propensity to encourage on-going (iterative, evolving) interactions and conversations that makes us "human". Note, however, that it isn't merely the "unexpectedness" that makes this a constructive form of interaction – if it was too unexpected (for example if the teller started yelling at us for no apparent reason) then the interaction would break down.
In such "multiple-loop" interactive systems, causality is much more difficult to ascribe than in merely reactive systems: A provokes B, but B affected A in the first place, in an ever-continuing loop. Note that complex thermostat systems such as those that take into account other environment input data are not, in their complexity, necessarily "multiple-loop" interactive systems. Multiple-loop interaction does not depend upon complexity, it depends upon the openness and continuation of cycles of response. It also depends on the ability of each system, while interacting, to have access to and to modify each other's goals.
This is the kind of interaction that is just not present in a cash machine (or many art installations); it is not, however, an interaction that I believe is impossible to achieve with machines!

We have discussed three different scenarios: one in which I claimed there was no interaction; a second in which there was interaction, in quite unsophisticated terms; and a third in which there was a constructive and continual interaction.
My contention that the third scenario is most interesting and also the most productive in the context of designed spaces and architecture.

Within human-machine relationships, the second scenario (i.e. the single-loop interaction, like a cash machine) provides us with a situation where a person is at the mercy of the machine and its inherent logical constructs.[4] (We may get unexpected results – for example the machine tells us that it is out of cash –, but the fact that the machine itself was selecting from a predetermined set of responses precludes any constructive interaction). The third relies on the creativity of the person and the machine as they negotiate across an interface, and it is this "conversational" creativity, I will argue, that makes these interactions the most desirable.

I concede that reactive or single-loop devices that satisfy our creature comforts are useful for functional goals (I am thinking here of Bill Gates's technologically-saturated mansion; or building management systems that seek to optimise sunlight distribution; or thermostats that regulate internal temperature). Such systems satisfy very particular efficiency criteria that are determined during, and limited by, the design process.

However, if one wants occupants of a building to have the sensation of agency and of contributing to the organisation of a building, then the most stimulating and potentially productive situation would be a system in which people build up their spaces through "conversations" with the environment, where the history of interactions builds new possibilities for sharing goals and sharing outcomes. In such architectural systems, inhabitants themselves would be able to determine efficiency criteria.

The cybernetician Gordon Pask, who collaborated with architects in the 1960s, '70s, '80s and '90s at the Architectural Association, London, provides us with rigourous guidance on how to develop such systems. His "Conversation Theory"[5] gives us a clear framework for designing interactions in which systems (humans, machines or environments) may engage in the constructive exchange of information, without needing to rely on perfect communication with each other (without, for example, requiring an environment to talk to us with the emotionally-inflected yet clearly robotic voice of Star Trek's onboard computer!). Pask's work was somewhat ahead of its time and was not fully grasped by the wider architectural community. Now that we have had certain technological developments (that alter our relationship to machines) and conceptual developments (that enable us to understand the constructive role that participants (formerly mere "users") in an open system may have), it is possible to consider how his "Conversation Theory" may help us build complex, dynamic interactive environments in the fullest senses of the words.

In such systems, there may be an environmental sensor/actuator device which monitors a space and is able to alter it. However, rather than simply doing exactly what we tell it (which relies on us knowing exactly what we want within the terms of the machine, i.e. within the terms of the original designer), or, alternatively, it telling us exactly what it thinks we need (which relies on the machine interpreting our desires, leading to the usual human-machine inequality, or, as some would say, mistreatment), a Paskian system would provide us with a method for comparing our conception of spatial conditions with the designed machine's conception of the space.

This enables us to converge, agree on and thereby share each others' conceptual models of the space and what alterations we decide it

requires. With this shared conception we are better able to act upon the space, in conjunction with an artefact, in a constructive, engaging and ultimately satisfying manner. Such systems would operate with "underspecified" sensors; i.e. either a whole collection of them, each individual sensor of which may or may not eventually be determined as useful in calculating its output; or better yet, it may evolve its own sensors, dependent on dynamically determined input criteria (Pask built such a system in the 1950s, which evolved its own sound receptors: variants are on show in the PaskPresent exhibition).[6]

For example, building on the rather prosaic model of the thermostat, an authentically interactive implementation would enable a person to add inputs to the temperature-regulating system as desired. These might range from "energy consumption over the last month" to "the exterior temperature for this day last year" to "the colour of my clothes today" to "the fifth letter of the second paragraph on the front page of today's newspaper". The system would evolve weightings for each of these input criteria in order to provide satisfactory output, again according to criteria determined dynamically with the person. Output criteria might include "increasing thermal comfort", "keeping my energy bills down", "keeping my neighbour's energy bills down", "minimising my hot chocolate drinking", "maximising the number of friends who come to visit". In all cases, both input and output criteria are dynamically constructed.

These systems allow us to challenge the traditional architectural model of production and consumption that places firm distinctions between designer, client, owner, and mere occupant. We can consider instead architectural systems in which the occupant takes prime role in configuring the space s/he inhabits, a bottom-up approach which would result in a more productive relationship to our spaces and to each other.

This way of thinking about interactive systems is not necessarily technological: it is not about making your online shopping experience more efficient. Nor is it about making another nice piece of hi-tech lobby art that responds to people flowing through the space (which is just as representational, metaphor-encumbered and unchallenging as a polite watercolour landscape).

It is about designing tools that people themselves may use to construct (in the widest sense) their environments and thus to build their own sense of agency. It is about developing ways to make people themselves more engaged with, and ultimately responsible for, the spaces that they inhabit. It is about investing the production of architecture with the poetries of its inhabitants.

To this end, I briefly discuss below some architectural experiments by Haque Design + Research concerned with some of these ideas.

"Sky Ear" was an experiment to develop a system that responded in realtime to input from people, from the environment and from electronic devices. It consisted of a floating carbon fibre cloud of 1000 helium balloons, electromagnetic sensors and mobile phones that drifted above a park in London, in 2004.[7] The purpose of the cloud was twofold: first, to provide a complex network of distributed sensors responding to electromagnetic fields, and second to explore how an "audience" might explicitly become a creative "participant" in the event by being encouraged collaboratively to affect the sensors that they would otherwise be merely observing. The cloud was

both a sensor system, responding to electromagnetic waves generated by mobile phone calls, and an actuator, producing electromagnetic fields itself.
Next is a pair of projects undertaken to understand perception: while the first explores how we perceive space, the second explores how a space might perceive us. "Haunt" (a collaboration with anomalistic psychologist Professor Chris French) involved measuring electromagnetic patterns, infrasonic frequencies and temperature and light conditions in supposedly "haunted" spaces and then recreating these phenomena in a "neutral" space in order to determine how people constructed, psychologically, a haunted space from these given phenomena.[8]

Taking the opposite approach, in "Evolving Sonic Environment" (a collaboration with Robert Davis, specialist in artificial neural networks, on show in the PaskPresent exhibition) we built a "spatialised" neural net into which people could actually enter, walk around and affect through their movements and occupancy patterns[9]. The system was composed of a society of autonomous devices, functioning analogously to the neurons in our brains - not intelligent in isolation, but behaving collectively in such a way that we can begin to infer different properties in their outputs. Learning circuits in each device enabled them to adapt over the long term to different patterns of occupancy so that after a while the society of devices collectively developed their own perceptual categories of "occupancy" that were not explicitly programmed, and which therefore did not necessarily correspond to human-determined patterns of occupancy.

Finally, "Paskian Environments", a collaboration with cybernetician Dr Paul Pangaro, will consolidate the approaches of "Haunt", "Evolving Sonic Environments" and "Sky Ear" (i.e. it will build upon what we now understand about humans perceiving environments, environments perceiving humans as well as the participative role for non-designers in designed systems) and broadly explore Gordon Pask's Conversation Theory in the context of architectural constructs. The intention in this project is to take interaction algorithms from Pask's past projects (which importantly are context-independent) and apply them to the construction of a dynamic large-scale environment. Sited in a building in London, England, the Paskian Environment will be partly multi-modal installation, partly event-oriented performance and partly interactive environmental construct, encompassing both internal and exterior spaces. We are particularly interested in working with existing systems of the building (facade, internal/external lighting, information management, wayfinding) and unused spaces (dead-end corridors, locked courtyards).
With these projects we hope to get closer to the goal of authentic multi-loop interaction in actual built architectural projects, forsaking the easier route of creating merely "reactive" works.

1 © 2006 Usman Haque www.haque.co.uk First developed for an article in AU: Arquitetura & Urbanismo, AU 149 August 2006, Brazil. Reproduced by permission of the author.
2 I would like to thank Dr Paul Pangaro for giving comments during the preparation of this article.
3 Adams, D. (1980) *The Restaurant at the End of the Universe*, London, Pan Macmillan
4 Glanville, R. (2007) *Try again. Fail again. Fail better. The Cybeernetics in Design and the Design in Cybernetics*, in Glanville, R. (2007) (ed.) *Cybernetics and Design*, special double issue of Kybernetes vol 36 nos 9–10) points out that the subtitle to Wiener's book *Cybernetics*, is usually interpreted in terms of a metaphor in which the mechanical stands for the animal. Wiener, N. (1948) *Cybernetics*, Cambridge Mass, MIT Press.
5 Pask, G. (1975) *Conversation Theory*, London, Hutchinson
6 See Cariani, P. (1993) *To evolve an ear: epistemological implications of Gordon Pask's electrochemical devices*, in Glanville, R. (1993) *Gordon Pask, a Festschrift*, special issue of Systems Research vol 10 no 3 pp 19–33
7 See http://www.haque.co.uk/skyear.php
8 See http://www.haque.co.uk/haunt.php
9 See http://www.haque.co.uk/evolvingsonicenvironment.php

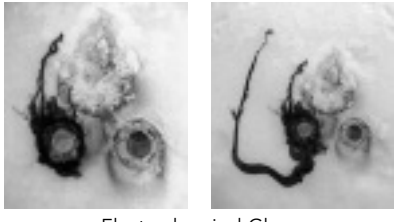
Richard Brown

Pask Parallels

This essay charts, over a period of ten years, a series of art and research experiments, which move between the analogue and the digital, resulting in the discovery of the work of Gordon Pask and culminating in the Pask inspired exhibition "Maverick Machines". The title of the essay reflects a series of research and experiments that bear striking similarities to the electrochemical work of Pask yet were created without any knowledge of Gordon Pask or his work.

Electrochemistry

In 1997, I created an evolving artwork I named "The Electrochemical Glass", which by 2000 had sprouted iron tendrils, and in 2003, over a two month period, in spectacular fashion, one tendril grew extremely rapidly.



Electrochemical Glass
Iron, Copper, Aluminium in conductive fluid, October – December 2003

The evolving metallic growths are created by the changing electrical activity between the dissimilar metals which act as a primitive battery, dissolving, transforming and reforming the metals through ionic migration under varying electric field potentials.
The resultant flow and formations of the metals embody the underlying layers of complex interactivity and emergence through electrochemical action between the three base metals of iron, copper and aluminium.
In creating the Glass I was completely unaware of the work of Gordon Pask. It was not until much later, through researching Artificial Life that I discovered the electrochemical dendrite experiments of Pask.

Virtual Unrealities

Parallel to the continuing evolution of the Glass, between 1995–2001 I created and exhibited three "Virtual Unreality" installations: Alembic, Biotica and the Starfish.


Alembic, 1997


Biotica, 2000


Starfish, 2006

The installations used a combination of projectors, digital computers, programming and transparent gestural interfaces to create dynamic, responsive and immersive environments.

Alembic
Alembic, an alchemical term for distillation vessel, was inspired by ideas of alchemical transformation and the notion of "Dynamic Form", a term Umberto Boccioni used in 1913 in reference to his sculpture "Unique Forms of Continuity in Space"[1].

Alembic uses a particle simulation of matter to represent Dynamic Form. A gestural interface enables participants to directly effect the simulation, transforming the simulated matter, thereby becoming creators of their own experience. By moving around the central projection, participants are able to melt, freeze and shape matter. The temperature of the Alembic moving through fire, air, earth and water is represented by filtered white noise, each element corresponding to a particular frequency range.

Biotica
The aims of Biotica were to produce an immersive three-dimensional flying simulation of Artificial Life and to harness emergence as a productive force for creating life-like organisms from a primitive soup. The Biotica software produced interesting emergent behaviours amongst colonies of Artificial Life creatures, however the Digital DNA that defined each creature had to be painstakingly hand crafted, rather than evolving or emerging from a primitive soup.

Due to the abstract rendering and somewhat difficult user interface, the Biotica installation was not so successful in producing an engaging or immersive experience of Artificial Life. However the connectionist finite state automata design behind the Biotica software may

serve as a foundation for further exploration of complex processes influenced by dynamic spatial relationships.
The design research and the successes and shortcomings of the Biotica project are documented in the book Biotica: Art, Life and Emergence[2].

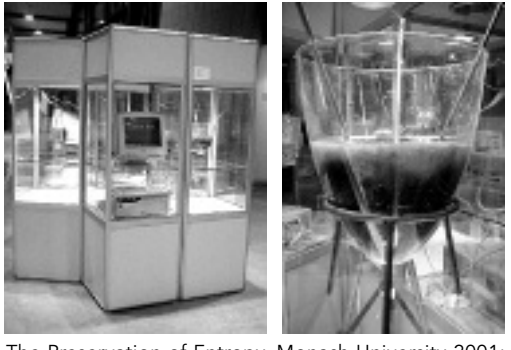
Starfish

Through a commission for the Mind Zone of Millennium Dome, the Neural Net Starfish was born, designed to be the opposite of Biotica – immediately accessible, easy to use, familiar and engaging.
The Starfish reaches out a tentacle towards the hand; if the participant moves too quickly the tentacle retracts suddenly in an organic and life-like manner, a bit like the way a snail eye stalk retracts if you touch it. Stroking the neural net skin causes the net to fire, producing pulsations of colour on the skin. The Starfish has magnetic and mimetic qualities: people caress, stroke, slap and prod the creature, reacting and treating the simulation as if it were a living thing.

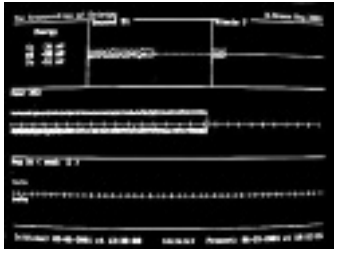
Electrochemical Emergence

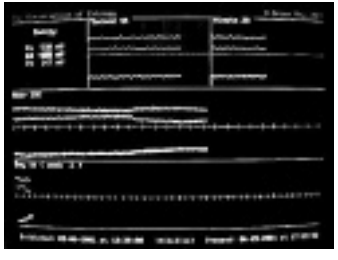
Through exhibiting Biotica at Siggraph in 2000, I met Jon McCormack and Alan Dorin, who were also creating A-Life artworks at CEMA – Centre for Electronic Media Art, Monash University in Melbourne Australia.
I was invited over for a three month residency. Upon arriving, although I felt it was expected that I might create another Biotica, I was a bit weary of programming and digital simulations, and wanted to create something new. The electrochemical glass and its evolving dendrites beckoned – the strangely alien, yet familiar organic beauty of the dendrite, exhibiting a type of emergence so much richer than anything possible in computer simulation.
In the book Biotica, Joe Faith suggests that emergence is dependent on "complexity all the way down". I set out to investigate and reproduce the hidden complex processes behind the electrochemical glass.
For my residency, I created "The Preservation of Entropy", a scientific experiment designed to be displayed as an evolving art work, examining and revealing the hidden processes in electrochemical activity.

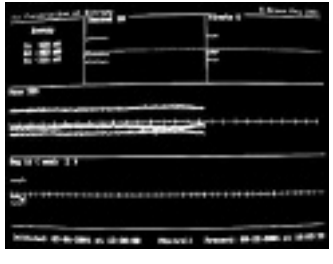
The Preservation of Entropy



The Preservation of Entropy, Monash University 2001; installation and close up of alkaline vessel.







Six Vitrine displays arranged in a triangular formation, held three hand-blown glass flasks containing liquids of acid, alkaline and salt and three old DOS computers. In the liquid in each flask were immersed three rods of aluminium, copper and iron. The electricity activity between the metals were monitored through A to D converters on the computers and displayed via a program written in BASIC.
The displays were similar to heart beat monitors, showing and recording activities over seconds, minutes, hours, and days. The work was displayed in a public thoroughfare so that people would notice and reflect on the progressive changes as they passed by over the weeks and months, possibly years.
The activities were indeed complex and varying, sometimes in cycles over odd lengths of time, one being recorded oscillating over a 23 hour period.

Screenshots of electrical activities: acid, alkali, salt (neutral).

I wondered how the recorded electrical waveforms might sound if converted to audio, but time had run out.

