Travelling Time

SONIC ACTS XIV

Travelling Time
Sonic Acts XIV

Edited by Arie Altena & Sonic Acts
Sonic Acts Press, Amsterdam
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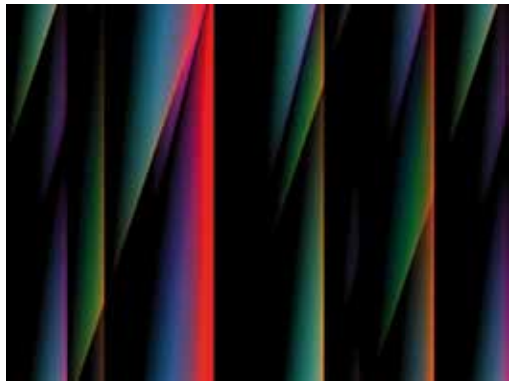
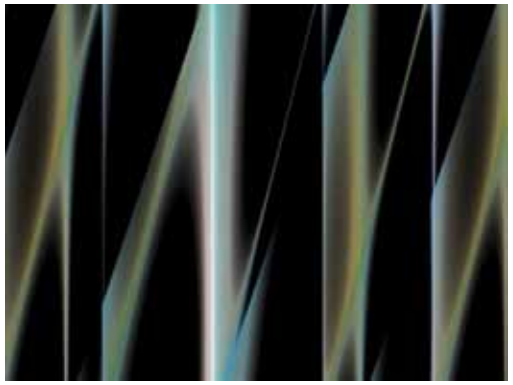
Julien Maire, *Perpendicular Cinema*, 2011.

Rod Maclachlan, *Megascope Projection,* 2011.





Bart Vegter, stills from *De Tijd*, 2008.

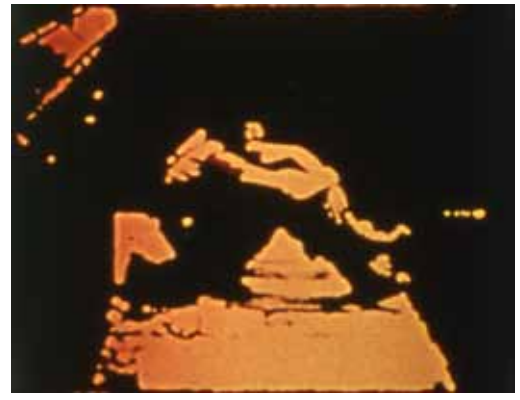
Philipp Lachenmann, *Space_Surrogate II (GSG9)*, 2000.

Mark Fell, *Factoid #3*, 2011.

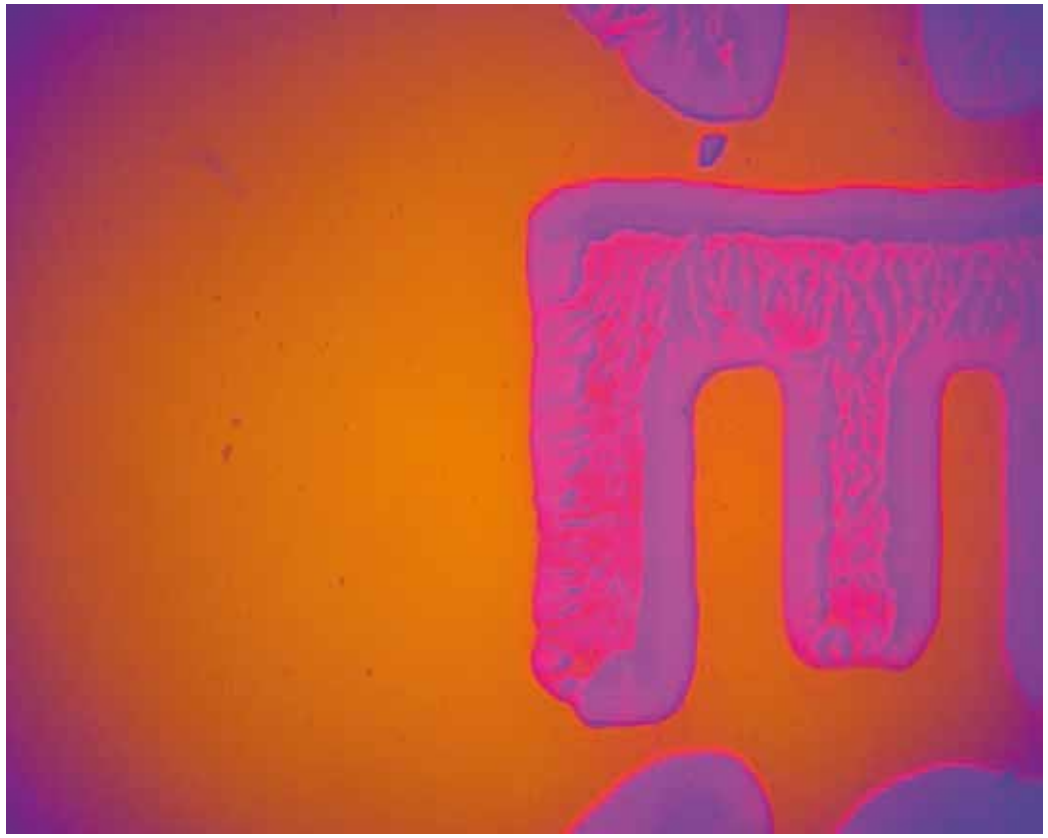
Daïchi Saïto, *Never a Foot Too Far, Even*, 2011.

Bronze set-bells (biānzhōng 編鐘) of the 5th century, unearthed in 1978 from the tomb of Marquis Yǐ 乙 of the Zēng 曾 State located at the present Suí 隨 County, Húbi 湖北 Province. The largest bell weighs 203.6 kg with a height of 153.4 cm and the smallest weighs 2.4 kg with a height of 20.4 cm.

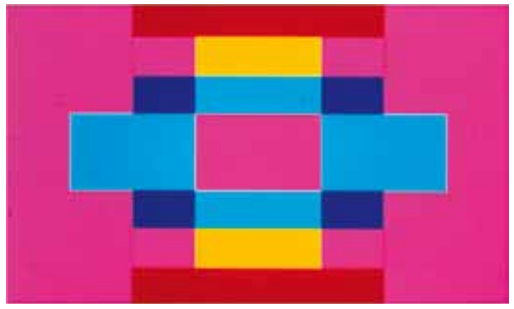
Robert Breer, still from *Blazes*, 1961.

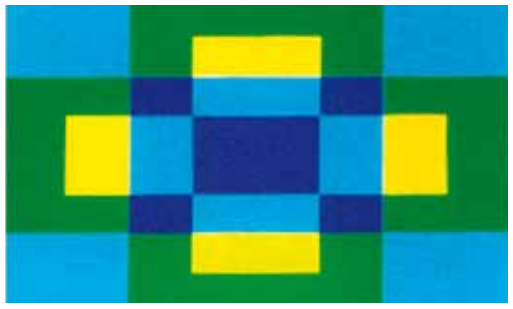


JJ Murphy, *Print Generation*, 1973–74.

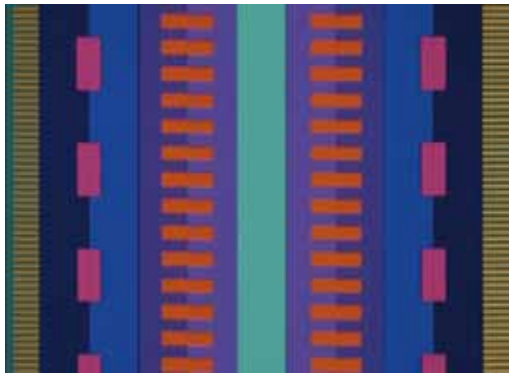


Ian Helliwell, *Letratone Leader*, 2009.

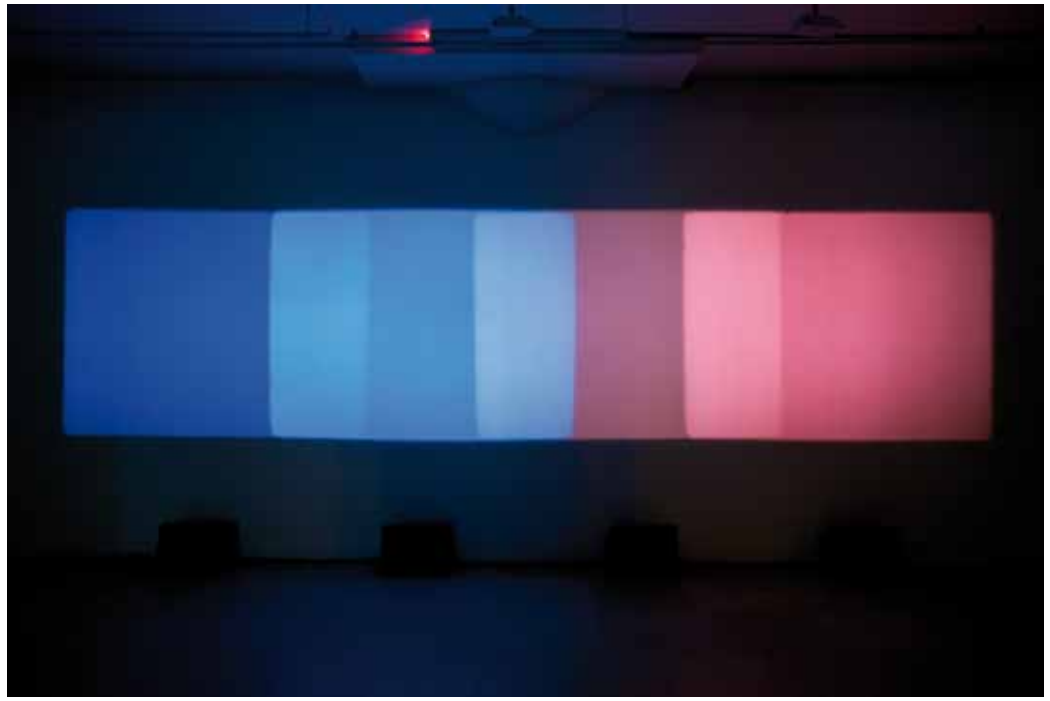




René Jodoin, *Rectangle and Rectangles*, 1984.



Norman Mclaren, *Synchromy*, 1971.



Paul Sharits, *Shutter Interface*, 1975.

Ryohei Shimada, *Garden*, Japan, 2010.

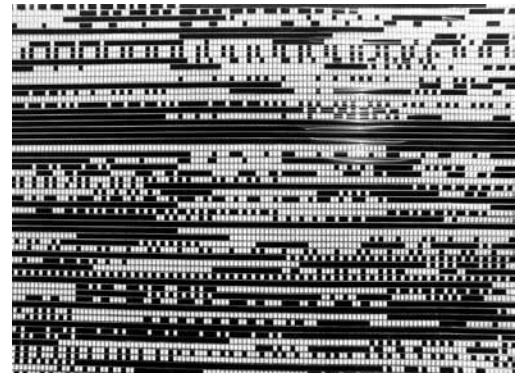
Barbara Hammer, still from *Bent Time*, 1983.

Ellen Fullman, *Long String Instrument*, Other Minds Festival, San Francisco, 2002.

Ellen Fullman, *Long String Instrument*, Headlands Center for the Arts.

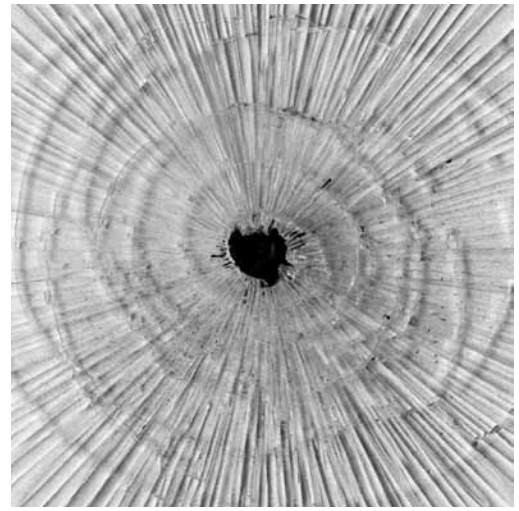
Eleh, *Circles.*

CC Hennix, *Aum.*



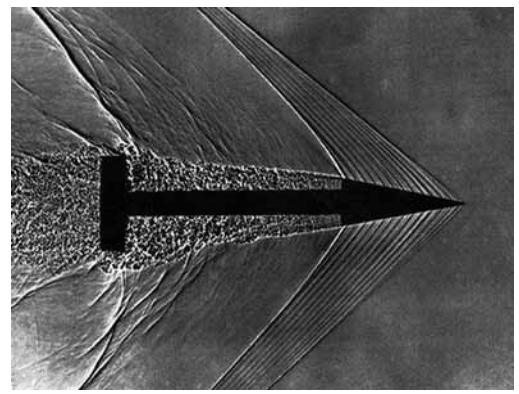
Installation of **Peter Kubelka**'s film *Arnulf Rainer* on a white wall.

Peter Kubelka installs his film *Arnulf Rainer* on a wall.



Emptyset, cover *Demiurge.*

Pauline Oliveros.



Roly Porter, *Aftertime.*

Introduction

An Ode to the Experience of Time

This book is an accompaniment to Sonic Acts XIV, a four-day festival of concerts, performances, lectures, presentations and exhibitions, taking place from 23–26 February 2012 in Amsterdam. *Travelling Time* explores a number of radical ideas relating to time. We usually conceive of time as something that passes, with the future being in front us, the past behind us, and the clock as a device for measuring time. But is there an absolute time, or is time always relative to motion? Relativity theorists and quantum mechanics have tinkered with the concept of time since the beginning of the previous century. And in September 2011 the global press announced that scientists had apparently made a neutrino travel faster than light – a revolutionary breakthrough. In July that same year it had already been reported that scientist had discovered a way to conceal events in time by creating an information gap in a beam of light. What do we know about time? Time is a highly complex and ambiguous concept that refuses simple conceptualisations. Yet we also have an intimate knowledge of time – as becomes clear in music making.

Travelling Time is based on the idea that music and the other arts enable us to investigate the nature of time and make the concept of time tangible. The arts are instruments that can change, manipulate, or intensify our experience of time. *Travelling Time* starts with the premise that ongoing technological developments constantly challenge, change and undermine our perception of time. Consider, for example, the fact that communication networks operate at light speed, or that computers process data in real time without human mediation. This has lead to mind-boggling financial shenanigans, and the idea that our society is increasingly ruled by algorithms that know no time. Rapid advances in technology have created a growing gap between 'machine time' and 'human time'. As George Dyson notes in his book *Turing's Cathedra*l: 'Time in the digital universe and time in our universe are governed by entirely different clocks. In our universe, time is a continuum. In a digital universe, time is a countable number of discrete, sequential steps.'

Travelling Time is a quest to reveal some of the significance and the intricacies of time and how we experience it. We can only scratch the surface by presenting a few perspectives on the experience of time,

and on the Deep Time of culture from a limited number of fields – notably contemporary music, and the history of technology. What these suggest is that our concepts and encounters with time are difficult to put in words, but we intuit a lot about time in non-verbal ways. This book is, in that sense, a homage to the human experience of time. One half of this anthology consists of articles dealing with conceptions and imaginings of time in the fields of technology, culture and literature. The other half consists of interviews with composers and performing musicians.

A short – but richly illustrated – excerpt from George Dyson's forthcoming study of the origins of the digital universe, *Turing's Cathedral* opens this anthology.

Siegfried Zielinski probes the Deep Time of media in his 'Minimal Encyclopaedia of Sound Apparatuses and Automata'. This account, which features Athanasius Kircher and Arabic inventors like Ibn al-Razzaz al-Jazari, can also be read as an assessment of the long and deep history of generative music.

This theme returns in the essay by Thomas Patteson about the composer Roland Kayn and his ideas relating to cybernetic music.

Usually the history of technology is seen as a progression of inventions, each one newer than its predecessor. David Edgerton – author of *The Shock of the Old* (2006) – argues in his essay that the history of technology should be seen in more complex ways.

Hillel Schwartz's essay is an exploration of noise and time in the twentieth century: 'When sounds run out of time, they end up as noise'.

In his long essay on *James Joyce's Ulysses*, Enda Duffy shows how this novel conveys a shift in a view of life in which notions of electricity and energy become central, and change the human relationship to lived time. According to Duffy, Joyce's work is a thorough analysis of the effects of the new technological era, presenting an aesthetics of adrenaline and the modernist regime of time.

An excerpt from a longer essay by Timothy Druckrey elaborates on how new technologies of the moving image have imposed new time regimes.

Time travel used to be one of the mainstays of science fiction. The essay by Omar Muñoz-Cremers treats the history and intricacies of this topic, how it became popular, and why its popularity declined. We have added to it a short excerpt from Alfred Jarry's instructions on how to build a time machine. The literary imagination of time travel is further illustrated by an index to time in Thomas Pynchon's *Against the Day* (2006) which is scattered throughout the book.

The interviews and conversations with musicians and composers are grouped in the middle, they are embraced by the essays, and form the heart of the book. There are interviews with: Joel Ryan, Mark Fell, Pauline Oliveros, Catherine Christer Hennix (& Bill Dietz), Robin Hayward, Hilary Jeffery, Keith Fullerton Whitman, and Gilles Aubry. They have an intimate knowledge of working with time, and though the interviews treat many subjects, they do touch on time, time after time – sometimes implicitly, sometimes explicitly. Together these eight interviews also present an intriguing, critical and exciting overview of contemporary music, with many detailed insights into the aesthetic positions of these boundary-breaking musicians and composers.

In making a book like this – working with texts from different backgrounds and with different approaches – it is always a pleasure to see how it comes together in the end: not as a rounded whole, but as a complex mix with unforeseen cross-references as well as many gaps to be filled by future research. That there would be many connections between the interviews was to be expected, as most interviews were conducted in the period leading up to the festival. The hidden affinities between the interviews and the articles were something we hoped for, but sometimes they came as a surprise. Part of the joy of reading this book lies in finding those relations, being inspired and acquiring knowledge for subsequent explorations of trajectories not followed here but alluded to: open roads to a future, to new imaginings (or old imaginings made new) of experiencing time – through art, music, sound, image…

Sonic Acts / Arie Altena

Reading Through *Against the Day*
Arie Altena

It was the connection between mathematics and time that led me back to Thomas Pynchon. Googling the subject of time I was repeatedly referred to the theory of quantum gravity, but the search engine also kept displaying links to the nineteenth-century Irish mathematician Sir William Rowan Hamilton (1805–65), especially his paper 'Algebra Considered as the Science of Pure Time', or, more correctly 'Theory of Conjugate Functions, or Algebraic Couples; with a Preliminary and Elementary Essay on Algebra as the Science of Pure Time'.[1]

Sir William Rowan Hamilton is the inventor of quaternions. It's a famous anecdote from the history of mathematics:

> Hamilton was looking for ways of extending complex numbers (which can be viewed as points on a 2-dimensional plane) to higher spatial dimensions. He failed to find a useful 3-dimensional system, but in working with four dimensions he created quaternions. According to Hamilton, on 16 October 1843 he was out walking along the Royal Canal in Dublin with his wife when the solution in the form of the equation $i^2 = j^2 = k^2 = ijk = -1$ suddenly occurred to him; Hamilton promptly carved this equation using his penknife into the side of the nearby Broom Bridge, for fear he would forget it.[2]

Quaternions – I knew the term from Thomas Pynchon's novel *Against the Day* (2006), which is also where I had previously read about Hamilton. Among the many subjects *Against the Day* (2006) deals with are the developments in mathematics and physics around 1900, just before Einstein's Special Theory of Relativity and the first formulations of quantum mechanics that would revolutionise our ideas of time and space. *Against the Day* anticipates these developments by referring to the struggle between the new mathematical theory of quaternions and the equally new theory of vector analysis at the end of the nineteenth century. The famous Michelson-Morley experiment from 1887 also features in the book – this was the experiment that should have proven the existence of the ether as the medium through which light travels. It failed to do so. Instead it became one of the strongest proofs against the existence of ether, and provided evidence that Einstein's Special Theory of Relativity was correct.