Gordon Pask

During the writing of Biotica in 2000, I met Joe Faith in Sussex University who was studying for a PhD in what was then known as Cognitive Systems (Cogs). Cogs researched emergent and evolving systems, across electronics, robotics, and music. Margaret Boden, (author of Artificial Intelligence and Natural Man) is based at Sussex, alongside Phil Husbands and Inman Harvey, among others.
Blip, a series of art/science experiments and engagements also emerged from Brighton, co-organised by Jon Bird who first introduced me the work of Gordon Pask. Alongside Andy Webster, they were working on recreating an experiment of Pask known as Pask's Ear. Andy and Jon had produced a video "Tuning Pask's Ear", which showed split screen, a growing dendrite accompanied by the playing and tuning of a wine Glass. Pask apparently had influenced a dendrite to "recognise" sound; in the video art work, the idea that a dendrite might be influenced by sound is suggested, rather than made real.
As a result of the work of Jon Bird and Andy Webster I recognised that the Electrochemical Glass was exhibiting, albeit slowly, the same kind of dendritic growth Pask had been experimenting with.
The idea that computational processes might be realised through electrochemical action of metals in solutions resonated with the experiments had I carried out in the Preservation of Entropy, and the complex interactions present in the continuing growth of the Glass.

In 2005, the journal Strange Attractor published images of the glass and an article "The Electrochemical Glass – A slow-evolving artwork from a living alchemist"; which describes the electrochemical processes behind the Glass, and its connections with the work of Gordon Pask and that of Jon Bird and Andy Webster.
In 2006, whilst working as Artist in Residence at the Edinburgh School of Informatics, I was awarded a grant from the Calouste Gulbenkian Foundation, which enabled me to further develop my interests in electrochemical processes and investigate further the dendritic work of Gordon Pask.
Rather than monitor the electrochemical processes as in the "Preservation of Entropy" installation, I set out to generate and control their formations.
One of the aims was to produce an active dendritic circuit able to oscillate or respond to its environment. I investigated varying metals and solutions, circuits and devices, including the use of "Water Glass" as used in the well known chemical experiment "Silica Garden", a type of chemical growth dating back to the work of Newton with his "Vegetative Metals"[3].
Further details of the research work and experiments I made as artist in residence in Edinburgh School of Informatics can be found at: artsinformatica.blogspot.com.

Electrochemical Silica Garden Experiment, 2006.

Maverick Machines: An exhibition inspired by the work of Gordon Pask

The Maverick Machines exhibition arose from a confluence of situations and experiences, particularly that of being Artist in Residence in Edinburgh Informatics, where the digital computer reigns supreme. Informatics, "the Science of Information", seemed to me very dry, digital and screen bound. One of my motivations behind staging the exhibition was to challenge this apparent preoccupation with the digital computer, its von Neumann architecture and associated concepts of Turing computability.
The exhibition became a celebration of alternative paradigms to the digital, a revisit to Cybernetics, where the medium is unimportant.

My desire was not only to open the eyes of the Informatics community, but also the public, to the idea that there is more to life than the digital, through works that conveyed the magic possibilities and invisible potentials of the electrochemical, electromechanics, static electricity and analogue processing.

Maverick Machines illustration, Richard Brown, 2007

The Maverick Machines exhibition represented the completion of a phase of research activity in electrochemical processes and blends my own investigations and interests with those of many others who are investigating and producing work inspired by Gordon Pask, especially Jon Bird and Andy Webster, Army of Clerks, Roman Kirschner and Usman Haque.

The title of the exhibition was suggested by Jon Bird and originates from the chapter by the same name in one of Pask's books, "Micro-man". The cartoon advertising the exhibition was drawn by myself and inspired by the Heath Robinson-like cartoons of Pask in "Calculator Saturnalia"[4].

Tim O'Shea, the Principal of the University of Edinburgh, had once invited Pask to visit Edinburgh University. Tim described to me the theatricality of the basement workshop of Gordon Pask, with its velvet drapes and roman columns. This theatricality and the eccentric kitsch of his cartoons very much influenced the design of the exhibition.

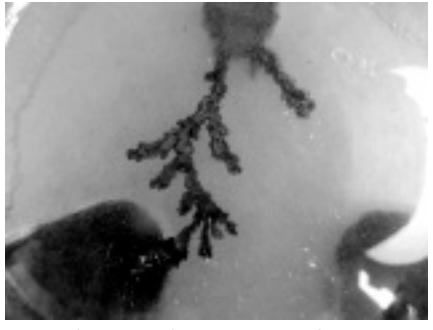
Tim opened the exhibition with a wonderful description of his encounters with Pask, his speech can be read in full on the maverick machine website[5].

Through creating the exhibition I became aware of Pask's ongoing influence on architecture; Karen Martin introduced me to Stephen Gage from the Bartlett School of Architecture, and the Bartlett Interactive Architecture Workshop, where the work of Pask has a great influence on performative architecture. Usman Haque (himself a former student in the Workshop) also has a Paskian influence on the Bartlett, and many of his works are concerned with "conversational spaces" of an architectural nature. Finally, Ranulph Glanville teaches one of the few courses on cybernetics, to students at the Bartlett, providing theoretical founding to a variety of student investigations and projects. Pask also taught at the Architectural Association – his ideas continue to branch dentrically outwards, influencing a range of activities and disciplines across art, architecture, computing theory, music and performance.

Cybernetics and the return of the analogue

Pask represented Cybernetics, a term now that seems very 60's. The concepts underlying cybernetics are not media specific, but can be applied to ecological, electrical, chemical, or biological systems – any set of connected processes that are able to influence and be influenced by each other.
I was lucky enough to study Computers and Cybernetics in 1997, and the ideas of feedback loops continue to influence my thinking about interactive systems.
Pask said "anything can be a computer", and he also appeared to be dismissive of the digital computer, likening it to a magic lantern, as if it were the projector of a seductive false reality. Much of Pask's work and thinking seems to revolve around the use of the analogue and analogies, with mechanical allusions to thinking about thinking, and conversation theory with actors playing varying roles. This theme is developed in the exhibition with computation devices using electrochemical, electromagnetic and static electricity processes.
The two beige computers in the exhibition certainly appeared dull in contrast to the visceral materials of the maverick machines – liquids, mechanics, copper, glass and wood. Like Pask, I am also interested in alternative computing paradigms, finding the digital rather dry and software programming very time intensive.
Axon Technologies, who are featured in the exhibition, have produced a nano-dendritic-memory device, a real world application of a maverick machine.

I first met Michael Kozicki from Axon Technologies through pure serendipity after exhibiting the image of a simple dendritic switch at an Arts and Informatics exhibition in October 2006 I organised entitled "OnSite"[6].



Dendritic Switch, OnSite. October, 2006

Michael approached me excitedly explaining that the dendritic image he had seen was exactly the same as those in the nano-devices his company Axon Technologies were developing. Axon are producing memory devices based on dendritic growth at the nano scale in a solid substrate of electrochemical glass. They knew nothing of the work of Gordon Pask and were extremely excited by the parallels between their research and his.
It is somewhat ironic that the maverick electrochemical experiments of Pask have now found commercial application by Axon without them having prior knowledge of his visionary work.

During my residency in Informatics I gave a talk in the Computational Thinking lecture series where I suggested that analogue computers can offer significant advantages over the digital, in areas of concurrency and non-Turing computability[7]. There are other examples of real world analogue applications, such as the Extended Analogue Computing of Jonathan Mills[8], which serves to demonstrate how modern day analogue devices can solve real-time problems not possible using conventional digital computing techniques. Further examples of alternative computing media can be found via the research strand "Unconventional Computing"[9].

A cybernetic view suggests that it is not the materiality that is of interest but the underlying interdependent processes and their modes of interaction. With the advent of nano-materials and molecular computing, Pask's concepts of systems thinking using physics and analogues now have a relevance and importance in the ongoing development in the expanding field of non-digital computing.

Ranulph Glanville who also knew Pask, visited and wrote a review of the exhibition entitled "A Cybernetic Serendipity", referencing the cutting edge show in 1968 at the ICA in London combining art and cybernetics, including the work "Colloquy of Mobiles", by Gordon Pask[10].

This review, alongside images, videos, exhibition development and further essays can be found on the website maverickmachines.com.

As a result of the enthusiasm of Ranulph Glanville and his belief in the importance of the link between cybernetics and art, Maverick Machines has been reconsidered and reformed, with a modified and extended collection of works for this new exhibition, in Vienna. The new exhibition, entitled "Pask Present", is co-curated by Ranulph, myself and Stephen Gage from the Bartlett, whose students also formed an important part of the Maverick Machines exhibition. Details of the new exhibition can be found on the ongoing website, www.paskpresent.com

Second Orders

In writing this essay, a feedback process in its own right, I am made aware of how my work has oscillated between "the real and the virtual". Over a period of time I perceive myself immersed in the power and capabilities of the digital computer as a medium for expression and simulation, then to almost reactively reject the digital in favour of working with visceral materials of glass, metal and liquids.

The digital computer can be very seductive especially when offering visual and audio simulacra, with the power to shape these visions as our own. Such illusions are especially made with relative ease using Games Engines, a means of harnessing the ever-increasing hardware power of 3D Computer Graphics technologies.

The Games Engine represents a system developed by the Gaming Industry to provide an authoring environment for the creation of believable animated and interactive three-dimensional audio-visual worlds. In 2002 and 2005 I created two works to highlight the formidable power of digital illusions and our susceptibility in becoming enchanted, entranced and entrapped.

Mimesia, Interactive Painting, 2002–03

Tale of the tower, machinima, 2005

These virtual worlds may be relatively easy to create without the need for programming, but the seduction becomes entrapment, the environments requiring a great deal of time spent polishing and refining, the careful arrangement of lighting, texturing and rendering in order that the worlds are believable and aesthetically pleasing. It is, I believe, the same seduction that drives adults to create escapist scenarios with railway modelling.
Walter Benjamin described our need and ability to learn and represent as the "mimetic faculty" suggesting that the faculty is innate, not only in our selves but as part of the external world.

> "Benjamin situates mimesis not as an imitation (or supplement) of nature but as an irreducible, material element of nature itself. "Nature creates similarities," Benjamin contends, citing mimicry as an example. He argues that the human capacity for producing similarities is, however, higher than nature's, since it is rooted in practice and specifically in the practice of becoming-other: "[The human] gift of seeing resemblances is nothing other than a rudiment of the powerful compulsion in former times to become and behave like something else [ähnlich zu werden und sich zu verhalten]" (Benjamin 1986b, 331).
> Mark Hansen[11]

The concept of the mimetic faculty enable us to examine how we are seduced by artificial representations and at the same time highlight the underlying forms and processes that may be behind the resonances driving the seduction. This I believe is the crux, the fulcrum that is present within all my work. I exploited A-life as a device for producing seductive behavioural rather than visual illusions, in the same manner as Eliza, a spin on The Turing Test, is about the viewers perception, rather than creating an Artificial Life or Intelligence that exists without a judgemental perceiver.
The electrochemical works produce naturalistic root-like threads, reminiscent of nerve and tree structures, whilst being at the same time representative of complex electrochemical potentials – the works resonate visually whilst at the same time embodying similar processes occurring in our own nervous systems during their perception, albeit at a different time rate and medium.
Parallel to this is the notion of a second order cybernetics, which includes the perceiver, the creator or the theory within the feedback process. My works represent a similar ideology. We are made to become aware of, or to question our cognitive processes in the process of

engagement with works that are designed to resonate with specific cognitive processes. Second order cybernetic art suggests a means for differentiating ad-infinitum, where the cognitive processes evoked by an external work alter the evocations of the work and which in turn modify the original cognitive process that are processes evoked by the producing new evocations work; a continuous process of feedback and two way dialogue between thought and effect.

The experimental work Stasis[12], a digital hypnosis system I presented at Consciousness Reframed in 1998, serves as an example of how the experience of time may be modified through interactive feedback and hypnosis. This work suggests a deeper methodology for engaging and effecting our cognitive processes using psychological techniques combined with hypnosis.

In the future, perhaps we may look towards the realisation of second order cybernetic art forms, hybrid multi-sensory-bio-analogue-digital works – "reflective mirrors of enhancement and differentiating cognition" able to evoke enlightenment and a deeper understanding of our mimetic and cognitive faculties.

February 2008

1 Umberto Boccioni describes Dynamic Form as a species of the Fourth Dimension. I came across this description in Chapter 1 of the wonderful book "The Fourth Dimension and Non Euclidean Geometry" by Linda Dalrymple Henderson., Princeton University Press, 1983.

2 Biotica: *Art, Emergence and Artificial Life* by Richard Brown, ISBN 1-874175-33-0, distributed by Art Books International, available via Amazon.
http://www.amazon.co.uk/Biotica-Art-Emergence-Artificial-Life/dp/1874175330

3 "Two incomplete treatises on the vegetative growth of metals and minerals", The Newton Project, University of Sussex.
http://www.newtonproject.sussex.ac.uk/catalogue/viewcat.php?id=ALCH00081

4 Gordon Pask, Ranulph Glanville, M. Robinson, *Calculator Saturnalia*, London1980.

5 Transcript of Maverick Machines opening speech by Tim O'Shea, Principle of Edinburgh University.
http://maverickmachines.com/WordPress/?attachment_id=79

6 OnSite was a collaborative exhibition with three students from Edinburgh College of Art designed to evoke a public awareness of Informatics and its new building, situated on the site of its forthcoming building.
http://Onsite01.blogspot.com

7 Computational Thinking Seminars, Wednesday 31 May 2006, Richard Brown: Art, Creativity, Innovation and Experimental Science: Alternative ways of thinking, challenging paradigms and pushing boundaries.
http://www.inf.ed.ac.uk/research/programmes/comp-think/previous.html

8 Jonathan Mills, Analog Computing.
http://www.cs.indiana.edu/~jwmills/ANALOG.NOTEBOOK/klm/klm.html

9 Unconventional Computing: definition and links to conferences:
http://en.wikipedia.org/wiki/Unconventional_computing

10 Cybernetic Serendipity, an exhibition curated by Jasia Reichardt at the ICA London, 1968.
http://www.medienkunstnetz.de/exhibitions/serendipity/

11 Mark Hansen, *Embodying Technesis: Technology Beyond Writing* (Michigan, May 2000).
http://www.stanford.edu/dept/HPS/WritingScience/EmbodyingTechnology.htm

12 Stasis: The Creation & Exploration of Subjective Experiential Realities through Hypnosis, Psychosynthesis & Digital Technology. Reframing Consciousness, Roy Ascott, 1999. Intellect Books, ISBN 1841500135

Gordon Pask, Vortrag auf dem zweiten Kongress der l'Association Internationale de Cybernétique, Namur, Belgien 1958, rechts: Ross Ashby.

Margit Rosen

‚The control of control' – Gordon Pasks kybernetische Ästhetik

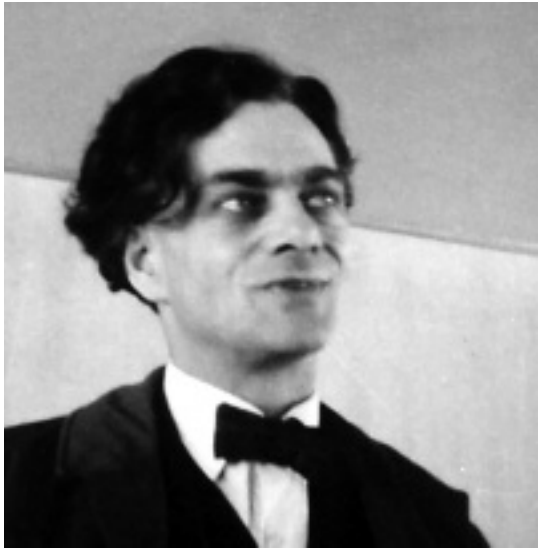
Bei einem Gang durch eine Ausstellung mit technischen Geräten machte Günther Anders in den 1960er Jahren an einem „Herrn T.", der die Gruppe führte, eine Beobachtung: „In seiner fleischlichen Tölpelhaftigkeit, in seiner kreatürlichen Ungenauigkeit vor den Augen der perfekten Apparaturen stehen zu müssen, war ihm [Herrn T.] wirklich unerträglich; er schämte sich wirklich."[1] Anders bezeichnete das Gefühl, mit dem der Mensch auf seine Unterlegenheit reagierte, als „prometheische Scham"[2]. Eine der *adaptiven Maschinen*, die der englische Kybernetiker Gordon Pask (1928–1996) um 1953 baute, schien dieses Verhältnis zwischen Mensch und Apparat weiter zu verschärfen: *Musicolour,* ein elektromechanisches System, das Klänge in Lichtprojektionen und Bewegung übersetzte. Wenn ein Pianist *Musicolour* nutzte, konnte es ihm passieren, dass sich das adaptive System plötzlich verweigerte und nicht mehr auf die Klänge reagierte – aus ‚Langeweile'[3], wie Gordon Pask es formulierte. Zu eintönig waren der Maschine Frequenzspektrum und Rhythmus geworden. Durch ihre Verweigerung zwang *Musicolour* den Musiker, seinen musikalischen Ausdruck zu variieren, wollte er sie nicht als Mitspielerin verlieren. Günther Anders hätte hier kein Opfer industrieller Maschinisierung beobachten können, einen Fabrikarbeiter, der sich plagt, sich den gleichförmigen Bewegungen und dem präzisen Rhythmus der Appa-