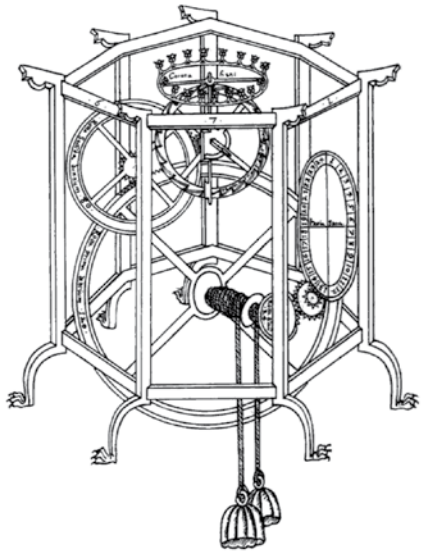
Against the Day elaborates in the form of a novel on some of the implications for the conception of time, space and light that the scientific developments around the turn of the century seemed to entail, and which people at the time were beginning to phantasise about. It was the period when H.G. Wells' novel, *The Time Machine* (1895), became immensely popular. All of this is related in a characteristic Pynchonian way with an eternally youthful crew of the sometimes invisible airship, Inconvenience (the Chums of Chance), a 'subdesertine frigate' for voyaging beneath desert sand, a cast of cowboys, criminal capitalists, mad inventors, shamans, clairvoyants, terrorists, beautiful women, drug abusers, and many clichés and stock figures from popular literature.

In his review 'Do the Math, Thomas Pynchon Returns', which was published in *The New Yorker* on 27 November 2006, the literary critic Louis Menand stated:

> I think that the idea behind *Against the Day* is something like this: An enormous technological leap occurred in the decades around 1900. This advance was fired by some mixed-up combination of abstract mathematical speculation, capitalist greed, global geopolitical power struggle, and sheer mysticism. We know (roughly) how it all turned out, but if we had been living in those years it would have been impossible to sort out the fantastical possibilities from the plausible ones. Maybe we could split time and be in two places at once, or travel backward and forward at will, or maintain parallel lives in parallel universes. It turns out (so far) that we can't. But we did split the atom – an achievement that must once have seemed equally far-fetched. *Against the Da*y is a kind of inventory of the possibilities inherent in a particular moment in the history of the imagination.[3]

As a way of 'Travelling Time', an index to the subject 'time' in Thomas Pynchon's *Against the Day* is spread throughout this book.[4]

1. Sir William Rowan Hamilton, 'Theory of Conjugate Functions, or Algebraic Couples; with a Preliminary and Elementary Essay on Algebra as the Science of Pure Time', in *Transactions of the Royal Irish Academy*, vol. 17, part 1 (1837), pp. 293–422.
2. Quoted from http://en.wikipedia.org/wiki/William_Rowan_Hamilton (accessed 31 December 2011).
3. Louis Menand: 'Do the Math, Thomas Pynchon Returns', in *The New Yorker*, 27 November 2006.
4. The indispensable PynchonWiki at http://pynchonwiki.com of course provided a first start for an index on 'time'. I checked all the entries and added to it.



Drawing of the bottom section of Giovanni de Dondi's **astronomical clock**, the *Astrarium*, Padua, Italy, 1461. This is a modern tracing of an illustration in a 1461 manuscript at Oxford University (MS Laud. Misc. 620 Folio 10). It is almost certainly originally from Giovanni de Dondi's 1364 treatise on his clock, *Tractatus Astrarii*, 14th century.

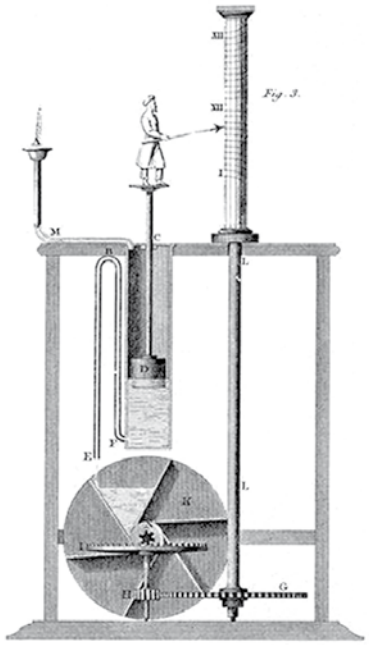
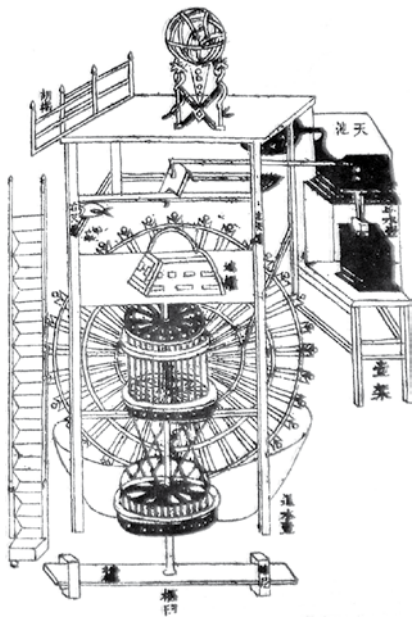
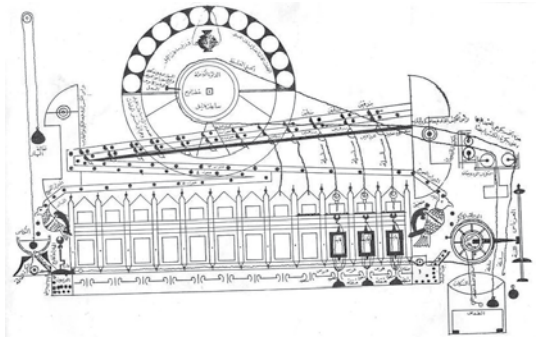


Diagram of a fancy **clepsydra**. Illustration by John Farey Jr. from Abraham Rees, *Cyclopædia: or, a New Universal Dictionary of Arts and Sciences*, 1819. Water enters and raises the figure, which points at the current hour for the day.



Chinese mechanical and horological engineering from the Song Dynasty, from Su Song's book Xin Yi Xiang Fa Yao, 1092. Reproduction from Joseph Needham, *Science and Civilization in China: Volume 4, Part 2, Mechanical Engineering*, 1965, p. 451.

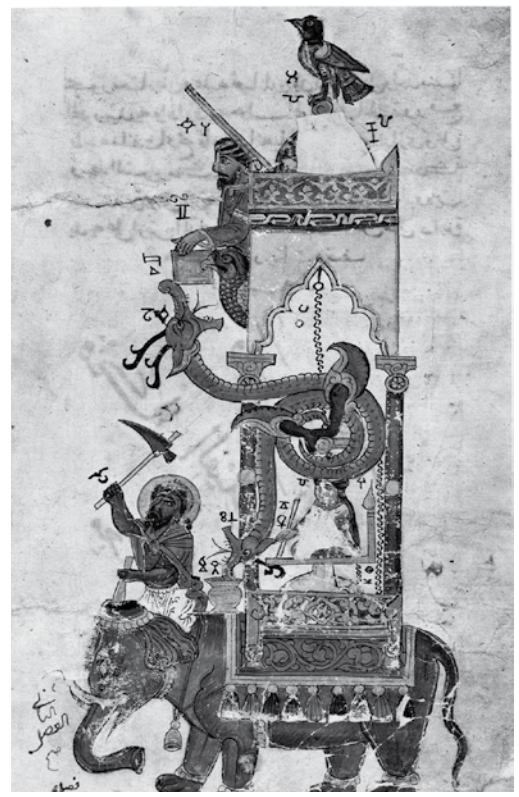


Facsimile of a **drawing of a water clock** from a treatise by Ridhwan al-Saati, from 1203.

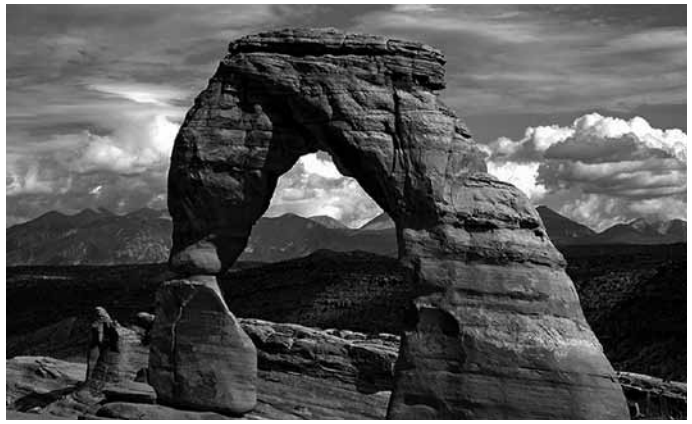
The miniature represents Richard of Wallingford, Abbot of St Albans. He is pointing to a clock, referring to his gift to the abbey. From Thomas Walsingham, *Golden Book of St Albans*.

Clock of al-Jazari, before 1206, from al-Jazari's *Al-Jami Bain Al-Ilm Wal-Amal Al Nafi fi sina'at Al-Hiyal.*

A candle clock from a copy of al-Jazari's treatise on automata, *Kitab fi ma'ari-fat al-hiyal al-handasiya*, Syria, 1315, dated Ramadan 715.



Elephant clock. Drawing from a transcript of the manuscript by al-Jazari, ca. 1200.











Natural arches, tent rocks and fairy chimneys represent the passing of time in nature.

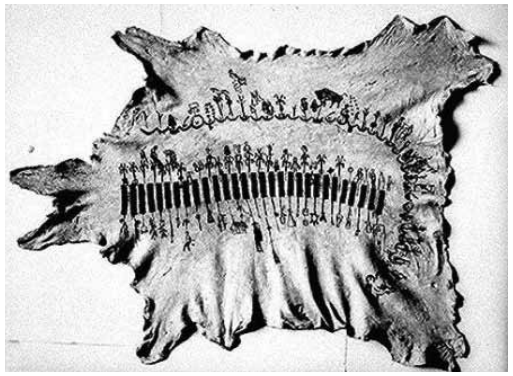






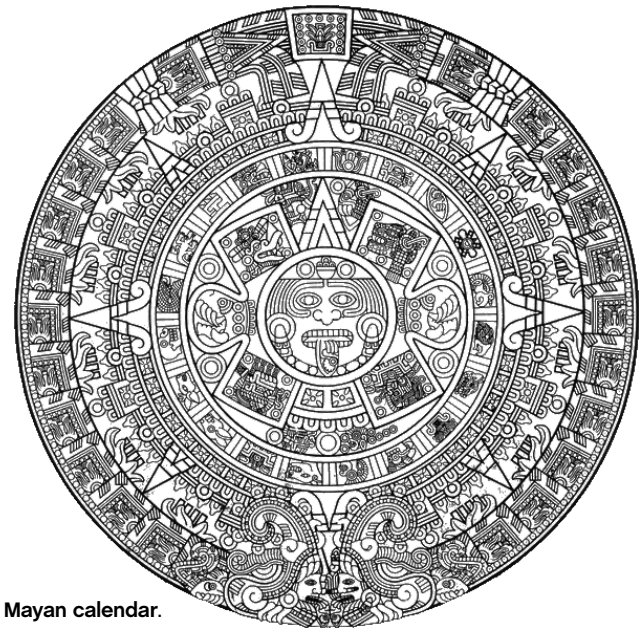



Calendar after Johannes von Gmunden, woodcut, 15th century.

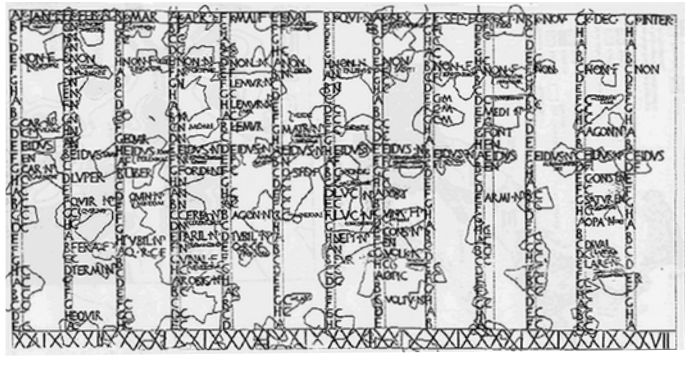


37-month calendar, 1889–92, kept on a skin by Anko, a Kiowa man, American Indian, ca. 1895.

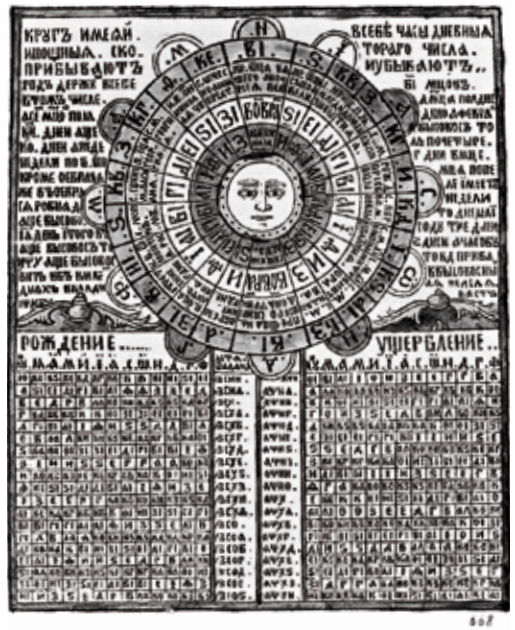
Fabric Hindu calendar/almanac corresponding to the Western years 1871–72, Rajastan, India, 1871.



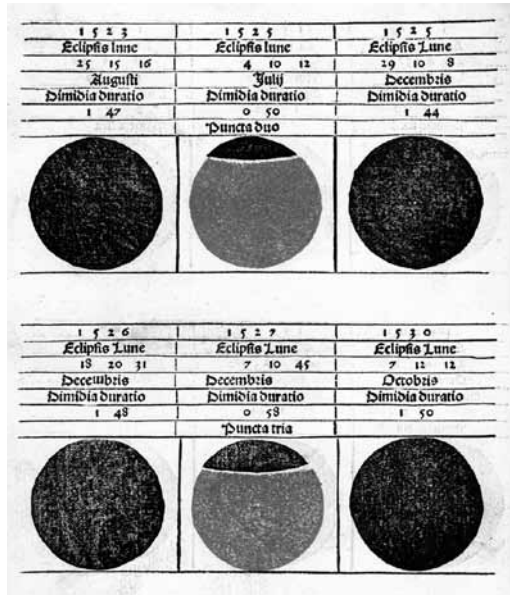
Mayan calendar.



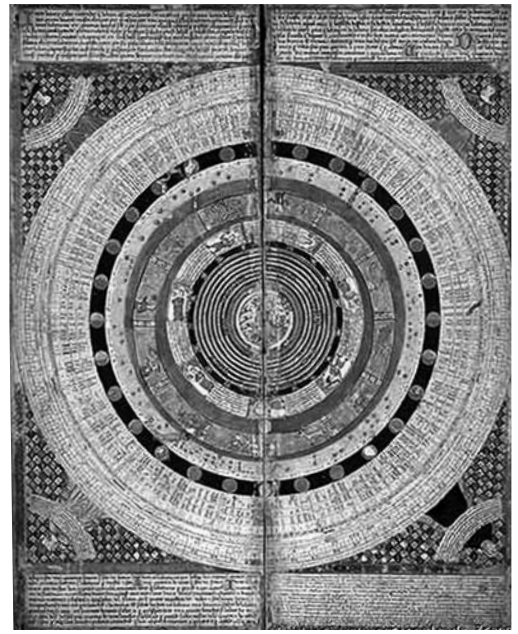
Fasti Antiates Maiores, miniature black and white image of a fragmentary fresco of a pre-Julian Roman calendar, 84–55 BC.



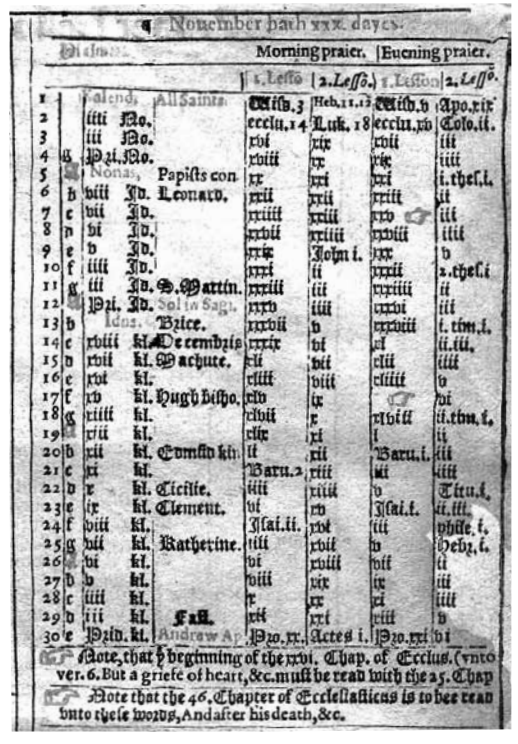
Lubok calendar of moon phases, Russia, 17th century.



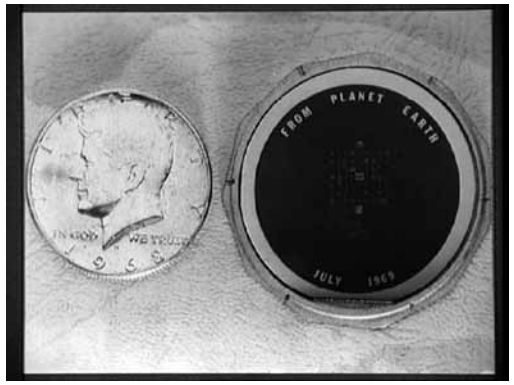
Sheet from the **calendar of Johannes Regiomontanus**, Augsburg, Erhard Ratdolt, 1499.



Cosmographical diagram, perpetual calendar, *The Catalan Atlas*, Majorca, Spain, 1375.



Church calendar for the month of November, *Book of Common Prayer*, printed by Robert Barker, London, 1614.

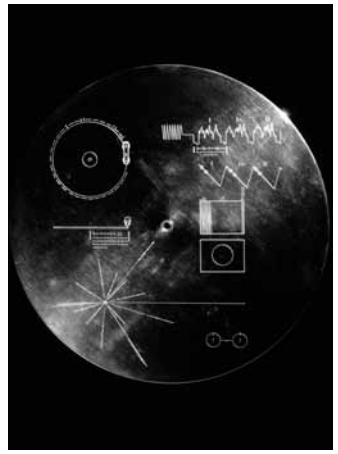


The one and one-half inch silicon disc which was left on the moon by the Apollo 11 astronauts, NASA, 14 July 1969.

EXPO70 Time Capsule in Osaka Castle, 1970.

Time capsule at Griffith observatory, 16 June 2011.