ratur anzupassen. Er hätte vielmehr einen Menschen gesehen, der einer launischen Maschine hinterher jagte und, glaubt man zeitgenössischen Schilderungen, dies auch noch genoss.
Gordon Pask begann Anfang der 1950er Jahre eine kybernetische Neubestimmung des Verhältnisses zwischen Mensch und Maschine unter den Bedingungen der automatisierten Gesellschaft vorzunehmen. In Aufsätzen, Vorträgen und mit dem Bau von Maschinen erarbeitete er das Ideal einer adaptiven technischen Umwelt, in der maschinelle und menschliche Systeme sich wechselseitig beeinflussen und weiterentwickeln. Sie treten in Form einer ‚Konversation' in Kontakt, einem Interaktionsprinzip, das auf die Begierde des Menschen nach Neuem[4] gleichermaßen abgestimmt war wie auf die Grenzen seiner Fähigkeit, Nachrichten aufzunehmen und zu verarbeiten.
Die Kybernetik, die 1948 von Norbert Wiener definierte universale Wissenschaft der ‚Regelung und Nachrichtenübertragung im Lebewesen und in der Maschine'[5], wurde ebenso aus dem Geiste der Neurologie geboren wie aus dem der Flugabwehr. Die im Folgenden dargestellten Projekte Pasks aus den Jahren 1953 bis 1968 zeigen die Entstehung kybernetischer Modelle und Maschinen in zwei anderen Bereichen: aus dem Geiste der Experimentalpsychologie sowie den schönen und performativen Künsten und der Architektur. *Musicolour* (1954), das *Cybernetic Theatre* (1964), Pasks Beitrag zum *Fun Palace* (1964) und die Installation *The Colloquy of Mobiles* (1968) erlauben es, Pasks Blick auf eine Welt am Ende des mechanischen Zeitalters zu folgen, in dem der Mensch nicht mehr von der „schweigsamen und unbeweglichen, an unserer Unrast und unseren Stimmungswechseln unbeteiligten Gesellschaft" der materiellen Gegenstände[6]

umgeben ist oder von Maschinen, deren starren Regeln er sich beugen muss. Er ist umgeben von maschinellen Systemen, die mit dem Menschen kooperieren und konkurrieren. Es ist auch eine Welt, in der maschinelle Systeme ihr jeweiliges Gegenüber fortwährend beobachten und vermessen, um durch eine angepasste Dosierung der Stimuli den kognitiven Bedürfnissen des Menschen zu entsprechen und seine Aufmerksamkeit für die Zeit der Konversation gänzlich zu binden. Der so hypnotisch in den Regelkreis mit der Maschine eingebundene Mensch erledigte in Lern- und Arbeitszusammenhängen seine Aufgaben effektiver und lernte schneller.
In der Kunst trat die ‚Konversation' bzw. das ‚Spiel' mit den neuen maschinellen Systemen an die Stelle der Kontemplation. Pask schenkte der automatisierten Gesellschaft eine Kunst der stimulierenden künstlichen Umgebungen und Gesprächspartner. Es waren Experimentalanordnungen für seine Utopie einer künstlichen adaptiven Welt, die so konstruiert sein würde, dass der Mensch sich als Individuum fühlen kann, dessen Fähigkeiten gefördert und gebraucht werden, dessen Entscheidungen und Äußerungen Wirkung zeigen. Diese Welt würde den Menschen beschützen, vor Regression und Langeweile.

Gordon Pask

Der junge, schmächtige Mann auf den Photographien blickt melancholisch. Die tiefen dunklen Ringe unter seinen Augen scheinen zu bestätigen, dass er der Mann war ‚der niemals schläft.'[7] Gordon Pask, 1928 in Derby geboren, wurde nur 67 Jahre alt. In seinem intensiven Leben, das dem Rhythmus eines 36 Stunden-Tages folgte, verfasste



Gordon Pask, Porträt

Pask mehr als 270 Artikel und sechs Bücher, hielt unzählige Seminare und Vorträge und baute eine beinahe ebenso unübersichtliche Anzahl kybernetischer Maschinen. Bereits Anfang 30 galt der stilbewusste Pask, der auf keinem einzigen der Bilder ohne dunkle Fliege zu sehen ist, als einer der wichtigsten Kybernetiker Großbritanniens – neben Ross Ashby, Stafford Beer, Frank H. George, William Grey Walter und Donald M. MacKay. Als Wegbereiter auf dem Gebiet adaptiver Lehrmaschinen erlangte er ab Mitte der 1950er Jahre internationalen Ruhm. Doch dieser Bereich war nur ein Experimentierfeld eines größeren theoretischen Unterfangens, das er Anfang der 1970er Jahre unter dem Namen *Conversation Theory* vorstellte: ein umfassendes konstruktivistisches Modell des Lernens und des Entstehens von Wirklichkeit.[8] Studiert hatte Pask Geologie und Bergbau, Chemie und Biologie, Medizin und Psychologie,[9] das Fach, das er 1964 am University College, University of London mit einem Doktortitel abschloss. Einen zweiten Titel, den ersten Doctor of Science in Kybernetik, erhielt er zehn Jahre später von der Open University.[10] Mit Elizabeth Poole, die er 1956 heiratete, und dem Physiker Robin McKinnon-Wood gründete er 1953 *Systems Research Ltd*, eine Firma, die sich der Forschung im Bereich der ‚Kybernetik psychologischer, sozialer und biologischer Systeme' widmete.[11] 1959 holte ihn Heinz von Foerster an das legendäre *Biological Computer Laboratory* in Urbana-Champaign.[12] Von Foerster, selbst einer der wichtigsten Protagonisten der Kybernetik, bezeichnete Pask als Genie, da dieser Ergebnisse von Problemen ‚sah', für die von Foerster selbst auf die Rechenkapazität von Computern zurückgreifen musste. „He just sees operational, functional, semantic, etc., relational structures at an arbitrary depth, a faculty for which I have no organs, no senses, no language."[13] Dass Pask diese Fähigkeiten als junger Medizinstudent Anfang der 1950er Jahre mit großer Leidenschaft in den Dienst des Musiktheaters stellte, resultierte in der Konstruktion der Lichtorgel *Musicolour*. Die Arbeit an der Maschine ließ Pask den Vorsatz Arzt zu werden aufgeben. Die Experimente mit *Musicolour* führten ihn in die Kybernetik.[14]

Musicolour – ein lebender Organismus

Der Mensch, schrieb Pask, habe die Neigung, in seiner Umwelt beständig nach Neuem zu suchen. Diese unbekannten Situationen müsse er lernen zu kontrollieren.[15] Lernen bedeute für Lebewesen und Maschinen, ihre Ungewissheit über die Ereignisse, die in ihrer Umwelt geschehen, zu reduzieren.[16] Pask betonte dabei, dass wir keine Voraussagen über ein Stück der sogenannten ‚wirklichen Welt' machten, sondern über vereinfachte Abstraktionen. Doch dieses private Bild erlaube uns, ‚mit der Umwelt zurechtzukommen und Entscheidungen zu treffen.'[17]

Musicolour, jenes Anfangs beschriebene adaptive Lichtsystem, das sich verweigerte, sobald der Musiker es langweilte, war nicht darauf aus, die Ungewissheit des Musikers rasch zu reduzieren, d. h. ihm zu erlauben, rasch ein Modell des Verhaltens der Maschine zu entwikkeln. Im Gegenteil, das System, das Gordon Pask und sein Partner Robin McKinnon-Wood möglicherweise ab 1952[18], aber spätestens ab 1953 entwickelten, war eine ‚nicht-triviale Maschine', ein *agent provocateur*, der fortwährend sein Verhalten ändern konnte. Auf eine Reihe gleicher Eingaben antwortete die Black Box zunächst mit einer Folge gleicher Ausgaben, dann reagierte sie plötzlich nicht mehr. Auf diese Weise erzeugte sie Konflikte, die der Musiker nur durch die Anpassung seines musikalischen Verhaltens lösen konnte, genauer gesagt durch eine im Rhythmus und Frequenzspektrum abweichende Darbietung.

Die erste Version von *Musicolour* wurde, wie Pask retrospektiv notierte, 1953 in seiner Werkstatt in Cambridge vorgeführt und tourte

bis 1957 durch Theater, Clubs und Tanzsäle in ganz England[19]. Von der Aufführung am 12. Januar 1954 im Boltons Theatre Club, Kensington, ist ein Programmheft erhalten. In ihm kündigte Pask *Musicolour* an als „The FIRST Public Demonstration of the 4th Dimensional Art Form".[20] Seine Firma, *System Research Ltd*, präsentierte zusammen mit *The Pocket Theatre Company* das Marionettenstück *Moon Music*, „a musicolour fantasy play or a pantomime in a new sort of ballet". Das Marionettentheater, geschrieben von Sheila Hughes-Smith, John Curtin and Pask, erzählte die Geschichte zweier Comicfiguren, des Cowboys Hank und einer heruntergekommenen Version von Guy Fawkes[21]. Der Zeichner der Figuren erhält den Auftrag, die beiden in einen Science-Fiction-Kontext versetzen. Er schläft ein und träumt, wie das Raumschiff der beiden Helden auf dem Mond abstürzt.

Die Pianistin Jone Parry begleitete die Abenteuer von Hank und Guy Fawkes auf dem Mond musikalisch und visuell. Sie steuerte über *Musicolour* mit ihrem Spiel nicht nur die Beleuchtung der Szenen, sondern kontrollierte auch Marionetten, beispielsweise das Ballett der Mondbewohner. Die Reaktionen des adaptiven Systems konnte sie dabei nicht mit Sicherheit voraussagen. *Musicolour*, der ‚elektronische Computer revolutionären Designs',[22] nahm die Klänge des Klaviers durch ein Mikrofon auf und verarbeitete die Impulse. Er antworte dabei sowohl auf die Frequenz und Amplitude der Klänge, als auch auf den Rhythmus. [23] Die Filter des Systems veränderten sich mit jeder Performance, so dass die Messdaten jeweils nach den Bedingungen seiner aktuellen Konfiguration verarbeitet wurden. Die ‚nicht-triviale Maschine' war ‚historisch abhängig'. Was sie tat, war bestimmt von

ihrer ‚Erfahrung'.[24] Die Resultate der analogen Umrechnungen der Klangsignale wurden über das Anschalten und Dimmen von Scheinwerfern und die Bewegung der davor montierten kontrollierbaren Farb- und Musterfilter oder Reflektoren in ein dynamisches Lichterspiel umgewandelt.[25] Das Experiment, mit *Musicolour* auch kleine Figuren zu bewegen, bewährte sich nicht: „marionettes and *Musicolour* proved to be unhappy bedfellows."[26] Schon bei der Premiere löste sich eine der Puppen aus der Aufhängung, einzelne Körperteile stürzten im Zuschauerraum nieder.
Im Programmheft bewarb Pask den elektronischen Analogcomputer[27] als „lebendigen Organismus", der sich abhängig von der Performance der Pianistin entwickle:

> Whereas most computors are designed to solve a problem according to a set of instructions, this particular system is revolutionary because it functions as a dummy partner for Jone [Parry]… and it has, quite literally, all the properties of a living organism. (…) the organism grows as a function of her performance.[28]

Das Konzept wachsender Organismen war in Pasks kybernetischer Forschungsarbeit dieser und der folgenden Jahre wesentlich für die Beschreibung evolutionärer Vorgänge bei der Differenzierung komplexer Systeme und für die Modellierung von Prozessen des Lernens bzw. der Wirklichkeitskonstruktion.[29] Doch auch ohne diese Inszenierung des Analogcomputers als Wesen an der Grenze zwischen toter Materie und Leben wäre *Musicolour* für den Laien schwer in die Gale-

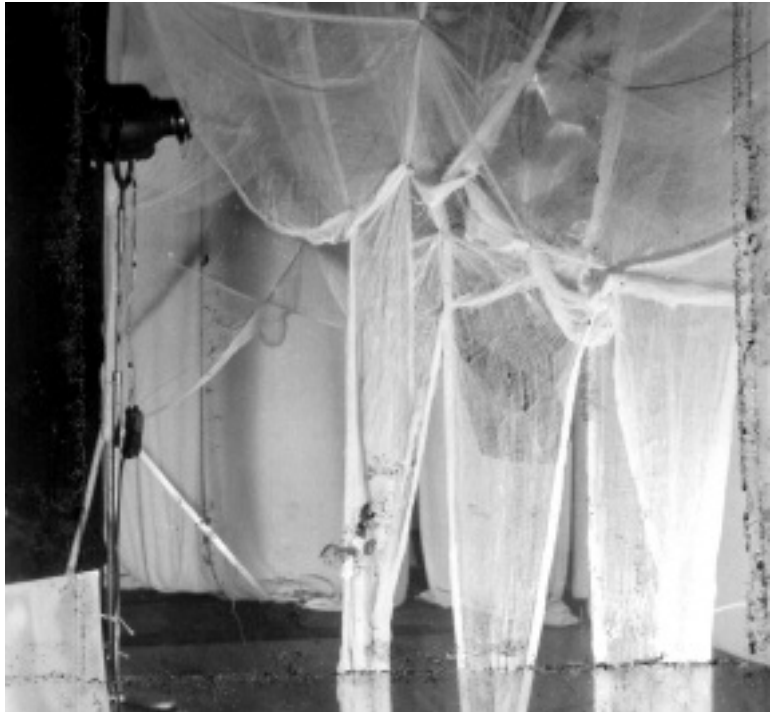
Gordon Pask, Robin McKinnon-Wood,
Teil einer Projektionsfläche für *Musicolour*, Boltons Theatre Club 1954,
Boltons Theatre Club, Moon-Music, Programmheft 1954

rie jener berühmten Maschine einzuordnen gewesen, die in den 1950er Jahren das populäre Bild der Computertechnologie prägten, und das nicht nur, weil es sich um einen Analogrechner handelte.[30] Denn ein Spezialcomputer, der mit zwei Kleinbussen von Theater zu Thea-

ter und Tanzsaal zu Tanzsaal transportiert wurde, um dort zur Unterhaltung des Publikums mit einem Musiker in ‚Echtzeit' zu interagieren, wies wenig Ähnlichkeit mit Computern wie beispielsweise dem ENIAC auf, dem ersten elektronischen Universalrechner, der im Februar 1946 der amerikanischen Öffentlichkeit vorgestellt worden war[31]: Er diente militärischen Zwecken, füllte mit einem Gewicht von fast 30 Tonnen einen ganzen Raum, musste in langwierigen Prozessen programmiert werden und arbeitete unter Ausschluss der Öffentlichkeit.
Pask beendet seine Ankündigung von *Musicolour* mit einer dramatisch formulierten Wendung, in der er das Motiv des ‚lebenden Organismus' nochmals aufnahm und einer kommenden Generation von Maschine einen neuen ontologischen Status in Aussicht stellte:

> It is realized that it may be difficult to accept even the contents of these notes, for they throw a new and disturbing light upon the nature of life and of thought … can there be machines which become alive when linked to another organism, a human being in much the same way a virus is alive only when in contact with a living cell? [32]

Musicolour erwachte zum Leben, wenn es – einem ‚selbstorganisierenden System' entsprechend – Energie und Ordnung aus seiner Umwelt aufnahm.[33] In einer späteren Version von *Musicolour*, um 1956/57, fügte Pask seinem System sogar noch eine ‚wachsende' elektrochemische Visualisierungvorrichtung hinzu. Er füllte Schalen mit Elektrolytlösung und einem Indikator, der seine Farbe mit dem pH-Wert veränderte und verband die Flüssigkeiten über Elektroden mit



Gordon Pask, Robin McKinnon-Wood,
Teil einer Projektionsfläche für *Musicolour*, 1953–1957

Musicolour. Wenn Strom floss, erfolgte eine lokale Elektrolyse, ‚künstliche Neuronen' wuchsen dem Stromfluss entlang, der pH-Wert verändert sich und in den Schalen entstanden Farbmuster, die für Projektionen genutzt werden konnten.[34] Pasks elektrochemikalische Experimente mit evolutionären Strukturen, hier in ihrer performativen Wirkung erprobt als Farbfilter für eine Lichtorgel, waren wegweisend für die AI-Forschung ebenso wie für das Problem experimenteller Epistemologie.[35]

Der Theaterrezensent des *The Freethinker* erwies sich jedoch als unempfänglich für die Faszination künstlicher ‚lebender Organismen' sowie für die auf diese Weise beworbene ‚neue Kunstform'[36] und äußerte sich zudem verärgert über die literarische Qualität des Stückes.[37]:

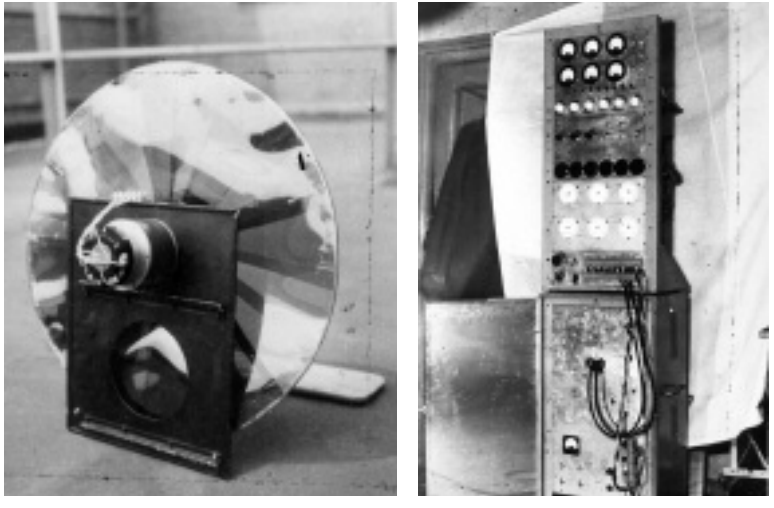
> (…) it is difficult to find anything stimulating in this combination of music and colour. Jone Parry is an excellent pianist who plays into a microphone connected with an electronic computer, which in turn projects colours on to a screen and a number of weird objects suspended in the air. Presumably the authors believe this is the beginning of a new art, but if they aspire to introduce it in the form of a play, they should at least make use of an experienced author rather than spoil their chances by writing bad dialogue. As for the invention, all things must have a beginning and I can only say that apart from being enlightened I failed to receive an impression. Maybe Walt Disney's film Fantasia is still fresh in my memory.[38]

Gerade den animierten Musikfilm *Fantasia* (1940) jedoch kritisierte Pask dafür, dass er die Annahme verbreitet habe, es gebe determinierte synästhetische Beziehungen. Er betonte, dass die Neuheit und wissenschaftliche Bedeutung von *Musicolour* speziell in der Ablehnung dieses Prinzips liege:

> On the contrary, we suppose that the relation which undoubtedly exists between sound (or sound pattern) and light (or light pattern) is entirely personal and that for a given individual it is learned throughout a performance.[39]

Deshalb habe er eine lernende Maschine geschaffen, die der Performer so lange trainieren könne, bis sie die Eigenschaften eines „persönlichen idealen Übersetzers"[40] angenommen habe. Denn die Handlungsmöglichkeiten des Musikers waren nicht darauf beschränkt, durch das Variieren von Rhythmus und Klang, die Maschine bei Laune zu halten. Durch das, was der Musiker als ‚Billigung' und ‚Ablehnung' erlebte, wirkte *Musicolour* als ‚Lehrmaschine' auf ihn ein. In diesem Regelkreis, schrieb Pask in seinen Erläuterungen aus dem Jahr 1954, habe der Musiker jedoch auch die Möglichkeiten, seine Präferenzen bestimmter Beziehungen von Musik und Klang, „acceptable translation characteristics", über ein Pedal gegenüber der Maschine durchzusetzen.[41] Das System konnte somit prinzipiell einen stationären Zustand erreichen, eine stabile Koppelung von den zwei Zeichensystemen Ton und Licht. Einen Eindruck dieser Sprache, die sich im Austausch zwischen Mensch und Maschine herausgebildet hatte – sowie von der musikalischen Form, in der *Musicolour* ihre Signale erhielt –

vermitteln Beschreibungen aus den Jahren 1954 bis 1957: Bei einem Walzer wechselte die Lichtstimmung zwischen tiefblau und rot, bei einem Quickstepp zwischen rosa und weiß, bei einem Samba zwischen tiefrot und orange und bei einem Blues zwischen blau und lila.[42]
Ein Rezensent des *Musicolour*-Stückes *Nocturne*[43], das im *Hovenden Theatre Club* aufgeführt wurde, äußerte differenziertere Kritik als sein Kollege vom *Freethinker*. Er zweifelte am Anspruch Pasks,



Gordon Pask, Robin McKinnon-Wood, Musicolour, 1953–1957,
linkes Bild: elektronisch kontrollierbarer Farbfilter.

die Maschine würde auf die musikalische ‚Stimmung' reagieren. Pask: „[The] sort of partner organism which it is, changes not so much with what she plays, as HOW she plays it, with what expression she uses, what MOOD."[44] Der Rezensent wandte ein, es handele sich einfach um eine Interpretation von Klang unabhängig vom Ausdruck der Musik:

> The effect is quite pleasing as a novelty, and it is interesting in that the machine does not merely reproduce the same colour pattern each time a particular note is played. Yet one may challenge his claim that this is an interpretation of music. It is an interpretation of sound (...) A mechanical response to the frequency and amplitude of a musical note does not seem to provide any significant comment on the expressive qualities of the music played.[45]

Pask verwendete den Begriff der ‚Stimmung' nicht allein, um die hier erwähnten expressiven Qualitäten von Musik und Lichtspiel zu charakterisieren. In den Beschreibungen der Erfahrungen, die Jone Parry mit *Musicolour* machte, spiegelt der Ausdruck die Ungewissheit über das Verhalten des adaptiven Systems wider, von dem selbst seine Konstrukteure bald nicht mehr sagen konnten, wie es reagieren würde[46]:

> In her view, it is almost impossible to make analytic statements about the training procedure (say, in terms of amplitude or rhythm), but that the attributes used to describe a musical sequence (such

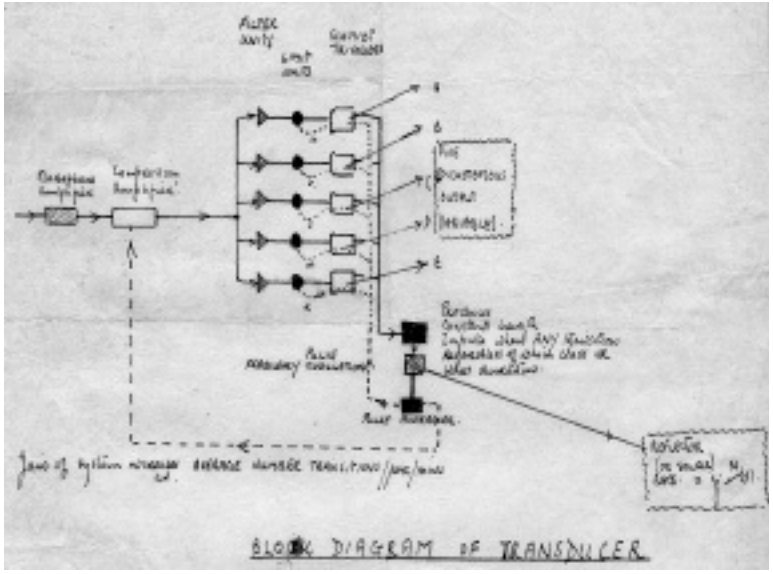
> as 'mood' or 'brilliance') also describe the variables to which the system is responsive and via which it can be trained.[47]

Nur wer mit *Musicolour* interagierte, sich an die Maschine koppelte und mit ihr einen Regelkreis bildete, hatte die Möglichkeit, ein Verfahren zu entwickeln, mit dem das System kontrollierbar wurde. Die Beobachtung wurde jedoch dadurch erschwert, dass der ‚lernende Organismus' mit der ersten Performance seinen Anfangszustand verlassen hatte und keine einfache Manipulation, ihn in diesen Zustand zurückbringen konnte, ein Problem, den Ross Ashby 1956 in seinen Ausführungen zur Black Box darstellte.[48] Psychologen, die Experimente mit lernenden Organismen durchführen, haben die Möglichkeit, den Ursprungszustand wiederherzustellen, indem sie einfach ein neues Individuum heranziehen,[49] eine Option, die den Musikern, verwehrt blieb. Musicolour gab es nur ein Mal.
Zahlreiche Testpersonen hielten die Ungewissheit des Anfangs nicht aus und brachen das ‚Gespräch' ab. Für Tests setzten Pask und McKinnon-Wood daher auch einen Schallplattenspieler ein, dessen immergleiche Interpretation eines Stückes es erlaubte die Funktionstüchtigkeit von *Musicolour* zu überprüfen, beispielsweise die Zeitspanne bis zum Einsetzen der ‚Langweile'.
Mit *Musicolour* setzte Pask Erfahrungen um, die er in einem früheren Experiment gesammelt hatte. Noch in der Ära von *Sirenelle*, der Firma, die er mit McKinnon-Wood, Valentine Boss, Anthony Forge und Richard Fletcher für die Produktion von Musiktheaterstücken gegründet hatte, versuchten Pask und McKinnon-Wood, ein Gerät zu bauen, das eine auf dem Klavier gespielte Melodie automatisch notieren

sollte, die „auto music scripting machine"[50]. Dieses Unterfangen scheiterte jedoch unter anderem daran, dass der Pianist sich als unfähig erwies, den Takt des Metronoms genau einzuhalten. Pask und McKinnon-Wood begannen daher, ein adaptives Metronom zu bauen, das dem Musiker folgte:

> This basic instrument sensed the position (or the probable position) of the last 'bar line' in the music (…) and compared this interval with the occurrence interval of relatively accentuated beats in the music (the machine's criterion of 'accentuated' being continually and automatically reset) [51]

Pask und McKinnon-Wood empfanden es als wenig wünschenswert, den Musiker zu disziplinieren. Retrospektiv bemerkte McKinnon-Wood, sie hätten einfach akzeptieren müssen, „that people are cussed and machines are inflexible."[52] Doch sie widerlegten Günther Anders' provokative Voraussage – „‚es genügt nicht (...) den Leib zu interpretieren, man muss ihn auch verändern.' Und zwar täglich neu; und für jedes Gerät anders."[53] Denn sie entschieden sich „[to] bend the machine to adapt to the person in such a way that he [the performer] doesn't notice."[54] Tatsächlich erfolgten Anpassung bzw. Kontrolle wechselseitig. Und je mehr das System übereinstimmte, desto weniger konnte ein äußerer Beobachter sagen, in welchem Maße sich der Musiker und wie weit sich die Maschine anpasste.



Gordon Pask: Schematische Zeichnung des Musicolour-Systems, 1954

Konversationen mit einem Umwandler

Ein Konvolut von Manuskripten, die in Cambridge um 1954 entstanden, zeigt den Horizont der Überlegungen auf, in dem Pask und McKinnon-Wood *Musicolour* entwickelten. Pask schilderte die Arbeitssituation jener Menschen, die in einer automatisierten und mobilisierten Gesellschaft die Produktionsmaschinen und Fahrzeuge kontrollieren müssen. Sie seien überlastet oder unterfordert, was der Arbeitsleistung und dem Individuum gleichermaßen schade. In diesem Kontext positionierte er den „Transducer", ein Gerät, für das *Musicolour* nur ein Anwendungsbeispiel war. In den Ingenieur- und Computerwissenschaften ist ein ‚Umwandler' ein Apparat, der einen Strom von Eingaben einer Art aufnimmt und einen Strom von Ausgaben anderer Art produziert. Pask definierte den Transducer als ‚Kodierungsgerät'[55]. Die ‚elektronischen Analogcomputer'[56], die er hier beschrieb, sollten aktiv jene Signale umformen, die in einem Regelsystem aus Mensch, Maschine und Umwelt an den Menschen ausgegeben werden:

> The transducers (…) obtain an input from a human operator's performance, and from the state of some job which he is doing. After organising this data, they use it to encode the information which the human operator gets from his job – so that it is optimally suited to him, as an individual. The adjustments are carried out continually. [57]

Der Prozess erhöhe die Effizienz des Menschen, reduziere die Ermüdung und mache seine Beschäftigung angenehmer. Rückblickend wird Pask *Musicolour*, mit einem industriellen ‚Optimiser' vergleichen.[58] Die umwandelnden Systeme waren gänzlich darauf ausgerichtet, die kognitiven Anforderungen an den menschlichen Bediener kontinuierlich so anzupassen, dass er weder über- noch unterfordert wurde: zu komplexe Daten eines Ablaufes sollten reduziert, die Komplexität zu einfacher Abläufe angehoben werden.[59] Pask würde in den folgenden Jahren, sowohl in seinen Experimenten mit Lehrmaschinen als auch im künstlerischen Kontext, immer wieder auf die Ober- und Untergrenze menschlicher Entscheidungsfähigkeit eingehen.[60] Pask verwies auf Experimente, die deutlich machten, dass die Leistung von Arbeitern bei Kontrollvorgängen – bis zu einer gewissen Obergrenze – mit zunehmender Komplexität steige und bei Unterforderung sinke.[61] Mehrfach erwähnte er als Negativbeispiele Sekretärinnen, die sich Tagträumen hingeben, oder Arbeiter, deren Gedanken von ihrer eigentlichen Aufgabe abschweifen.
Die gewünschten Qualitäten des Interaktionsprozesses zwischen Mensch und Maschine beschrieb Pask einerseits mit dem Begriff des ‚Spiels'[62] andererseits mit dem der ‚Konversation', jener Analogie, auf der er sein theoretisches Hauptwerk der 1970er Jahre, die *Conversation Theory,* aufbauen würde. „The transducer", notierte Pask 1954, „is the performer's partner in conversation, and the performance is the conversation itself."[63] Wie in einem Gespräch gehe das maschinelle System auf sein Gegenüber ein: „It is, essentially distinct from converse with some sort of automatic 'yes man' who replies in the same terms whatever has been said to him."[64] In ihrem Verlauf wird die

Konversation durch ein Verfahren von Versuch und Irrtum[65] effizienter, da die Bedeutung, welche die Gesprächspartner ihren ‚Worten' geben fast identisch wird.
Pasks spezifische Beschreibung der Begründung von Sprache und Bedeutung in der Interaktion zählte Heinz von Foerster zu seinen wesentlichen Beiträgen in der Forschungsarbeit des Biological Computer Laboratories, da er, so von Foerster, eine Brücke geschlagen habe zwischen der Spieltheorie John von Neumanns und Oskar Morgenstern und dem Sprachspiel Ludwig Wittgensteins.[66]

Unpräzise Vergnügen

Über 200 Jahre bevor *Musicolour* konstruiert wurde, fragte der französische Jesuit Louis Bertrand Castel (1688–1757), „Why not make ocular as well as auricular harpsichords?"[67] Er baute bereits 1734 ein Modell seines *Clavecin oculaire*, des ‚Klaviers für die Augen'. In einer Skizze für die Ankündigung von *Musicolour* erinnerte Pask an die Geschichte der Lichtorgeln, die wahrscheinlich mit Castel begann. Namentlich erwähnte er dabei nur den englischen Maler Adrian Klein, der um 1920 einen über eine Klaviertastatur steuerbaren Bühnenlichtprojektor konstruiert und 1926 in London das Buch *Colour-Music: The Art of Light* veröffentlicht hatte[68]. Ferner beschrieb Pask einen Apparat, bei dem es sich möglicherweise um jenen Entwurf für eine Lichtorgel handelt, den D. D. Jameson 1844 publiziert hatte – ebenfalls in London und unter dem Titel *Colour-Music*: Durch Glasgefäße, die mit bunten Flüssigkeiten gefüllt waren, wurde Licht in einen mit Blechplatten ausgekleideten Raum projiziert. Über eine Klaviatur

konnten die beweglichen Abdeckungen der Lichtfenster, in denen die Gefäße standen kontrolliert werden.[69] Von derartigen, nach seinen Worten, ‚primitiven Anfängen' suchte Pask sich abzusetzen und den Fortschritt in dieser ‚möglicherweise wichtigen Kunstform' einzuleiten: „The new science (if science it can be rightly called) of Cybernetics offers opportunities for more sophisticated devices". [70]
Die verfeinerte Technik diente dabei nicht der Weiterführung jener künstlerischen Ziele, wie sie in den 1920er Jahren, der aktivsten Phase der Lichtmusik, formuliert worden waren. Pask diskutierte weder eine Intensivierung der Musikerfahrung, noch die Möglichkeiten einer Malerei der bewegten Form.[71] Seine Beschreibungen konzentrierten sich auf die kybernetische Modellbildung, das Mensch-Maschine-Verhältnis und Protokolle psychologischer Beobachtungen im Rahmen dieser spezifischen Experimentalanordnung.
Mit *Musicolour* nutzte Pask die Bühnen der Theater und Tanzhallen als kybernetische Laboratorien. Das Musiktheater, das er so liebte, konfrontierte ihn mit Aufgaben oder bot ihm die Möglichkeit, sich Aufgaben zu erfinden, denen er kybernetisch begegnen konnte, beispielsweise die Bühnenbeleuchtung oder die automatische Musiknotation. Es erlaubte ihm, außerhalb eines universitären oder wirtschaftlichen Forschungs-Kontextes Lernprozesse durch elektronische Systeme zu simulieren – ein Gebiet, dass ihn im Rahmen seines Medizinstudiums zunehmend beschäftigt hatte.[72] Die Kunst bot Aufgaben und Anregung für die Forschung, die performative Wissenschaft wiederum brachte neue ästhetische Kategorien hervor, die jedoch erst ein Jahrzehnt später im Kunstkontext wahrgenommen und diskutiert werden sollten. Die Theaterwelt war nur das erste einer Folge wechselnder und paralleler Milieus, in denen Pasks Maschinen in den folgenden Jahren auftauchten. Das Ideal der disziplinenübergreifenden Kybernetik spiegelt sich in der Vielfalt der Anwendungsbereiche seiner Forschung wider – Kunst, Architektur, Militär und Pädagogik.
Für Pask war Kunst eine von mehreren Formen unserer symbolischen Umwelt. Seine künstlerischen Kriterien waren psychologisch und von seinem Interesse an Lernprozessen geprägt. Den Erfolg einer *Musicolour* Performance maß Pask beispielsweise daran, ob der Musiker sich mit völliger Konzentration dem Austausch mit der Maschine hingab und möglicherweise sogar eine ‚hypnotische' Einstellung entwickelte[73]. Von Bedeutung war außerdem, ob die von der Maschine provozierten Konflikte zu einer Erweiterung seines musikalischen Repertoires führte, d. h. zu einer Stärkung problemlösenden Verhaltens im Sinne künstlerischer Kreativität.
„Did we have a Variety Amplifier?" fragte Robin McKinnon-Wood rückblickend, „Perhaps."[74] Abraham Moles, einer der Gründer der *Informationsästhetik*[75], schrieb 1962, programmierbare Maschinen könnten im Bereich von Kunst und Design als „Intelligenzverstärker" eingesetzt werden[76]. Damit spielte er auf die Möglichkeit an, eine künstlerische Idee mit Hilfe eines Rechners in all ihren Varianten permutativ zu erproben. Pasks und McKinnon-Woods ‚Vielfalts-Verstärker' unterschied sich deutlich, von jenen ‚Verstärkern' im Dienste der „permutationellen" Computerkunst wie sie ab 1962 auf Großrechnern in USA und Europa erzeugt wurde. Die Autoren der frühen Computergrafik, wie Michael A. Noll, Georg Nees oder Frieder Nake, definierten die gewünschte Form algorithmisch, dann wurde das Programm über Lochkarten oder -streifen in den Computer eingegeben. Dieser