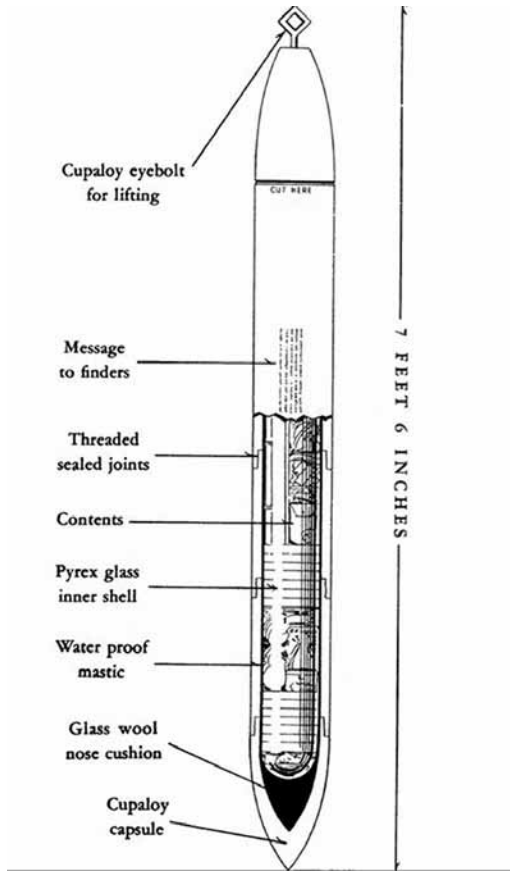
The Helium Monument Time Capsule in Amarillo, Texas, US. It was constructed in the late 1960s.



Voyager Golden Record, 4 September 1977.

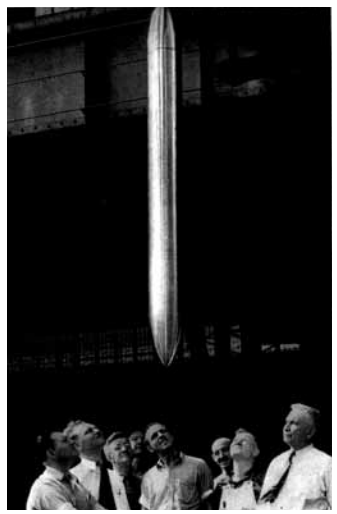
Old City Cemetery time capsule, Sacramento, CA.

Marker of **Westinghouse Time Capsule**.

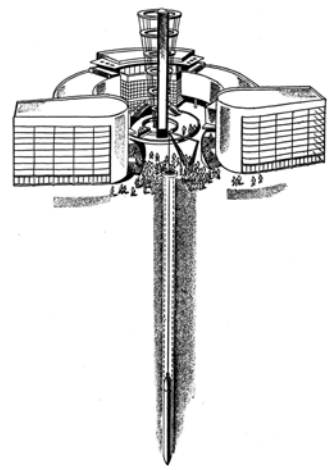


Time Capsule Cupaloy from New York World's Fair, from *The Book of Record of the Time Capsule of Cupaloy, 1938.*

Westinghouse exhibit, 1964/65 New York World's Fair.



Scan of the frontispiece from *The Book of Record of the Time Capsule of Cupaloy*, 1938. The caption reads 'The Envelope For A Message To The Future Begins Its Epic Journey'.



Sketch of the Westinghouse 1939 exhibit with Time Capsule burying place, from Westinghouse Electric and Manufacturing Company, *The Book of Record of the Time Capsule of Cupaloy*, 1938.

Time Capsule II from New York World's Fair, 1965.

Point Source Solution

George Dyson

I am thinking about something much more important than bombs. I am thinking about computers.
—John von Neumann, 1946

There are two kinds of creation myths: those where life arises out of the mud, and those where life falls from the sky. In this creation myth, computers arose from the mud, and code fell from the sky.

In late 1945, at the Institute for Advanced Study in Princeton, New Jersey, Hungarian American mathematician John von Neumann gathered a small group of engineers to begin designing, building, and programming an electronic digital computer, with five kilobytes of storage, whose attention could be switched in 24 microseconds from one memory location to the next. The entire digital universe can be traced directly to this 32-by-32-by-40-bit nucleus: less memory than is allocated to displaying a single icon on a computer screen today.

Von Neumann's project was the physical realisation of Alan Turing's Universal Machine, a theoretical construct invented in 1936. It was not the first computer. It was not even the second or third computer. It was, however, among the first computers to make full use of a high-speed random-access storage matrix, and became the machine whose coding was most widely replicated and whose logical architecture was most widely reproduced. The stored-program computer, as conceived by Alan Turing and delivered by John von Neumann, broke the distinction between numbers that *mean* things and numbers that *do* things. Our universe would never be the same.

Working outside the bounds of industry, breaking the rules of academia, and relying largely on the US government for support, a dozen engineers in their twenties and thirties designed and built von Neumann's computer for less than $1 million in under five years. 'He was in the right place at the right time with the right connections with the right idea', remembers Willis Ware, fourth to be hired to join the engineering team, 'setting aside the hassle that will probably never be resolved as to whose ideas they really were'.

As World War II drew to a close, the scientists who had built the atomic bomb at Los Alamos wondered, 'What's next?' Some, including Richard Feynman, vowed

the labyrinth of Time 33;

never to have anything to do with nuclear weapons or military secrecy again. Others, including Edward Teller and John von Neumann, were eager to develop more advanced nuclear weapons, especially the 'Super', or hydrogen bomb. Just before dawn on the morning of July 16, 1945, the New Mexico desert was illuminated by an explosion 'brighter than a thousand suns.' Eight and a half years later, an explosion one thousand times more powerful illuminated the skies over Bikini Atoll. The race to build the hydrogen bomb was accelerated by von Neumann's desire to build a computer, and the push to build von Neumann's computer was accelerated by the race to build a hydrogen bomb.

Computers were essential to the initiation of nuclear explosions, and to understanding what happens next. In 'Point Source Solution', a 1947 Los Alamos report on the shock waves produced by nuclear explosions, von Neumann explained that 'for very violent explosions… it may be justified to treat the original, central, high pressure area as a point.' This approximated the physical reality of a nuclear explosion closely enough to enable some of the first useful predictions of weapons effects.

Numerical simulation of chain reactions within computers initiated a chain reaction among computers, with machines and codes proliferating as explosively as the phenomena they were designed to help us understand. It is no coincidence that the most destructive and the most constructive of human inventions appeared at exactly the same time. Only the collective intelligence of computers could save us from the destructive powers of the weapons they had allowed us to invent.

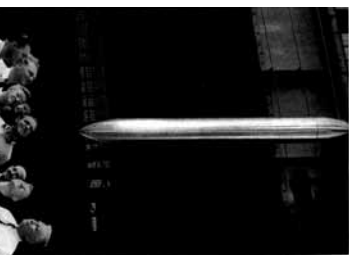
Turing's model of universal computation was one-dimensional: a string of symbols encoded on a tape. Von Neumann's implementation of Turing's model was two-dimensional: the address matrix underlying all computers in use today. The landscape is now three-dimensional, yet the entire Internet can still be viewed as a common tape shared by a multitude of Turing's Universal Machines.

Where does time fit in? Time in the digital universe and time in our universe are governed by entirely different clocks. In our universe, time is a continuum. In a digital universe, time (T) is a countable number of discrete, sequential steps. A digital universe is bounded at the

beginning, when T = 0, and at the end, if T comes to a stop. Even in a perfectly deterministic universe, there is no consistent method to predict the ending in advance. To an observer in our universe, the digital universe appears to be speeding up. To an observer in the digital universe, our universe appears to be slowing down.

Universal codes and universal machines, introduced by Alan Turing in his 'On Computable Numbers, with an Application to the Entscheidungsproblem' of 1936, have prospered to such an extent that Turing's underlying interest in the 'decision problem' is easily overlooked. In answering the *Entscheidungsproblem*, Turing proved that there is no systematic way to tell, by looking at a code, what that code will do. That's what makes the digital universe so interesting, and that's what brings us here.

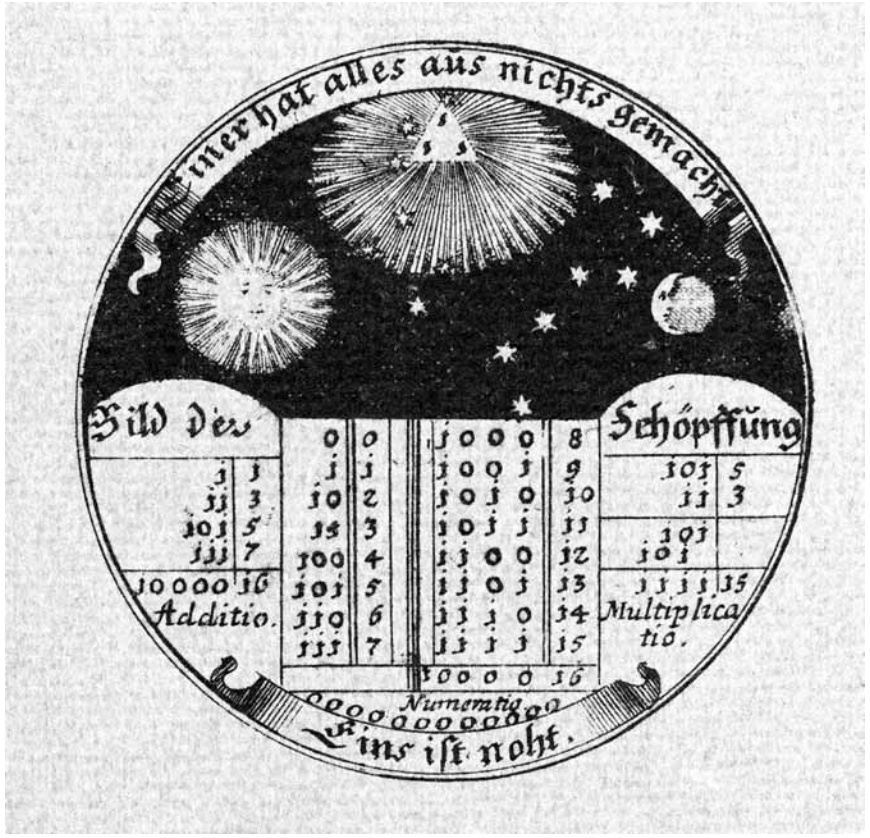
It is impossible to predict where the digital universe is going, but it is possible to understand how it began. The origin of the first fully electronic random-access storage matrix, and the propagation of the codes that it engendered, is as close to a point source as any approximation can get.



time is intrinsic
in every recipe
111;

Where does time fit in? Time in the digital universe and time in our universe are governed by entirely different clocks. In our universe, time is a continuum. In a digital universe, time (T) is a countable number of discrete, sequential steps.