errechnete unter Verwendung eines Pseudozufallsgenerators eine Vielfalt ähnlicher Zeichnungen, die mit Hilfe eines Plotters automatisch gezeichnet wurden.[77] Der Computer arbeitete die einmal festgelegten Handlungsanweisungen ab, ohne dass der Künstler intuitiv in den Prozess hätte eingreifen können, denn die in den 1960er Jahren verbreiteten Rechner boten keine Möglichkeit der Interaktion an. Im Gegensatz zu diesem determinierten Prozess, erlaubte Pasks und McKinnon-Woods Analogrechner, mit ihm in Echtzeit Nachrichten auszutauschen. Sein ‚Programm' modifizierte sich fortwährend in Abhängigkeit vom Musiker. Pask lehnte den künstlichen Zufall ab, da er beim Performer zu Frustration führe.[78] In der engen Koppelung mit der Maschine interpretierte der Musiker diese zufälligen Ereignisse als Reaktion auf sein Verhalten und scheiterte dann, diese Erfahrung in sein Modell der Maschine einzufügen. Das Verhalten von *Musicolour* sowie das des Performers war unvorhersagbar, jedoch nicht zufällig. [79] Die visuellen Ergebnisse entstanden in einem Regelkreis zwischen Mensch und *Musicolour*. Pask glaubte nicht an die Möglichkeit, die ‚Intelligenz' einer Maschine im Detail antizipieren und festgelegen zu können. Ebenso wenig könne man Automaten konstruieren, die autonom ‚einen ästhetisch wertvollen Output' hervorbringen. Die ästhetischen Äußerungen sollten aus dem Zusammenwirken von Maschine und menschlichem Wesen entstehen.[80] Pask und McKinnon-Wood hatten ein kybernetisches System entworfen, für – wie der Wissenschaftshistoriker Andrew Pickering es formulierte – „a vision of the world as a place of emergent agency in performative interaction"[81]. *Musicolour* war somit, ästhetisch gesprochen, näher an der Indetermination John Cages, das heißt, an dem Zusammenwirken zufälliger

Ereignissen der Welt, als an der errechneten *pseudorandomness* der Computerkunst der *Mainframe*-Ära. Pasks Performer gaben sich, um den Philosophen Max Bense zu paraphrasieren, „unpräzisen Vergnügen" hin.[82]

SAKI – ein maschineller Akteur

Jenseits der Begeisterung für die ästhetischen Effekte dieser Maschine war *Musicolour* für Pask, der als sein Spezialgebiet die Psychologie betrachtete, eine Experimentalanordnung, in der er Lernverhalten beobachten konnte. Sie inspirierte ihn in seiner Arbeit, mit der er die größte Reputation erlangen sollte, in der Entwicklung adaptiver Lehrmaschinen.
Teaching Machines gab es bereits seit den 1920er Jahren[83], sie erfuhren jedoch Ende der 1950er Jahre speziell in den USA ein enormes Interesse, das in Großbritannien und auf dem Kontinent widerhallte. Unter dem Schock der sowjetischen Raumfahrtserfolge, suchte man nach einer Erklärung „wieso der sowjetische Bauer unter bolschewistischer Herrschaft dem freien, in einer Demokratie lebenden Amerikaner den Rang abgelaufen hatte".[84] Der vermuteten Wunderleistung der sowjetischen Erziehung sollte mit Lehrmaschinen begegnet werden. Pask hatte bereits 1952 begonnen[85], unterschiedliche Exemplare dieser Automaten zu konstruieren. Seine Maschinen waren ‚lehrende' und ‚lernende' Geräte, da Pasks Aufmerksamkeit nicht allein der ‚Beobachtung von Systemen', sondern vor allem ‚beobachtenden Systemen' galt .

Von all den Maschinen Pasks, mit denen entweder sensomotorische Fähigkeiten oder kombinatorische Fähigkeiten trainiert werden konnten, sei hier SAKI herausgegriffen, der *Semi Automated Keybord Instructor*. Das Trainingsgerät für das Stanzen von Lochkarten war ein kommerzieller Erfolg. Und auch Pasks Freund Stafford Beer, der Begründer der Management-Kybernetik, sah sich als Testperson verblüfft ein 12-Tasten *Punch*-Gerät für die Vorbereitung von Lochkarten verwenden: „I had never touched such a device before, nor could I type, and yet, ‚forty-five minutes later I was punching at the rate of eight keys a second: as fast as an experienced punching girl.'"[86] Es war gelungen, um Pasks Formulierung aufzugreifen, bei Beer das gewünschte ‚Verhaltensmuster' bzw. ‚Muster von Zustandsänderungen im Gehirn' zu erzeugen.[87]
SAKI kontrollierte den Lernprozess auf der Basis genauer Beobachtung des Studierenden. Nicht nur falsche Tastenkombinationen wurden vermerkt, sondern auch zeitliche Verzögerungen. Der *Instructor* verhielt sich kooperativ und kompetitiv, um dem Lernenden darin zu unterstützten ein ‚geistiges Bild' der Tätigkeit zu gewinnen.[88] Das heißt, *SAKI* wählte nicht nur Aufgaben aus, die der jeweiligen Leistung entsprachen, sondern gab er dem Lernenden darüber hinaus Hinweise über eine Reihe von Lampen, die entsprechend der Tastatur angeordnet waren.[89] Diese Hilfe wurde langsam reduziert und, scheiterte der Student, vorübergehend wieder gewährt. Beide, Schüler und lernende Lehrmaschine agierten über ein Verfahren von Versuch und Irrtum. Wie bei *Musicolour* veränderten sich das Verhalten des Studierenden und das der Lehrmaschine wechselseitig.[90] Obwohl die Maschine die Anforderungen stetig zu steigern suchte, fand der

Regelkreis ein eigenes dynamisches Schwierigkeitsniveau, abhängig vom menschlichen Benutzer. Der Beobachter und die Maschine waren ‚in ein homöostatisches Ganzes'[91] integriert. „When the system as a whole is stable", schrieb Pask, „the two subsystems, man and machine, are indistinguishable and the student uses bits of machine like bits of his brain in solving a problem."[92]

Gordon Pask: SAKI, Semi Automated Keyboard Instructor, 1956
(Elizabeth Pask), Solartron Electronic Group Ltd.

Auch im konkreten Bezug auf seine Lehrmaschinen betont Pask, dass die Interaktion zwischen Mensch und maschinellem System den Status einer ‚Konversation' habe. Zwar lasse sich der Austausch auch als kooperatives und kompetitives ‚Spiel' bezeichnen, die Eigenschaf-

ten eines Spiels wiederum seien aber – davon abgesehen, dass diese Interaktion sich nonverbal vollziehe – identisch mit denen eines ‚wirklichen Gesprächs'.[93] Der Begriff der ‚Konversation' wurde ab Ende der 1950er Jahre auch in den Computerwissenschaften ganz selbstverständlich verwendet, bezog sich für den normalen Computernutzer allerdings auf die einfache Vorstellung, mit dem Computer direkt kommunizieren zu können, zum Beispiel über Timesharing-Systeme, anstatt zeitverzögert über Lochkarten oder -streifen. Die Bezeichnungen „conversational" oder „interactive" wurden meist synonym gebraucht.[94]
Pasks Ziele, die er mit der ‚Konversation' verband, gingen weit über die Beseitigung von Kommunikationsbarrieren wie dem Batchprocessing oder bestimmter Programmiersprachen hinaus. Während Siegmund Freud psychische Vorgänge durch Metaphern aus der allgemeinen Mechanik, Elektrodynamik, Chemie und Hydraulik verdinglichte – ‚Mechanismus', ‚Widerstand', ‚Neutralisierung', ‚Verdrängung'[95] – animierte Pask die Maschine durch den, dem menschlichen Umgang entnommenen, Konversationsbegriff und betonte die Prozesshaftigkeit der Beziehung zwischen Mensch und Apparat. Er definierte Maschinen als Akteure. Sie ‚verwickelten' das menschliche Gegenüber in eine singuläre Konversation, indem sie – in einem auf das Individuum abgestimmten Rhythmus – die Möglichkeit anboten, Entscheidungen zu treffen bzw. den Menschen dazu nötigten. Die Maschine konnte vom Lernenden nicht nur ‚wie eine Art Lehm' geformt werden, sondern war aktiv, und entsprach mit dieser Eigenschaft dem Studierenden, ‚der nie ruhig sein darf und immer Entscheidungen treffen muss.'[96] Die Entscheidungen bezogen sich auf die ‚konzeptionellen Kategorien', die sich der Lernende im Entscheidungsprozess aneignete. Voraussetzung für den Erfolg des Prozesses, war es, auch hier, das ‚Interesse' des Lernenden zu halten, die feine Balance zwischen den Obergrenzen und Untergrenzen der Entscheidungsfähigkeit, zwischen Überlastung und Langeweile zu wahren.[97]

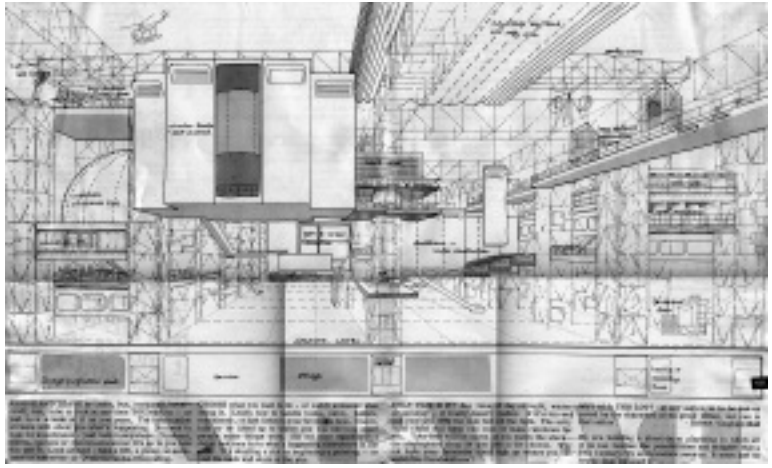
Der kybernetische *Fun Palace* – a foretaste of the pleasures of the future

Bald ergab sich für Pask eine Möglichkeit, nicht allein Individuen in eine ‚Konversation' mit der Maschine zu verwickeln, sondern eine adaptive Umgebung für eine größere Gruppe von Menschen zu konzipieren. Pask wurde 1964 als Berater für eines der spektakulärsten architektonischen Projekte dieser Jahre geholt, den *Fun Palace* des britischen Architekten Cedric Price. Geboren aus einer Idee der Theater-Aktivistin, Schauspielerin und Regisseurin Joan Littlewood im Jahr 1962[98], entwarf Price für die neuen *Vauxhall Gardens* ein Gebäude bestehend aus einer offenen Stahlstruktur: 260 Meter lang, 114 Meter tief und 50 Meter hoch. Die Konstruktion war mit riesigen Brückenkränen ausgestattet. Wände, Böden, Treppen, Deckenmodule konnten bewegt und – den Bedürfnissen der Besucher folgend – neu zusammengesetzt werden. Die Architektur dieses Projektes, das letztendlich nie realisiert werden sollte, beeinflussten Renzo Piano und Richard Rogers entscheidend in ihrem Entwurf des Centre George Pompidou.

Der Titel *Fun Palace* stand für das Konzept, einer „University of the streets – not a gracious park, but a foretaste of the pleasures of the future"[99]. Der ‚Vergnügungs-Palast' war somit kein Ort für den passiven Konsum. Die Bürger Londons sollten vielmehr aktiv in einem „science playground" experimentieren, Lehrmaschinen nutzen, in der „acting area" und künstlerischen Werkstätten die therapeutische Wirkung des Theaters und der Kunst erleben dürfen, um ihre Alltagserfahrungen zu verarbeiten und ein kritisches Bewusstsein zu entwickeln.[100]: „A space to try new skills, waste time pleasurably, extend interests."[101]

> Choose what you want to do – or watch someone else doing it. Learn how to handle tools, paint, babies, machinery, or just listen to your favourite tune. Dance, talk or be lifted up to where you can see how other people make things work. Sit out over space with a drink and tune in to what's happening elsewhere in the city. Try starting a riot or beginning a painting – or just lie back and stare at the sky.[102]

Pask, Leiter des kybernetischen Komitees, arbeitete daran, Cedric Prices Wunsch entsprechend, eine anpassungsfähige Umgebung zu entwickeln, die die Menschen zur Partizipation ermutigen sollte.[103] Über elektronische Sensoren und Antwort-Terminals sollten Daten über das Verhalten und die Interessen der Besucher erfasst und über einen *IBM 360-30*-Computer analysiert werden. Auf Basis der Resultate sollten sich dann die räumliche Struktur und das Aktivitäten-Programm verändern.[104]
Im *Fun Palace* Project fanden die Impulse des links-aktivistischen Theaters Joan Littlewoods, das stark von der Arbeitertheaterbewe-



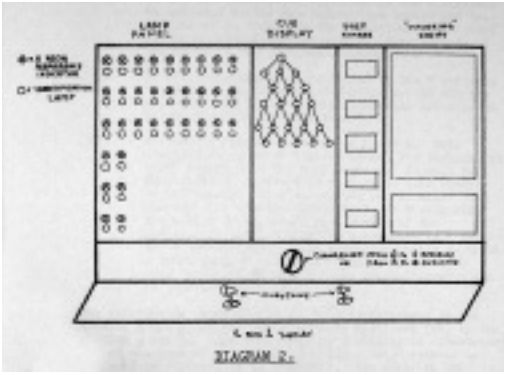
„Joan Littlewood presents the FIRST GIANT SPACE MOBILE IN THE WORLD it moves in light turns winter into summer .... toy .... EVERYBODY'S what is it?", Informationsbroschüre, Juli 1964

gung beeinflusst war, mit den kybernetischen Technikvisionen Pasks zusammen; die Idee der Ermutigung des passiven, entfremdeten, bürgerlichen Individuums zu sozialer Partizipation verband sich mit dem Konzept ‚konversationeller Interaktion' in kybernetischen Mensch-Maschine-Systemen. Der *Fun Palace* wurde als kybernetisches System konzipiert: „a system for encouraging the creative behaviour that is necessary in an automated, society."[105] Pask und Littlewood folgten