All images from George Dyson's *Turing's Cathedral*. With kind permission of the author.



Leibniz's digital universe. Design for a silver medallion, presented by Gottfried Wilhelm Leibniz to Rudolph August, Duke of Brunswick, 2 January 1697, demonstrating 'the creation of all things out of nothing through God's omnipotence' by means of binary arithmetic. From a reproduction in Erich Hochstetter and Hermann-Josef Greve, eds., *Herrn von Leibniz' Rechnung mit Null und Einz* (Berlin: Siemens Aktiengesellschaft, 1966).

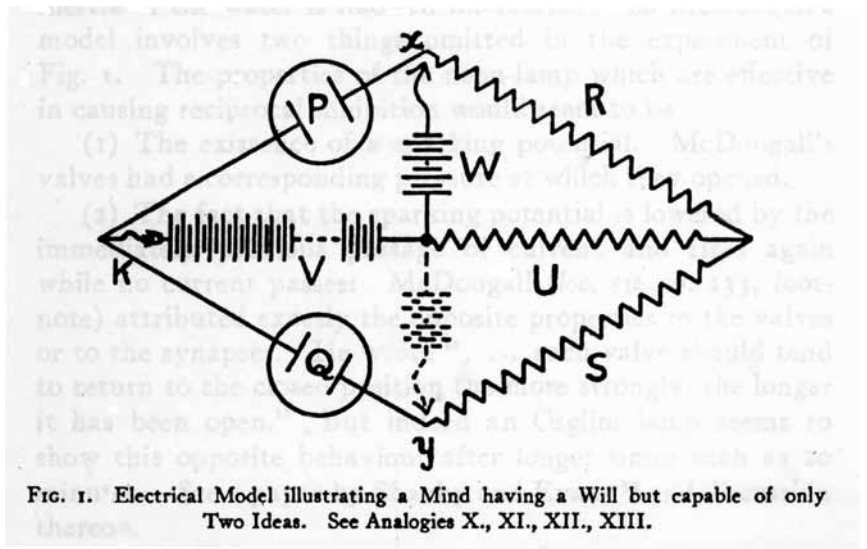
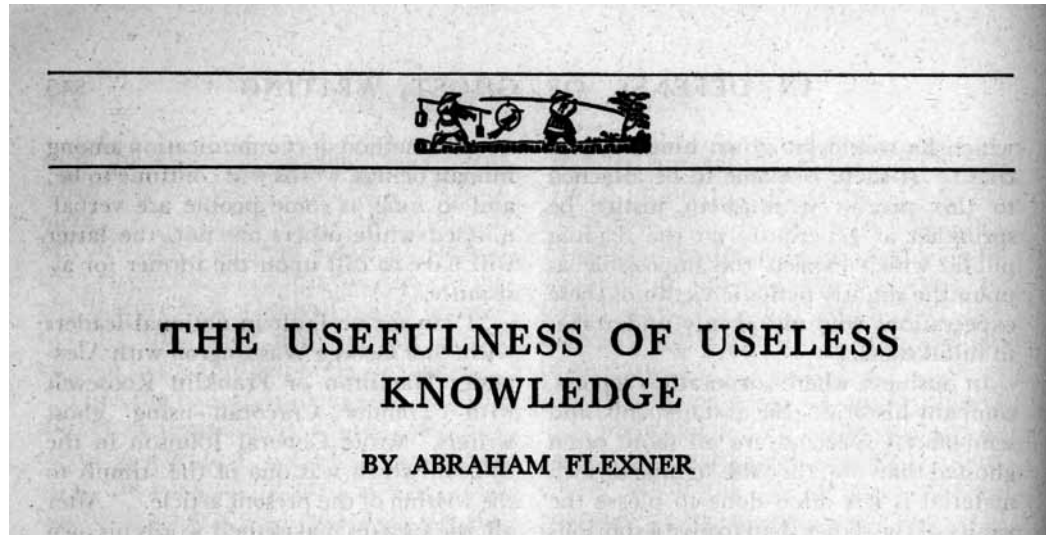


FIG. 1. Electrical Model illustrating a Mind having a Will but capable of only Two Ideas. See Analogies X., XI., XII., XIII.

In 1930, Lewis Fry Richardson raised the possibility, later taken up by Alan Turing, that random electronic indeterminacy could be amplified into creative thinking and even free will. From Lewis Fry Richardson, 'The Analogy Between Mental Images and Sparks', in *Psychological Review*, vol. 37, no. 3 (May 1930) p. 222.

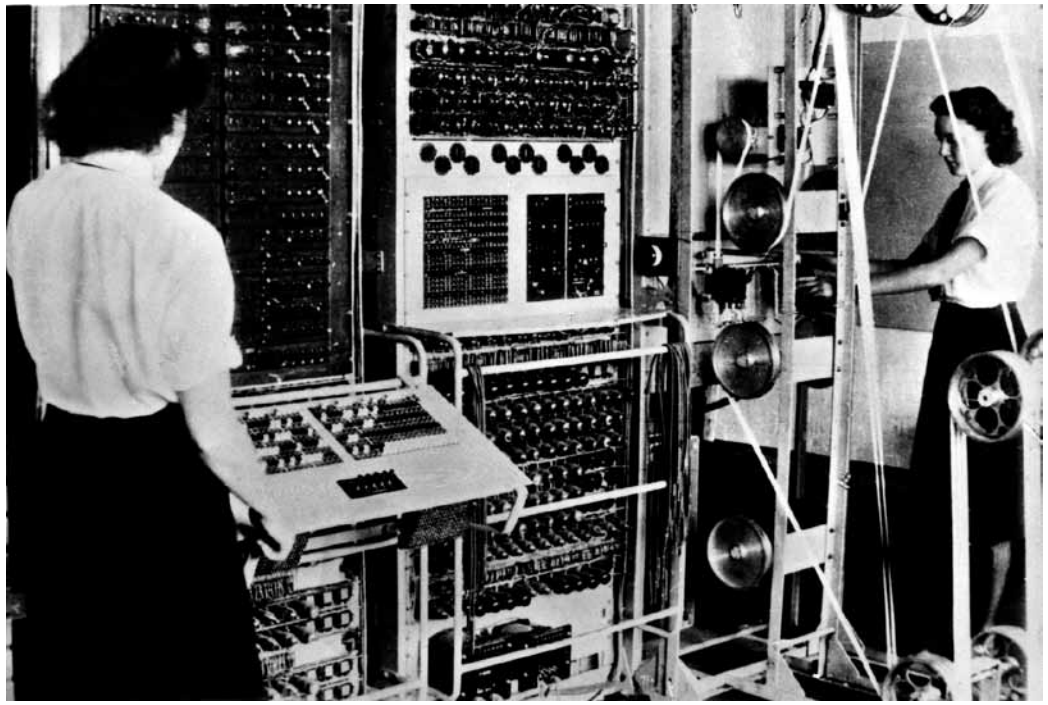


THE USEFULNESS OF USELESS KNOWLEDGE

BY ABRAHAM FLEXNER

On the eve of war in Europe, in October 1939, Abraham Flexner announced in *Harper's Magazine* that, 'among the most striking and immediate consequences of foreign intolerance I may, I think, fairly cite the rapid development of the Institute for Advanced Study ... a paradise for scholars who, like poets and musicians, have won the right to do as they please.' From *Harper's Magazine*, Issue 179, June–November 1939, p. 544.

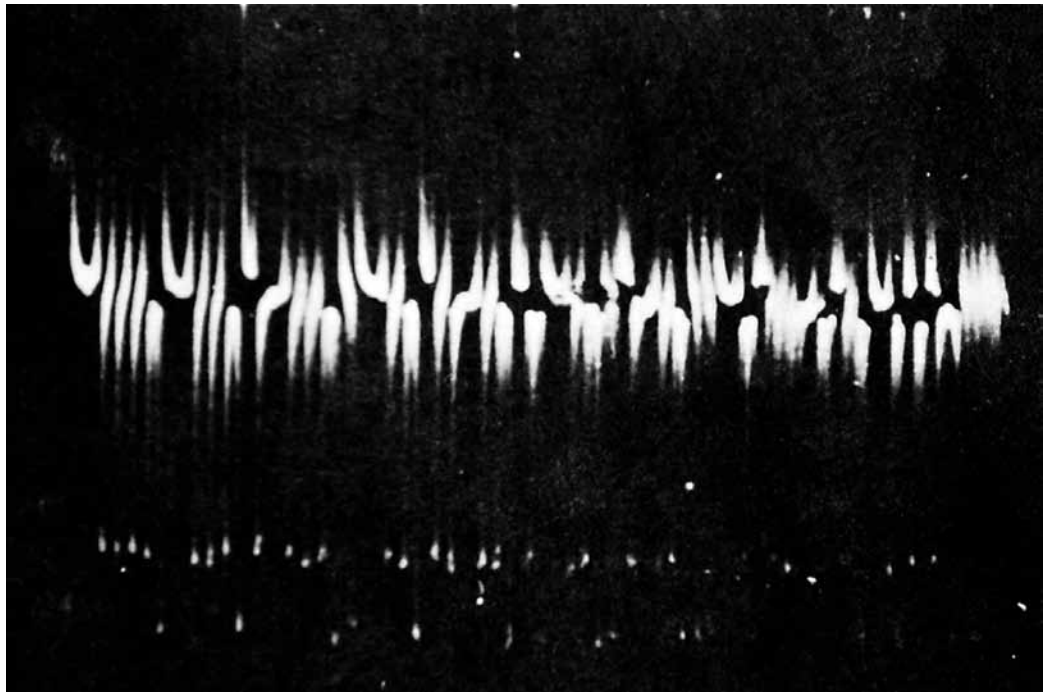
IAS School of Mathematics, meeting in Fuld Hall, 1940s. Left to right: James Alexander, Marston Morse, Albert Einstein, Frank Aydelotte, Hermann Weyl, and Oswald Veblen (dressed, as usual, for the woods). Von Neumann was likely absent due to wartime consulting work.