Pasks Diktum „Man is a System that needs to learn"[106] und gingen somit davon aus, dass die Passivität der Bevölkerung Londons überwunden werden könnte. Befürchtungen, dass die Besucher den *Fun Palace* durch ihre Präferenzen auf ein Programm umtrainieren könnten, das ein Höchstmaß an passivem Erleben erlaubt, hatten sie nicht.
Neben der Regelungstechnik für das Gesamtsystem entwarf Pask ein *Cybernetic Theatre* sowie eine Zone mit Lehrmaschinen, die den Besuchern Fähigkeiten wie effektive Zusammenarbeit, Muster- und Fehlererkennung vermitteln sollten.[107] Pask plante offensichtlich, einige der Trainingssysteme, die er vor allem für die US Air Force entwickelt hatte, für den *Fun Palace* zu adaptieren, beispielsweise die Verfolgung von Flugkörpern auf Kontrollbildschirmen. Außerdem schlug Pask adaptive Spielplätze vor, in denen Kinder zu kreativer Aktivität ermutigt werden könnten. Er hielt speziell dieses Projekt für leicht realisierbar, „because systems of this kind exist for the use of apes and are known to be effective in catalysing the appearance of symbolic behaviour amongst groups of these animals."[108] Erwachsene sollten mit Wirtschaftssimulationsspielen für den Umgang mit Problemen auf höherer Entscheidungsebene trainiert und dadurch in ihrer demokratischen Kompetenz gestärkt werden. [109]
Der *Fun Palace* war jedoch nicht für die Herausbildung spezieller Fähigkeiten bei Individuen konzipiert worden, sondern als System zur Transformation des Sozialverhaltens und damit der Gesellschaft. Er entsprach einer gigantischen Realisierung einer ‚Übersetzungsmaschine', wie sie Pask bereits 1958 beschrieben hatte. Seine Lehrmaschinen waren nur ein Sonderfall dieses allgemeinen Mechanismus: „a device which translates the trainees surroundings into a language system which is familiar to the trainee and the words of which form an efficient mental currency."[110] Die Komponenten dieses Mechanismus, schrieb Pask, könnten auch Menschen oder Teile der Gesellschaft sein. Er verwies auf die Konzepte ‚organischer Kontrolle' industrieller und sozialer Systeme des Management-Kybernetikers Beer, der diese Idee 1971 in Chile mit dem *Cybersyn*-Projekt für die Regierung von Salvador Allende verwirklichte.[111] „I think that the real use of teaching machines, translating devices, or whatever they are called, is the practical means of associating men with machines, or", ergänzte Pask, „of associating man with man." [112]
Joan Littlewood begeisterte sich für die Möglichkeit, die soziale Interaktion in dem Mikrokosmos der Gesellschaft des *Fun Palace* beeinflussen zu können. Das Paradigma für die ‚Kontrolle einer derartigen Population', schrieb sie 1964 an Pask, sei ‚die Reifung eines Kindes'.[113] In welchem Maß Littlewood in ihre Überlegungen mit einbezog, dass in einem informationellen Regelkreis der Steuermann nicht autonom ist, sondern seinerseits ein Gesteuerter, wird nicht deutlich. Sie poetisierte den Kontrollbegriff, indem sie notierte, die Maschine verwende einen „calculus of love and laughter".[114] Die soziale Kontrolle und Beeinflussung im Fun Palace wurden als Mittel im Dienste eines höheren Sinns präsentiert. Sie dienten einem Ziel, das weder zur Legitimationsrethorik öffentlicher Institutionen noch der der Wissenschaften gehörte – dem Glück: „as an ultimate goal, we aim to foster the achievement of happiness."[115]

The Cybernetic Theatre – Konversation als Unterhaltung

Stimmungsäußerungen wie das Klatschen des Publikums, die Unruhe im Zuschauerraum, das vorzeitige Verlassen der Vorstellung genügten Pask als Formen der Rückkopplung im Theater nicht. Sein ‚Kybernetisches Theater', das er im Rahmen des *Fun Palace*-Projektes mit Joan Littlewood und Jerry Raffles entwickelte, erforderte präzisere Verfahren.[116] Das System des *Cybernetic Theatre* verlangte dem Zuschauer in einem festen Rhythmus eindeutige Entscheidungen ab. Durch diese Partizipation sollte es sich vom traditionellen Theater unterscheiden, vor allem jedoch von Kino und Fernsehen.[117] Pask plante, das gesamte Publikum – bis zu 750 Personen[118] – mit Signalgebern und Kopfhörern auszustatten. Das dafür konzipierte ‚programmierte'[119] Stück sah vor, dass das Publikum an bestimmten Punkten signalisieren konnte, welche Handlungsoptionen die Akteure auf der Bühne wählen sollten. Über Kopfhörer erhielten die Zuschauer als Entscheidungsgrundlage ‚Metainformationen', das heißt, sie hörten den inneren Monolog eines der Protagonisten. Produziert wurde diese Information während der Proben, in denen die Schauspieler ermutigt werden sollten, ihre Gedanken zu externalisieren.[120] Diese Reflexionen wurden mitgeschrieben oder auf Tonband aufgenommen. ‚Interpreten' hinter der Bühne übernahmen die Aufgabe die Zuschauer mit ‚Metainformationen' zu versorgen und die Entscheidung, die mit Hilfe unterschiedlicher Algorithmen aus dem Zuschauervotum errechnet wurden, über Handzeichen oder eine Funkverbindung an den Schauspieler weiterzuleiten. Der Zuschauer erhielt jeweils nur die ‚Metainformationen' jenes Akteurs, mit dem er



Gordon Pask, Skizze der Kontroll- und Kommunikationsvorrichtung der ‚Interpreten', Proposal for a Cybernetic Theatre 1964

sich vorher über Knopfdruck ‚identifiziert' hatte – beispielsweise mit A, „a foppish young man but (...) intelligent and inclined to Socialist ideals" oder B, „an attractive woman with an obsession about motor cars and with pretensions to being a singer".[121]
Auch im Zusammenhang mit dem *Cybernetic Theatre*, einem Projekt das letztlich nie über eine Testphase hinaus ging, beschäftigte Pask die Frage, wie er die Aufmerksamkeit der Zuschauer binden, das heißt, wie er Unterhaltung in ‚Konversation' wandeln könne. Er versuchte aus seiner Erfahrung mit Lehrmaschinen zu schließen, in welchem Verhältnis Erfolg – der Protagonist folgt der Entscheidung des Zuschauers – und Misserfolg zu stehen hätten. Außerdem suchte Pask

nach dem optimalen Zeitabstand, um den Zuschauer zur ‚Entscheidung' aufzufordern. Dabei orientiert er sich an Beobachtungen zwischenmenschlicher Konversation:

> Very roughly, people seem to be satisfied if they can express preference once every 2,5 mins. (This figure is rough and comes from a content analysis of an unduly small sample of recorded discourse. (...)[122]

Die Reichweite der Frage nach der Optimierung der Entscheidungsbedingungen wird in einem Artikel deutlich, den Pask und sein Mentor Heinz von Foerster 1960 verfassten. Sie erachteten die Möglichkeit der Entscheidung als wesentlich für die Subjektkonstitution: „Man must make decisions about something, in order to be man"[123]

The Colloquy of Mobiles

Das *Cybernetic Theatre* verschwand zusammen mit dem *Fun Palace*. In den folgenden Jahren entwickelte Pask das Konzept einer ‚ästhetisch wirksamen Umgebung', in dessen Zentrum zwar weiterhin das Konzept lernender Systeme stand, jedoch nicht in einem so deutlich sozialreformerischen Sinne wie im Zusammenhang mit Littlewoods *Fun Palace*. Im Auftrag von Jasia Reichardt, entwickelte Pask für die Ausstellung *Cybernetic Serendipity* im Londoner *Institute of Contemporary Arts*[124] im August 1968 das *Colloquy of Mobiles*. Die Ausstellung, die in der Projektphase den Untertitel „an extensive international exhibition exploring creative forms engendered by technology"[125] trug, bot ihm einen Rahmen, seine Ideen im Kontext zeitgenössischer bildender Kunst zu erproben.[126]

Das *Colloquy of Mobiles* war ein lernfähiges System aus fünf von der Decke hängenden Mobiles, die sich drehen konnten und über Licht und Ton miteinander kommunizierten. Um der Kommunikation zwischen den Mobiles eine Bedeutung zu geben, entwarf Pask das *Colloquy* als Allegorie auf soziale Systeme:

> The colloquy of mobiles is a social allegory. It has suggested various situations to different people; a parody of the chitchat at a cocktail party or the discourse of some bizarre philosophers; the courting ritual of a strange and stylised animal species. All these are possible interpretations of the work, but none of then is necessary. For the dynamics of the system are greatly abstracted from reality.[127]

Obwohl der Titel „Colloquy" auf eine formelle Zusammenkunft schließen ließ, dominierte in Pasks eigenen Beschreibungen eine Interpretation, die die Aktivitäten der Maschinenpopulation als Paarungsverhalten deutete: Zwei ‚Männchen' und drei ‚Weibchen' kommunizieren miteinander mit dem Ziel der wechselseitigen ‚Triebbefriedigung'. Pask entwarf die Männchen als schmale Quader, an denen lose mehrere Photozellen baumelten. Die Bühnenbildnerin Yolanda Sonnabend gestaltete die Weibchen als semitransparente Muscheln, die von innen leuchteten.[128]

Die technische Lösung entwickelte Pask zusammen mit seinen Mitarbeitern Tony Watts und Mark Dowson, der auch als technischer Berater

der Gesamtausstellung fungierte. Aus elektro-mechanischen Relais und einfacher Elektronik bauten sie einen Spezialcomputer mit dem die Mobiles an ihrer Aufhängung über Kabel verbunden wurden.[129] Die publizierten Flussdiagramme entsprechen nicht völlig der vereinfachten Implementierung, dennoch erlauben sie eine Rekonstruktion der Abläufe: Nach einer Ruhephase, beginnt das Männchen sich zu drehen und mit Hilfe des Autoscheinwerfers in der Mitte seines Körpers Lichtimpulse auszusenden. In dieser Phase ist es empfindlich für Klang. Es versucht mit seinem Lichtstrahl in die Öffnung des Weibchens zu treffen. Dieses hält – vom Lichtstrahl getroffen – in seiner Drehbewegung inne, gibt einen hupenden Laut von sich, um anzuzeigen, dass es kooperieren möchte. Das Männchen stoppt seine zielsuchende Bewegung und wartet darauf, dass das Weibchen seinen Lichtstrahl über einen beweglichen Spiegel zurück auf seine lichtempfindlichen Sensoren reflektiert. Eines der Männchen bevorzugt dabei die oberen Sensoren, das andere die unteren. Gelingt es dem Weibchen, das Licht auf die Fotozellen zu lenken, produziert das Männchen ebenfalls einen hupenden Laut und das ‚Triebniveau' der beiden Mobiles sinkt. Die Männchen, die durch ihre Aufhängung in ihrer Bewegung aneinander gekoppelt sind, konkurrieren im Wettstreit um Gelegenheiten der ‚Kooperation' mit einem Weibchen. Pask konstruierte die Mobiles ähnlich wie *Musicolour* mit der Fähigkeit zu lernen. Sie lernten, ihr Verhalten so zu optimieren, dass der Zustand der Befriedigung mit dem geringsten Energieaufwand erreicht werden konnte.
Die Mobiles begehrten einander ebenso wenig wie die von dem Neurophysiologen und Kybernetiker William Grey Walter gebaute *Machina Speculatrix* Neugierde verspürte. Es gibt keinen Autopiloten aus Leidenschaft. Doch die Mobilees inspirierten die Ausstellungsbesucher, mit Taschenlampen in das, was als Liebesspiel wahrgenommen wurde einzugreifen. Sie mischten sich in die ‚Konversation' der Mobiles ein, beeinflussten dadurch jedoch unwillkürlich den Lernprozess und sorgten somit dafür dass ‚Männchen' und ‚Weibchen' einander immer wieder entfremdet wurden.

Ästhetisch wirksame Umgebungen

Das *Colloquy of Mobiles* sollte ein Beispiel sein für eine neue Form ‚ästhetisch wirksamer Umgebungen'. Mit diesem Konzept resümierte Pasks die experimentalpsychologischen Erfahrung, die er mit *Musicolour*, dem *Fun Palace* und seinen Lehrmaschinen gemacht hatte:

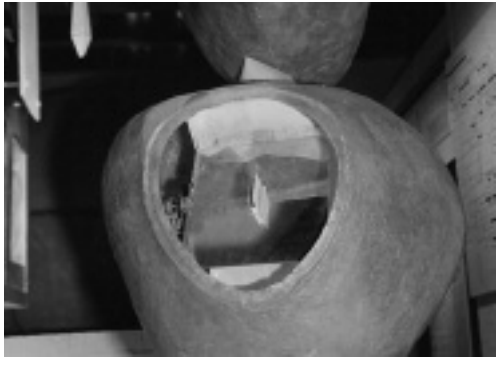
> An aesthetically potent environment encourages the hearer or viewer to explore it, to learn about it, to form a hierarchy of concepts that refer to it; further, it guides his exploration: in a sense, it makes him participate in, or at any rate see himself reflected in the environment.[130]

Auch diese Umgebung sollte auf die Wahrnehmungs- und Lernmöglichkeiten des Menschen hin optimiert sein, hier im Hinblick auf das Verhältnis von Neuem und Vertrautem. Ähnlich wie die Lehrmaschine SAKI sollte die Umgebung dem Menschen Hinweise geben, die das Verstehen des Systemverhaltens erleichtern, ihn in eine Konversation verwickeln und eine gemeinsame Sprache aufbauen. Pask begründete in diesem Zusammenhang nochmals, warum er Menschen mit

Umgebungen versorgen wollte, die sie zwangen, kontinuierlich neue Informationen in ihre Weltmodelle zu integrieren. Dieser Vorgang der Wissensassimilation, so Pask, sei für den Menschen „an inherently pleasurably mode of activity."[131]
Der Kybernetiker wies darauf hin, dass auch Gemälde oder Musikstücke ästhetisch wirksame Umgebungen darstellen, mit denen wir gleichermaßen interagieren: „[O]ur internal representation of the picture, our active perception of it, does respond and does engage in an internal ‚conversation' with the part of our mind responsible for immediate awareness."[132] Doch während beim Betrachten eines Bildes oder dem Hören von Musik der Diskurs zwischen ‚innerer Repräsentation' und dem ‚unmittelbaren Selbst' eben ein innerlicher Vorgang bliebe, ziele eine ‚reaktive oder adaptive Umgebung' darauf, ‚diesen Diskurs zu externalisieren'. Der Vorteil dieses Vorgangs liege darin, dass somit die Konversation zwischen Betrachter und Werk wissenschaftlich beobachtbar werde.
Grundsätzlich sah Pask keinen Sinn darin, eine rigide Unterscheidung zwischen den unterschiedlichen Formen kunstbezogener ‚geistiger Prozesse' zu machen: „The composer is, in some sense, mentally akin to the performer and listener; the man who views a picture is mentally akin to the artists who painted it." [133] Dennoch sollte die Interaktion mit dem Environment dem Betrachter die zusätzliche Option bieten, mit der bestehenden Differenz zwischen Betrachter und Künstler zu spielen. Der Betrachter könne frei zwischen den Rollen hin- und her wechseln, schrieb Pask. Er kommentierte dies allerdings lakonisch: „Whether there is virtue in this, I do not know. But there might be."[134]

Gordon Pask, *The Colloquy of Mobiles, Cybernetic Serendipity*
Mixed Media ca. 5 x 4 Meter, 2. August – 20. Oktober 1968
Institute of Contemporary Art, London

Die Erinnerungen daran, wie die Besucher sich gegenüber dem „aesthetically potent environment" *The Colloquy of Mobiles* verhielten, kontrastieren. Pask schilderte 1982, die Besucher seien stundenlang geblieben, hätten mit ihnen getanzt, Koalitionen mit ihnen oder anderen Besuchern gebildet.



Gordon Pask, *The Colloquy of Mobiles,*
Detailaufnahme des ‚Männchens' [links] und des ‚Weibchens' [rechts]

> Did they really communicate with the mobiles, or the mobiles with them? Did they interact with, or merely act upon, the mobiles? Did they impose personalities, or project their own personalities, on them? Did they use them to resolve their own inner conflicts?[135]

Marc Dowson bezweifelt in seinen Erinnerungen, dass das Publikum das Verhalten verstand und wirksam interagieren konnte. Ohne Vorinformationen, allein auf der Grundlage von Beobachtung sei es nicht möglich gewesen, eine klare Vorstellung der Interaktion der Mobiles zu gewinnen.[136]

Gordon Pask,
The Colloquy of Mobiles

Dass die Aufmerksamkeit mit einfachsten Mitteln gebunden werden konnte, zeigte ein Objekt, dass ebenfalls in *Cybernetic Serendipity* präsentiert wurde: *SAM* (1968), das *Sound-Activated Mobile* des Künstlers Edward Ihnatowicz (1926–1988), eines der beliebtesten Werke der Ausstellung. Der wie eine Blüte gestaltete Kopf, der auf einer hydraulisch bewegten Aluminiumwirbelsäule angebracht war, neigte sich dorthin, wo Menschen sprachen, sangen oder klatschten.[137] Die Schaltkreise errechneten einfach die Differenz zwischen den Lautmessungen des linken und rechten Mikrophons. Im Kontext einer Kunstausstellung schien der triviale Umgang mit einer geräuschempfindlichen Pflanze die Besucher leichter zu involvieren als die ‚Konversation' mit einem komplexen sozialen System. So blieb das technisch störanfällige *Colloquy* eine prototypische Verkörperung bzw. ein ‚poetischer indicator'[138] des *aesthetically potent environment*.

Die Freiheit der Dinge

„Warum ein Naturwissenschaftler zu Methoden seine Zuflucht nimmt, die dem Schausteller, dem Künstler oder dem Priester angemessener wären"[139], versuchte der Grey Walter in dem Kapitel „Totems-Spielzeuge-Werkzeuge" seines Buches *The Living Brain* (1953) zu erklären:

> Als Spielzeuge erfrischen sie den Geist der Laboratoriumskinder, die wir doch alle mehr oder weniger sind, indem sie uns zur Vertrautheit mit immer verfeinerten Mechanismen führen. Als Werkzeuge sind sie zuverlässige Instrumente der Forschung, die häufig unerwartete Erleuchtungen bringen. Als Totems nähren sie die Ehrfurcht vor dem Leben (...).[140]

Die Spielzeuge Gordon Pasks stehen in der langen Tradition spektakulärer Automaten seit der Antike, die gleichermaßen der Unterhaltung als auch der Sichtbarmachung und Entwicklung wissenschaftlicher Ideen dienten. Pask präsentierte jedoch nicht einfach technische Wunderwerke. Er installierte öffentliche Experimentalanordnungen, sowohl im Hinblick auf die Funktionen des maschinellen Systems als auch im Hinblick auf das Verhalten der interagierenden Menschen. Der Pianist, der *Musicolour* bediente, war nicht nur Künstler, die Besucher des *Colloquys* waren nicht nur Kunstrezipienten. Sie fungierten immer auch als Probanden. Ihr Verhalten, das durch die Apparate beeinflusst werden sollte, wurde beobachtet und kontrolliert. Pask setzte die Ziele des Experiments, in dem der Teilnehmer immer auf einem hohen Erregungsniveau gehalten wurde, sehr allgemein fest: sei es nun die Erzeugung von variantem Verhalten im Sinne künstlerischer Kreativität oder die beglückende kognitive Immersion bei der Bewältigung der vom System gestellten Aufgaben. Zu diesen Zielen zählte auch der therapeutische Gedanke des ‚Lösens innerer Probleme'[141]. Die ‚Konversation' mit dem System bedeutete, Entscheidungen fortwährend externalisieren zu müssen. Diese Externalisierung durch Interaktion, und sei es auf dem Niveau körperlicher Bewegung, war eine Form der Subjektkonstitution; sie zwang ihre Teilnehmer sich ihrer selbst bewusst zu werden. Für Pask war dies auch jenseits psychotherapeutischer Zusammenhänge gültig.

Gordon Pask bezog sich nicht auf die künstlerische Avantgarde der 1950/60er Jahre. Er liebte den melodiösen Schlager, schrieb Liebes- und Verwicklungskomödien, malte und zeichnete verspielte phantastische Welten. Er verfolgte mit seiner Forschung jedoch Ziele, die mit Interessen zeitgenössischer Künstler korrespondierten. Pask musste sich im Jahr 1968 die Diskurse der Kunstwelt nicht aneignen, denn Künstler wie Nicolas Schoeffer oder Giovanni Anceschi hatten schon einige Jahre zuvor begonnen, Norbert Wieners Kybernetik und Claude E. Shannons Informationstheorie auf künstlerische Fragestellungen zu übertragen. In den Jahren, in denen Pask an adaptiven Lehrmaschinen sowohl für zivile als auch für militärische Zwecke gearbeitet hatte, waren in der Kunstwelt die Grundlagen einer ‚partizipativen' oder ‚interaktiven' Kunst gelegt worden. Vertreter der kinetischen Kunst und der Op-Art machten sich auf die „Suche nach einem neuen Betrachter"[142] und schufen veränderliche Objekte und Environments, mit denen der Zuschauer interagieren musste. Er sollte gegenüber dem Künstler aufgewertet werden. Gleichzeitig wurde die Kunst als geschützter Raum gesehen, in dem partizipatives Sozialverhalten trainiert werden konnte. Kunsttheoretische, politische und therapeutische Motive überlagerten sich in der Besetzung der Begriffe Partizipation und Interaktivität. In einer Ausstellung ein Bild selbst durch Manipulation neu zusammenstellen zu können, wurde als Befreiung gegenüber der Autorität des Künstlers und als Ermächtigung des Subjekts empfunden, nicht als Zwang zu Handlung und Externalisierung, die es beobachtbar und kontrollierbar macht. Die positive ‚Befreiungsthese' prägte die Legitimation ‚interaktiver' Kunst langfristig.[143]

Pask fügte sich mit seinem *Colloquy* in die künstlerischen Projekte der 1960er Jahre ein, die den Betrachter aus der Innerlichkeit der stillen Kunstkontemplation lockten. Der Betrachter durfte nicht mehr jene *Blackbox* bleiben, an deren Ausgang es sich nicht lohnte zu lauern. Das brennende Interesse Pasks, den Menschen bei der Interaktion zu beobachten und zu kontrollieren, teilten die meisten Künstler jedoch nicht. Obwohl „Kunst als Forschung"[144] die Leitidee einer ganzen Künstlergeneration war, wurden vergleichsweise wenig systematische Untersuchungen durchgeführt. Ausnahmen sind Projekte der *Groupe de Recherche d'Art Visuel* oder das von der *Informationsästhetik*[145] inspirierte *Ambiente per un test di estetica sperimentale* (1965) von Giovanni Ancheschi und Davide Boriani, beide Mitglieder der Mailänder *Gruppo T.* In einem mit programmierten Projektoren ausgestatteten Raum, wurde die jeweilige Aufenthaltszeit der Besucher vermessen. Nach dem Verlassen des *Ambiente* mussten sie zusätzlich einen Fragebogen zu ihren ästhetischen Erfahrungen ausfüllen.

Die durch Kybernetik und Systemtheorie veränderte Perspektive der Künstler auf die Welt beschrieb der Bildhauer und Theoretiker Jack Burnham 1968 als „Systems Esthetics"[146]. Pask fand für die veränderte Rolle des Künstlers ein Jahr später einen weiteren treffenden Begriff, den er zwar im Kontext zeitgenössischer Architektur entwickelt hatte, der jedoch auch sein künstlerisches Verfahren treffend beschrieb: „design is control of control"[147]. Der Designer schafft kein Werk mehr sondern ein Regelsystem, in dem Maß und Form der Steuerung festgelegt sind. Pask empfahl in diesem Zusammenhang, weite Bereiche nicht zu spezifizieren und stattdessen Möglichkeiten für eine benut-

zerabhängige Entwicklung einzubauen, eine Vorstellung die in der Architektur größeren Widerhall fand als in der bildenden Kunst.
Das Jahr 1968, als Pask in *Cybernetic Serendipity* ausstellte, war ein Hoch- und Wendepunkt im Verhältnis von Kunst und Maschine bzw. Technologie. Jasia Reichardt eröffnete in London *Cybernetic Serendipity,* Pontus Hultén am New Yorker *Museum of Modern Art* die Ausstellung *The Machine as Seen at the End of the Mechanical Age*. Die Präsentationen konstatierten das Ende des mechanischen Zeitalters und die Ankunft einer neuen Generation von Maschinen, der Kontrollsysteme und Elektronenrechner. Ein Ausstieg aus der ‚technischen Existenz'[148] war für die Kuratoren Reichardt und Hultén unvorstellbar geworden. „No one can escape from the machine. Only the machine can enable you to escape from destiny"[149], paraphrasierte der schwedische Kurator eine Bemerkung Tristan Tzaras über DADA.
Pasks ‚konversationelle' Maschinen zählten zu den möglichen Fluchthelfern. Sein Ziel war nicht, die Automation abzuschaffen, sondern triviale Maschinen durch nicht-triviale zu ersetzen, und das seiner Meinung nach veraltete Konzept autoritärer Kontrolle und reibungsloser Kommunikation zu überwinden: „Effective controls bear a closer resemblance to catalysis and really efficient communication is akin to a conversation."[150] Mit seinen Lehrmaschinen und künstlerischen Projekten, die mit dem Menschen wie in einem Gespräch im dynamischen Austausch stehen, zielte Pask auf eine Emanzipation innerhalb des technischen Dispositivs, in einem Regelkreis aus Mensch und Maschinen.
Der seit tausenden von Jahren unveränderte Mensch ist, aus der Perspektive der Geräte gesehen, die kontinuierlich ihre Form und Funktion verändern, „konservativ, unprogressiv, antiquiert, unrevidierbar", schrieb Günter Anders und schloss: „Kurz: die Subjekte von Freiheit und Unfreiheit sind ausgetauscht. Frei sind die Dinge: unfrei ist der Mensch." [151] Pask entschied sich, die Freiheit der Dinge auszukosten.

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Anmerkungen

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16 Vgl. Gordon Pask, *An Approach to Cybernetics*, London 1961, 18–19.
17 Ebd., 22.

18 Dieser Schluss könnte – vor dem Hintergrund seiner Beschreibung der Entwicklung von *Musicolour*, die er 1967 für Jasia Reichardts Buch verfasste – aus einem Brief an Leslie Dyer gezogen werden. Außerdem datiert Pask in seinen Artikel für Reichardt den Bau von *Musicolour* auf 1953, die Präsentation im Boltons Theatre, die einer längeren Entwicklungsphase folgte, jedoch fälschlich auf 1955 statt auf 1954. In dem 1962 erschienen Aufsatz zu *Musicolour* gibt Pask als Zeitpunkt der Konstruktion der Maschine allerdings ebenfalls die Jahre 1953/54 an. In einem Zeitungsartikel von 1965 [„Moon Music", Daily Express, 23. Mai 1956] wird die Maschine als Resultat von ‚fünf Jahren Arbeit' präsentiert. Vgl., ders., Brief an Leslie Dyer, [o. J.] (wahrscheinlich Jahresende 1952), Gordon-Pask-Archiv am Institut für Zeitgeschichte Wien, Box 4.43.2., ders., „A Comment, a case history, a plan", in: Reichardt, *Cybernetics*, wie Anm. 15, 79.; ders., „*Musicolour*", in: Irving John Good, *Phantasie in der Wissenschaft. Eine Athnologie unausgegorener Ideen*, Düsseldorf u. Wien 1965, 134–139, 135; [Original: ders. *The Scientist Speculates, an anthology of partly-baked ideas*, London 1962, 135–137, 135].
19 Gordon Pask „A Comment, a case history, a plan", in: Reichardt, *Cybernetics*, wie Anm. 15, 77.
20 Pasks Konzept der „vierten Dimension" wird im Programmheft nicht weiter erläutert. Vgl. *Moon Music*, Programmheft des Boltons Theatre Club Kensington, 1954, Gordon-Pask-Archiv am Institut für Zeitgeschichte Wien.
21 Guy Fawkes (1570, York – 1606, London) war ein englisch-katholischer Offizier, der an dem Versuch mitwirkte, am 5. November 1605 das englische Parlament im Palast von Westminster in London in die Luft zu sprengen.
22 Gordon Pask, „Moon-Music and *Musicolour*. Explanatory Notes", in: *Moon Music*, wie Anm. 20.
23 Gordon Pask, „The machine itself", Manuskript (Konvolut 1954), 25. August 1954, Gordon-Pask-Archiv am Institut für Zeitgeschichte Wien, Box 4.43.2.
24 Heinz von Foerster, zitiert nach Lynn Segal, *The Dream of Reality: Heinz von Foerster's Constructivism*, New York 2001, 95.
25 Ebd.

26 Gordon Pask „A Comment, a case history, a plan", in: Reichardt, *Cybernetics*, wie Anm. 15, 81.
27 Gordon Pask, „Matching Transducers fort he Human Operator, Technical Notes compiled for Mr. Kennerly Edwards", Manuskript (Konvolut 1954), August 1954, 1, Gordon-Pask-Archiv am Institut für Zeitgeschichte Wien. Box 4.43.2.
28 Gordon Pask, „Moon-Music and *Musicolour*. Explanatory Notes", in: *Moon Music*, wie Anm. 20.
29 Vgl. Gordon Pask, „Artificial Organisms", in: *General Systems Yearbook*, Vol. 4 (1959), 151–170; ders., „Physical Analogues to the Growth of a Concept", in: *Mechanization of Thought Processes*, *NPL Symposium 10 H.M. Stationery Office*, London 1959, 877–922; ders., „The growth process inside the cybernetic machine", in: *Proceedings of the 2nd Congress of the International Association for Cybernetics*, Namur 1958, Paris 1960, 765–794; ders. und Heinz von Foerster, „A predictive model for self-organizing systems" (I) und (II), in: *Cybernetica: revue trimestrielle de l'Association Internationale de Cybernétique*, Vol. 3, Nr. 4, (1960) 258–300 u. Vol. 4, Nr. 1, (1961) 20–55.
30 Zur Geschichtet des Analogcomputers vgl. Kent H. Lundberg, „The History of Analog Computing. Introduction to the Special Secion", in: *IEEE Control Systems Magazine* (Juni 2005), 22–28.
31 Über den im englischen Bletchley Park entwickelten speicherprogrammierbare Computer *Colossus*, der ab 1943 in Betrieb war, wurde die Öffentlichkeit erst 1970 informiert. Beispielhaft für die ersten Großrechner ist auch der ebenfalls in England an der University of Manchester gebaute Manchester Mark 1, der ab Oktober 1949 voll funktionsfähig war. Vgl. „Machines behind the codes", in: *Bletchley Park*,
http://www.bletchleypark.org.uk/content/machines.rhtm (09.01.08).
„The Mark 1 Story", in: *Computer 50. The University of Manchester Celebrates the Birth of the Modern Computer*,
http://www.computer50.org/index.html (09.01.08).
32 Gordon Pask, „Moon-Music and *Musicolour*. Explanatory Notes", in: *Moon Music*, wie Anm. 20.

33 Heinz von Foerster, „Selforganizing Systems and Their Environment", in: *Electrical Engineering Research Laboratory, Engineering Experiment Station, University of Illinois, Urbana Illinois*, (Warren S. McCulloch, „Infallible Nets of Fallible Neurons", Gordon Pask, „Natural History of Networks", Heinz von Foerster, „Self Organizing Systems and Their Environment"), Contract No. Nonr 1834(21), Nr 049–123, 1. Juli 1959, 61–89, 69.
34 Gordon Pask „A Comment, a case history, a plan", in: Reichardt, *Cybernetics*, wie Anm. 15, 86
35 Vgl. Peter Cariani, Some epistemological implications of devices which construct their own sensors and effectors, in: Francisco J. Varela and Paul Bourgine, Hg., *Toward a practice of autonomous systems: proceedings of the first European Conference on Artificial Life*, Paris, 11–13. Dezember 1991, Cambridge, Mass. 1992, 484–493; Gordon Pask, „Physical analogues to the growth of a concept", in: Mechanization, wie Anm. 29, ders. „The natural history of networks", in: Marshall C. Yovits, Hg., *Self-Organizing Systems*, proceedings of a conference, Chicago, May 5–6, 1959, New York 1960, 232–261.
36 Gordon Pask, „Moon-Music and *Musicolour*. Explanatory Notes", in: *Moon Music*, wie Anm. 20.
37 Ebd.
38 Raymound Douglas, „Theatre", in: The Freethinker, 29. Januar 1954, Gordon-Pask-Archiv am Institut für Zeitgeschichte Wien.
39 Gordon Pask, „The ‚*Musicolour*' System. Introduction", Manuskript (Konvolut 1954), [o. J.], Gordon-Pask-Archiv am Institut für Zeitgeschichte Wien. Box 4.43.2. Gordon Pask, „Matching Transducers fort he Human Operator, Technical Notes compiled for Mr. Kennerly Edwards", wie Anm. 27, 1. Mit diesem Konzept unterschied sich Pask deutlich von den Thesen anderer Erbauer von Lichtorgeln, beispielsweise Alexander Wallace Riminton (1854–1918), Professor der bildenen Künste am Londoner Queen's College, dessen „Color Organ" 1893 patentiert wurde. Rimington vermutete eine feste Entsprechung bestimmter Klänge und Farben, d. h. Parellelen zwischen den Schwingungsfrequenzen. Jeder Taste der Tonleiter war eine Farbe zugeordnet. Die Lichtorgel und ein Klavier spielten simultan nach der gleichen musikalischen Notation, vgl.

Kenneth Peacock, „Instruments to Perform Color-Music: Two Centuries of Technological Experimentation", in: *Leonardo*, Vol. 21, Nr. 4 (1988) 397–406, 401f.

40 Gordon Pask, „The ‚*Musicolour*' System. Introduction", Manuskript (Konvolut 1954), [o. J.], Gordon-Pask-Archiv am Institut für Zeitgeschichte Wien. Box 4.43.2.

41 Ebd.

42 N.N., „‚Mad' Machine plays coloured music", Zeitungsartikel ohne Angaben, [o. J.], wahrscheinlich 1955/1956); vgl. außerdem N.N., *Musicolour*, Zeitungsartikel ohne Angaben, [o. J.], aus den Altersangaben zu Pask und McKinnon-Wood ist zu schließen, dass der Artikel zwischen Juni 1955 und April 1956 publiziert wurde, beide Gordon-Pask-Archiv am Institut für Zeitgeschichte Wien, Box. 4.34.b1 und 4.6.1.

43 Bühnenstück: Gordon Pask, Musik: Jone Parry und Paddy Dickson, Produzentin: Elizabeth Poole; vgl. *Nocturne*, Theaterplakat Hovenden Theatre Club,), August [o. J.],(1954–57), Gordon Pask Archiv am Institut für Zeitgeschichte Wien.

44 Gordon Pask, , „Moon-Music and *Musicolour*. Explanatory Notes", in: *Moon Music*, wie Anm. 20.

45 N.N., „‚Nocturne' at the Hovenden Theatre", Zeitungsartikel, [o. J.], 1954–1957, Gordon-Pask-Archiv am Institut für Zeitgeschichte Wien. Im Zusammenhang mit *Nocturne* machten Pask und McKinnon-Wood auch den Versuch die Bewegungen eines Tänzers als Eingabesignal zu verwenden, was sich jedoch als technisch schwierig erwies. Gordon Pask „A Comment, a case history, a plan", in: Reichardt, *Cybernetics*, wie Anm. 15, 86.