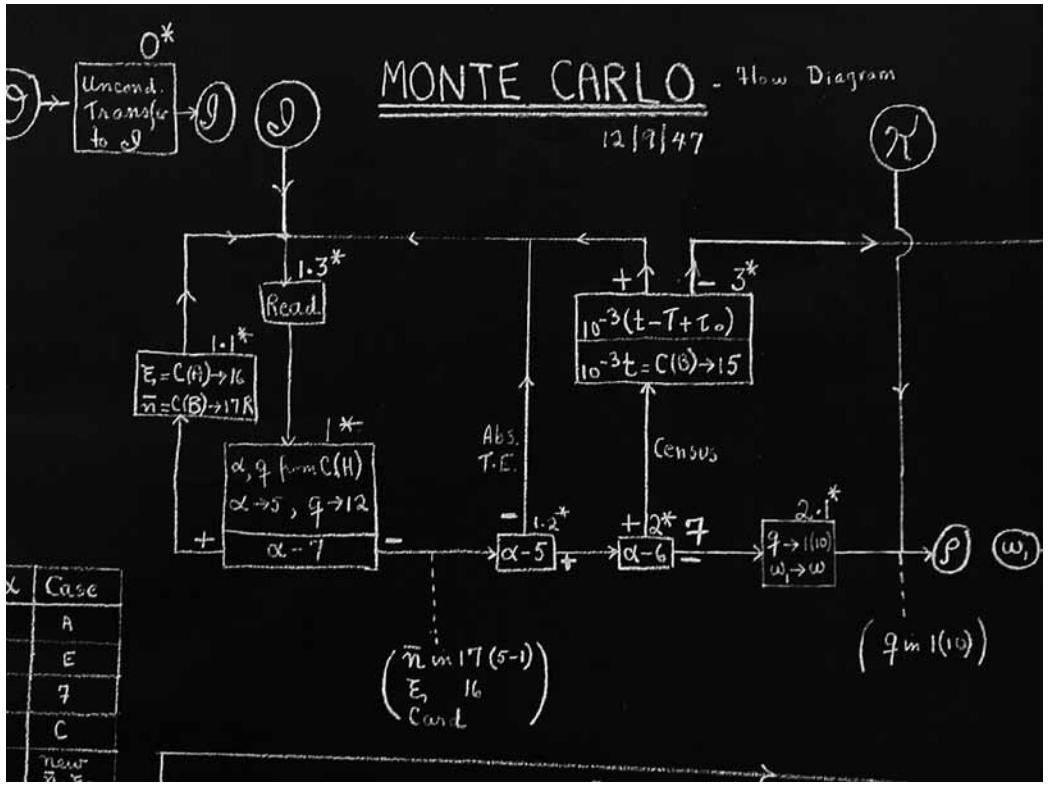
Colossus at Bletchley Park in 1943. To help decipher digitally encrypted enemy telecommunications during World War II, British cryptanalysts built a series of versatile, if not yet universal, logical computing machines.

The US Army's ENIAC (Electronic and Numerical Integrator and Computer) was publicly unveiled at the Moore School, University of Pennsylvania, on 16 February 1946.

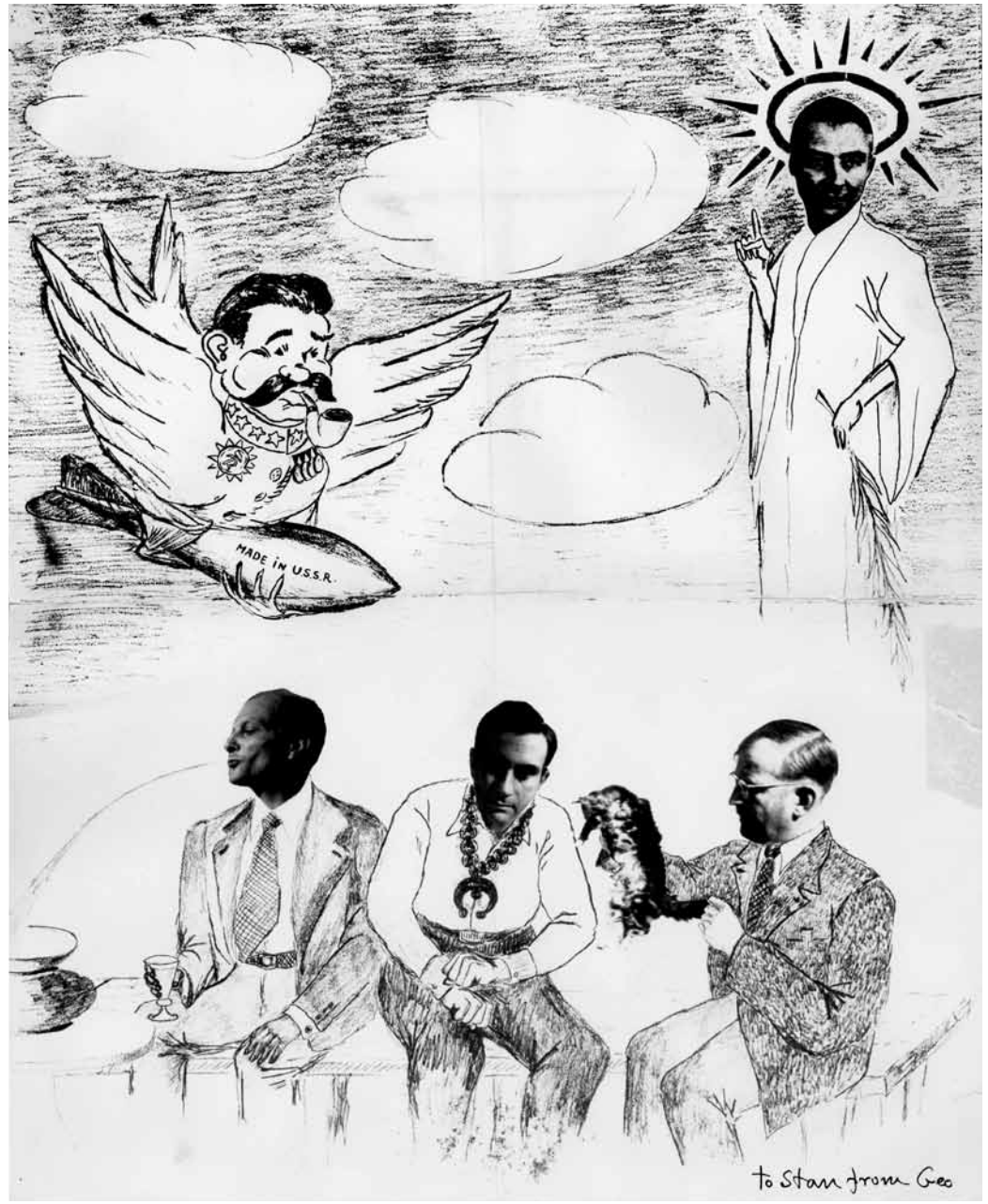
Trinity nuclear test (20 kilotons) at the Alamogordo Bombing Range, White Sands Proving Ground, New Mexico, 12 seconds after detonation at 5:29 am, 16 July 1945.



Oscillogram of 40-bit word produced directly from magnetic recording wire, 1947.



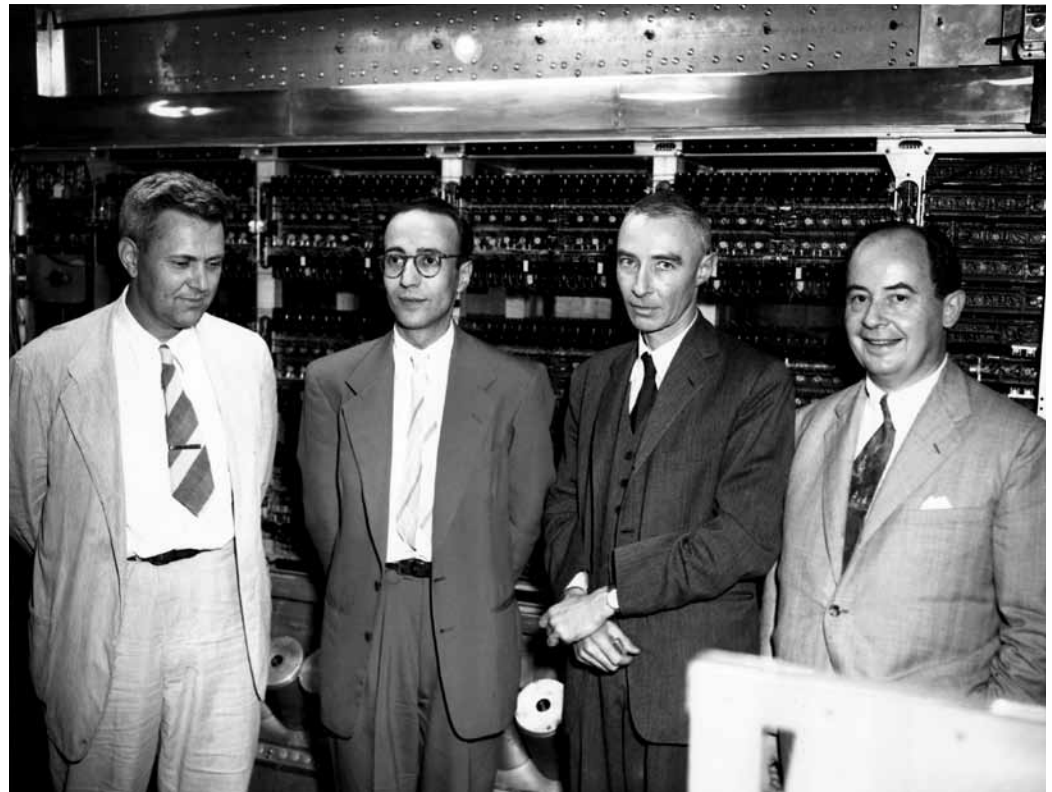
Flow diagram, 9 December 1947, for a Monte Carlo problem being coded, with Klári von Neumann's assistance, as part of a hand-computed rehearsal conducted at Los Alamos in advance of running the problem on the ENIAC.