46 Gordon Pask, „The purpose and Functioning of the system",Manuskript (Konvolut 1954), 25. August 1954, Gordon-Pask-Archiv am Institut für Zeitgeschichte Wien. Box 4.43.2.

47 Gordon Pask, „The ‚*Musicolour*' System. Introduction", Manuskript (Konvolut 1954), [o. J.], Gordon-Pask-Archiv am Institut für Zeitgeschichte Wien. Box 4.43.2.

48 W. Ross Ashby, *An Introduction to Cybernetics*, London: 1956. Internet (1999): **http://pcp.vub.ac.be/books/IntroCyb.pdf** (25.01.08)

49 Ebd., 92.

50 Brief Pask an Valery Hovenden, 9. April [o. J.], Gordon-Pask-Archiv am Institut für Zeitgeschichte Wien, Box. 4.43.2.

51 Gordon Pask, „Transducers used as statistical matching devices in feedback systems which employ one or more human operator(s)", Manuskript (Konvolut 1954), [o. J.], Gordon-Pask-Archiv am Institut für Zeitgeschichte Wien. Box 4.43.2.,102.

52 Robin McKinnon-Wood, „Early Machinations", in: *Systems Research* 10 (1993), 129–132,131.

53 Anders, *Antiquiertheit*, wie Anm. 1, 38.

54 McKinnon-Wood, „Early Machinations", s. Anm. x, 131.

55 Gordon Pask, „Matching Transducers fort he Human Operator, Technical Notes compiled for Mr. Kennerly Edwards", wie Anm. 27.

56 Ebd.

57 Ebd.

58 Gordon Pask, „*Musicolour*"; in: Good, *Phantasie*, wie Anm. 18, 135.

59 Gordon Pask, „Matching Transducers fort he Human Operator, Technical Notes compiled for Mr. Kennerly Edwards", Manuskript, Cambridge", wie Anm. 27.

60 Gordon Pask, „Teaching Machines", in: *Proceedings of the 2nd Congress of the International Association for Cybernetics*, Namur 1958, Paris 1960, 961–968, 967.

61 Gordon Pask, „Matching Transducers fort he Human Operator, Technical Notes compiled for Mr. Kennerly Edwards", Manuskript, Cambridge, wie Anm. 27, 3.

62 Ebd., 8

63 Gordon Pask. „The purpose and functioning of the system", wie Anm 46.

64 Ebd.

65 Ebd.

66 Vgl. Heinz von Foerster, „On Gordon Pask", in: *Systems Research*, wie Anm. 13, 38; John von Neumann und Oskar Morgenstern, *Theory of Games and Economic Behaviour*, Princeton 1953; Ludwig Wittgenstein, *Philosophical investigations*, Oxford 1953.

67 Louis Bertrand Castel, „Clavecin pour les yeux", in: *Mercure de France*, November 1725, 2557–2558, zitiert nach Kenneth Peacock, „Instruments to Perform Color-Music ", in: *Leonardo*, wie Anm. 39, 399.
68 In den späteren Texten „*Musicolour*" (1961) und „A comment, a case history and a plan" (1967/1971) verweist Pask auch auf ein Musiksystem von Alexander Yakob Lerner (1913/1914–2004), einem Star der sowjetischen Kybernetik, das in London Ende der 1950er, Anfang der 1960er Jahre vorgestellt wurde.
69 Jameson wiederum hatte sich wahrscheinlich von einem Vorschlag Erasmus Darwins, dem Großvater Charles Darwins, aus dem Jahr 1789 inspirieren lassen, sichtbare Musik mit Hilfe der neuen Öllampen-Technik Aimé Argands und farbiger Gläser zu erzeugen, vgl. Kenneth Peacock, „Instruments to Perform Color-Music ", in: *Leonardo*, wie Anm. 39, 401.
70 Gordon Pask, Skizze für die Ankündigung von *Musicolour*, [o. J.], um 1953/54, Gordon-Pask-Archive am Institut für Zeitgeschichte Wien., Box 4.43.2.
71 Zur Geschichte der ‚Lichtmusik' vgl. Sara Selwood, „Farblichtmusik und abstrakter Film", in: Peter Weibel, Gregor Jansen, Hg., *Lichtkunst aus Kunstlicht*, 408–423; Frank Popper, *Lichtkinetik* (1975), ebd., 424–447.
72 Elisabeth Pask, zitiert nach Andrew Pickering, „Gordon Pask, Kybernetik und die Künste", in: Schramm, *Spektakuläre*, wie Anm. 13, 475.
73 Gordon Pask, „Matching Transducers fort he Human Operator, Technical Notes compiled for Mr. Kennerly Edwards", wie Anm. 27.
74 Ebd.
75 Pask setzte sich mit Moles 1968 auseinander, vgl. Gordon Pask, *Information Theory and Aesthetic Perception by Abraham Moles*, in: Leonardo, Vol. 1, No. 2., (April 1968), 205–206.
76 Abraham A. Moles, *Erstes Manifest der permutationellen Kunst*, gg. von Max Bense, Elisabeth Walther, reihe Rot, texte 8, Stuttgart 1962, 21.
77 Siehe Christoph Klütsch, Computergrafik. Computerkunst in den 60er Jahren. Ästhetische Experimente zwischen zwei Kulturen, Wien 2007.
78 Gordon Pask, „Matching Transducers for the Human Operator, Technical Notes compiled for Mr. Kennerly Edwards",wie Anm. 27, 1.

79 Gordon Pask, Briefentwurf, [o.J.] 1954/1955, Gordon-Pask-Archiv am Institut für Zeitgeschichte Wien, Box 4.43.2.
80 Gordon Pask, „*Musicolour*"; in: Good, Phantasie, wie Anm. 18, 134; in Österreich etablierten Otto und Oskar Beckmann mit dem von Ihnen gebauten Ateliercomputer (Konzeption 1968, Grundstufe 1970) ein auf Interaktion und Unbestimmbarkeit basierendes Kreativitätsmodell, das sich bewusst von der Konzeption Max Benses und den technischen Bedingungen der Digitalcomputer der Mainframe-Ära absetzte. Siehe: Margit Rosen, „Denken in funktionellen Verkettungen. Zum Werk von Otto Beckmann", in: Archiv Otto Beckmann, Otto Beckmann, Wien. Privatdruck, Juni 2006. 5-11 sowie Oskar Beckmann, „Frühe Beiträge zur Computerkunst von Prof. Otto Beckmann", 18–29.
81 Andrew Pickering, „Ontological Theater: Gordon Pask, Cybernetics and the Arts", Vortragsankündigung, 24.10.2005, **http://turing.ace.uci.edu/index.php/weblog/event_full/270** (14.05.2007).
82 Max Bense, *Die präzisen Vergnügen*, Wiesbaden 1964.
83 Vgl. Alan J. Mayne, „Learning and teaching machines and conversation theory", in: *Kybernetes. The International Journal of Systems & Cybernetics* 30 (2001), 762–768, 764.
84 Charles I. Foltz, *Lehrmaschinen. Geräte, Programme Anwendungsbereiche*, Weinheim 1965, 16f.
85 Vgl. Gordon Pask, „Automatic Teaching Techniques", in: *British Communications and Electronics* (April 1957), 210–211. und ders., *Approach*, wie Anm. 16 , 89.
86 Stafford Beer, „A filigree friendship", in: *Kybernetes. The International Journal of Systems & Cybernetics 30* (2001), 551–559, 552.
87 Gordon Pask, „Teaching Machines", in: *Proceedings*, wie Anm. 60, 962.
88 Gordon Pask, „Automatic Teaching Techniques", in: British, wie Anm. 85, 210.
89 Gordon Pask, „Saki: Twenty-Five years of development", in: *International Journal of Man-Machine Studies*, 17 (1982), 69–74, 69f .
90 Pask, *Approach*, wie Anm. 16, 69.
91 Stafford Beer, „A filigree friendship", in: *Kybernetes*, wie Anm. 86, 552.
92 Pask, *Approach*, wie Anm. 16, 93.

93 Gordon Pask, „Teaching Machines“, in: *Proceedings*, wie Anm. 60, 975.
94 Vgl. Jörg Pflüger, „Konversation, Manipulation, Delegation: Zur Ideengeschichte der Interaktivität“, in: Hans Dieter Hellige, Hg., *Geschichten der Informatik: Visionen, Paradigmen, Leitmotive*, Berlin und Heidelberg 2004, 367–408, 375.
95 Geert Keil, *Kritik des Naturalismus*, Berlin u. New York 1993, 134.
96 Gordon Pask, „Teaching Machines“, in: *Proceedings*, wie Anm. 60, 976.
97 Ebd., 968.
98 Stanley Mathews, „The *Fun Palace* as Virtual Architecture. Cedric Price and the Practices of Indeterminacy“, in: *Journal of Architectural Education* (2006), 39–48, 39.
99 Joan Littlewood, *Joan's Book. Joan Littlewood's peculiar history as she tells it*, London 1994, 704.
100 Ebd.
101 Camden Pilot Project Report, Manuskript, Januar 1965, 5, Gordon-Pask-Archiv am Institut für Zeitgeschichte Wien.
102 „Joan Littlewood presents the First Giant Space Mobile in the World it moves in light turns winter into summer ... toy ...“, Informationsbroschüre, [o. J.], (Juli 1964), Gordon-Pask-Archiv am Institut für Zeitgeschichte Wien.
103 *Fun Palace* Cybernetics Committee, meeting notes, *Fun Palace* document folio DR1995:0188:526, Cedric Price Archives, zit. nach Stanley Mathews, „The *Fun Palace* as Virtual Architecture“, in: *Journal*, wie Anm. 39, 44.
104 *Fun Palace* Project, *Cybernetics Committe, Introductory Document, Circulation List and Basic Plans*, Manuskript, 1, [o. J.], Cedric Price Archive, Canadian Centre for Architecture Montreal.
105 Ebd., 5
106 Vgl. Gordon Pask, „Man is a System that needs to learn“, in: Stewart, *Automaton*, siehe wie Anm. 4.
107 Vgl. hierzu Draft of *Fun Palace* Booklet (um 1964), hier zitiert nach Wiederabdruck in Stanley Mathews, *An Architecture for the New Britain: The Social Vision of Cedric Price's Fun Palace and Potteries Thinkbelt*, Diss., Columbia University, New York 2003, 459.

108 *Fun Palace Project, Cybernetics Committe, Introductory Document*, wie Anm. 104, 7.
109 Ebd., 8.
110 Gordon Pask, „Teaching Machines“, in: *Proceedings*, wie Anm. 60, 968.
111 Vgl. Enrique Rivera, Catalina Ossa, Cybersyn project, **http://www.cybersyn.cl/** (01.06.07).
112 Gordon Pask, „Teaching Machines“, in: *Proceedings*, wie Anm. 60, 968.
113 Joan Littlewood, Brief an Gordon Pask, 26. Februar 1964, beigelegter Text „Cybernetic Aspects“, Cedric Price Archives, Canadian Centre for Architecture Montreal.
114 Ebd.
115 *Fun Palace Project, Cybernetics Committe, Introductory Document*, wie Anm. 104, 1.
116 Gordon Pask, Theatre Workshop & System Research, Proposals for a Cybernetic Theatre, Manuskript, 1964, 21, Pask Archive at Pangaro Incorporated; Dank an Maria Fernandez, die 2006 eine Kopie des Manuskripts zur Verfügung stellte; zu Pask siehe auch Fernandez, „Gordon Pask: Cybernetic Polymath“, Vortrag gehalten im Rahmen der Konferenz refresh!, Banff New Media Institute, Kanada, PDF, Oktober 2005, www.banffcentre.ca/bnmi/programs/archives/2005/refresh/docs/conferences/Maria_Fernandez.pdf (14.02.06)
117 Ebd., 1.
Kinautomat, ein ‚interaktives Kino', dass der Tscheche Radúz Çinçera auf der Expo 1967 in Montreal einer größeren Öffentlichkeit vorstellte simulierte mit sehr viel einfacheren Mitteln eine große Wahlfreiheit im Hinblick auf die Kontrolle Filmverlaufs. Vgl. Rudolf Frieling, „Kinoautomat“, in: Medienkunstnetz, **http://www.medienkunstnetz.de/werke/kinoautomat/** (07.01.08).
118 Pask, *Proposals for a Cybernetic Theatre*, wie Anm. 116, 2.
119 Ebd. 6.
120 Ebd. 17, 29.
121 Ebd. 30.
122 Ebd. 26.

123 Gordon Pask und Heinz von Foerster, „A predictive model for self-organizing systems" (I) wie Anm. 29, 297.
124 Die Ausstellung, die im Zeitraum vom 2. August bis 20. Oktober 1968 stattfand, ist retrospektiv die spektakulärste Ausstellung kinetischer, kybernetischer und computergenerierter, wissenschaftlicher und künstlerischer Artefakte der 1960er Jahre.
125 Jasia Reichardt, *Project for an exhibition. Institute of Contemporary Arts, London*, [o. J.] (1966–1967), 1, Gordon-Pask-Archiv am Institut für Zeitgeschichte Wien.
126 Das Projekt wurde gesponsert von Maurice Hyams und Sampson Electronics.
127 Gordon Pask, „The Colloquy of Mobiles", Manuskript, [o. J.], (1967–1968), Gordon-Pask-Archiv am Institut für Zeitgeschichte Wien.
Pask und Yolanda Sonnabend stellten mit ihren Mobiles keine bewussten Bezüge zu Marcel Duchamps *Das Große Glas* (1915–1923) her. Yolanda Sonnabend war Duchamps Werk dabei durchaus bekannt, 1966 hatte die Londoner Tate eine Reproduktion von *Das Große Glas* präsentiert. Die sexuelle Allegorie von Pasks Mobiles hat in ihrer Bedeutung keine Ähnlichkeiten mit dem ewig unerfüllten Begehren der Protagonisten Duchamps; Korrespondenz mit Yolanda Sonnabend, 28. März 2007.
128 Die Fieberglaskörper wurden von Pip and Adele Youngman hergestellt; Korrespondenz mit Marc Dowson, 3. November 2005.
129 Marc Dowson, Kommunikation mit dem Autor, 3.11.2005.
130 Gordon Pask, „The Colloquy of Mobiles", in: Jasia Reichardt, Hg., *Cybernetic serendipity: the computer and the arts*, London 1968, 34f.
131 Gordon Pask „A Comment, a case history, a plan", in: Reichardt, *Cybernetics*, wie Anm. 15, 76.
132 Ebd., 77.
133 Ebd.
134 Ebd., 77.
135 Pask, Microman, s. Anm. 132, 79.
136 Mark Dowson, Korrespondenz, 3. November 2005.

137 Alexander Zivanovic, „SAM, The Senster and The Bandit: Early Cybernetic Sculptures by Edward Ihnatowicz", Vortrag gehalten im Rahmen der Konverenz Robotics, Mechatronics and Animatronics in the Creative and Entertainment Industries and Arts, AISB 2005 Convention, Hatfield, UK, April 13, 2005, **http://www.aisb.org.uk/publications/proceedings/aisb05/4_CreatRob_Final.pdf** (05.01.08), ohne Seitenzahlen.
138 Ranulph Glanville, „Gordon Pask", **http://www.isss.org/lumPask.htm** (05.01.08.).
139 W. Grey Walter, *Das lebende Gehirn, Entwicklung und Funktion*, Köln, Berlin 1961, 127. [Originalausgabe: ders., *The Living Brain,* London 1953]
140 Ebd. 145.
141 Pask, *Microman*, wie Anm. 132, 79.
142 Vgl. Kat. *Participation. À la recherche d'un nouveau spectateur. Groupe de recherche d'art visuel*, Museum am Ostwall, Dortmund, 11.2.–31.3.1968.
143 Vgl. Claus Pias, „Zombies of the Revolution", Vortrag gehalten im Rahmen der Konverenz refresh!, Banff New Media Institute, Kanada, PDF, Oktober 2005, **www.banffcentre.ca/bnmi/programs/archives/2005/refresh/docs/conferences/Claus_Pias.pdf** (14.02.06)
144 Vgl. Giulio Carlo Argan, „Arte Come Ricerca", in Kat. *Nova Tendencija 3* (internationale Ausgabe), Zagreb 1965, 19–22.
145 Vgl. Abraham Moles, *Théorie de l'information et Perception esthétique*, Paris 1958; Max Bense, *Aesthetica*, Baden-Baden 1965.
146 Vgl. Jack Burnham, „Systems Esthetics", in: *Artforum*, 9, September (1968), 30–35.
147 Gordon Pask, „The architectural relevance of Cybernetics", in: Architectural Design, September (1969), 494–496, 496.
148 Max Bense, *Technische Existenz*, Stuttgart 1949.
149 Pontus Hultén, *The Machine as Seen at the End of the Mechanical Age*, New York 1968, 13.
150 Gordon Pask, „Viewpoint for Control", Manuskript, Gordon-Pask-Archiv am Institut für Zeitgeschichte Wien, Box 11.13.
151 Anders, *Die Antiquiertheit*, wie Anm. 1, 33.