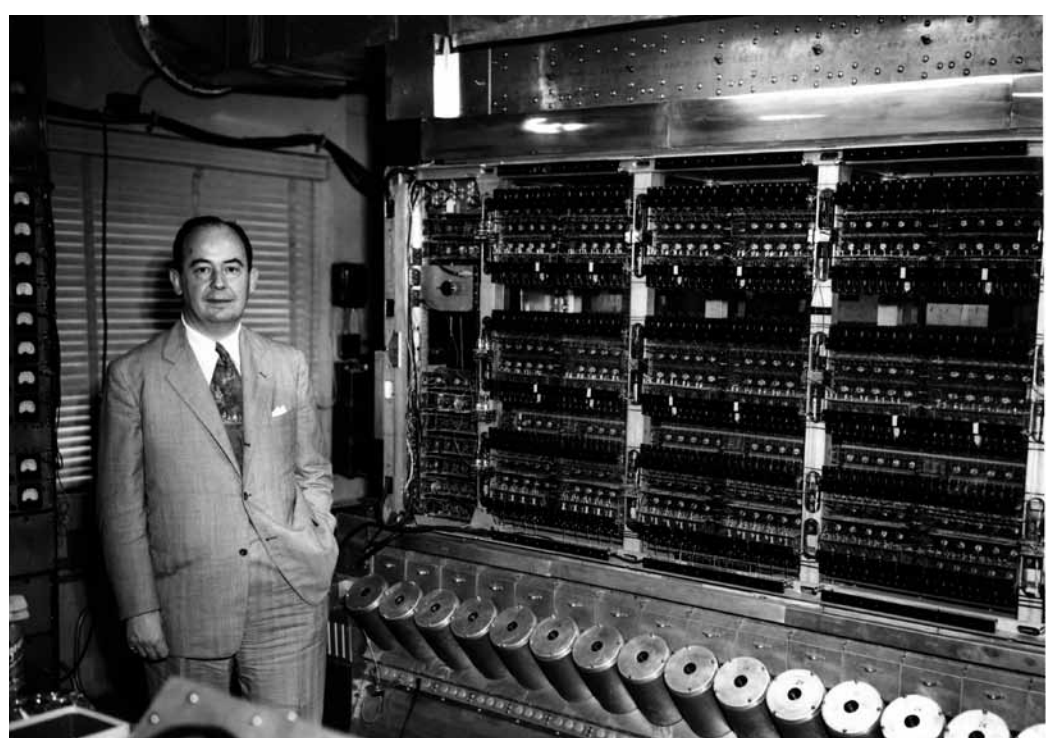
Actors in the Hydrogen Bomb drama, ca. 1950: Joseph Stalin (with 'Made in U.S.S.R.' Bomb), J. Robert Oppenheimer (as an Angel), Stanislaw Ulam (with spittoon), Edward Teller (centre); George Gamow (with cat). Montage by George Gamow.

The RCA Selectron, or Selective Electrostatic Storage Tube, invented by Jan Rajchman, promised an all-digital 4096-bit electrostatic storage matrix in a single vacuum tube. The applications included numerical weather prediction, as portrayed in this advertisement in the February 1950 issue of *National Geographic*.

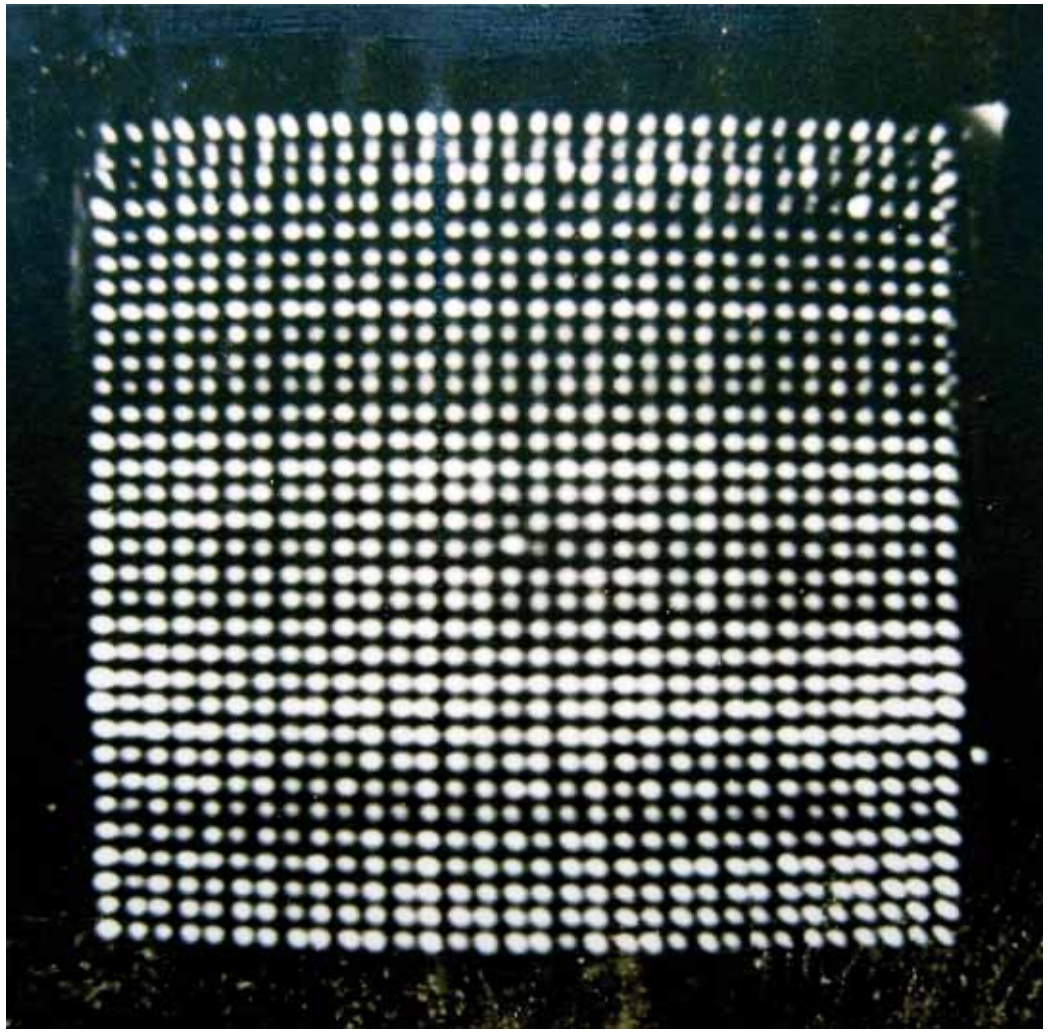
Alan Turing (standing) with Brian Pollard (left) and Keith Lonsdale (right) seated at the console of the Ferranti Mark 1 computer at the University of Manchester in 1951. The Ferranti Mark 1, with 256 40-bit words (1 kilobyte) of cathode-ray tube memory and a 16,000-word magnetic drum, was the first commercially available implementation of Turing's Universal Machine.



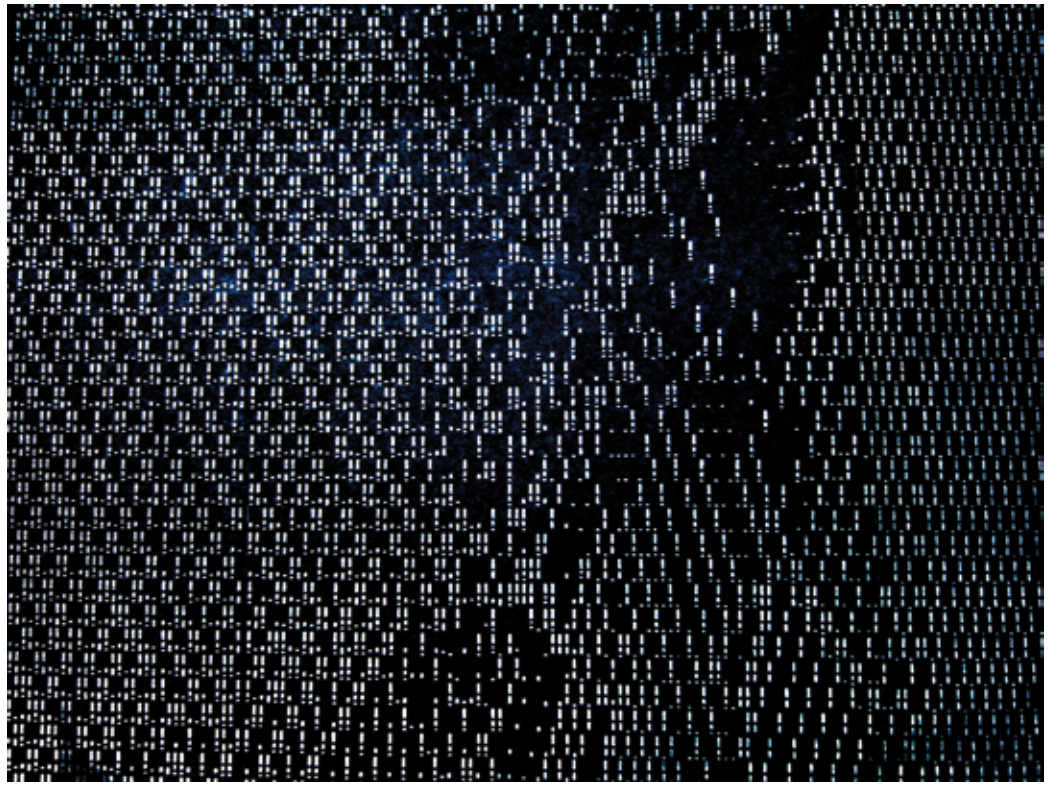
Julian Bigelow, Herman Goldstine, J. Robert Oppenheimer, and John von Neumann, at the public dedication of the IAS computer, 10 June 1952.



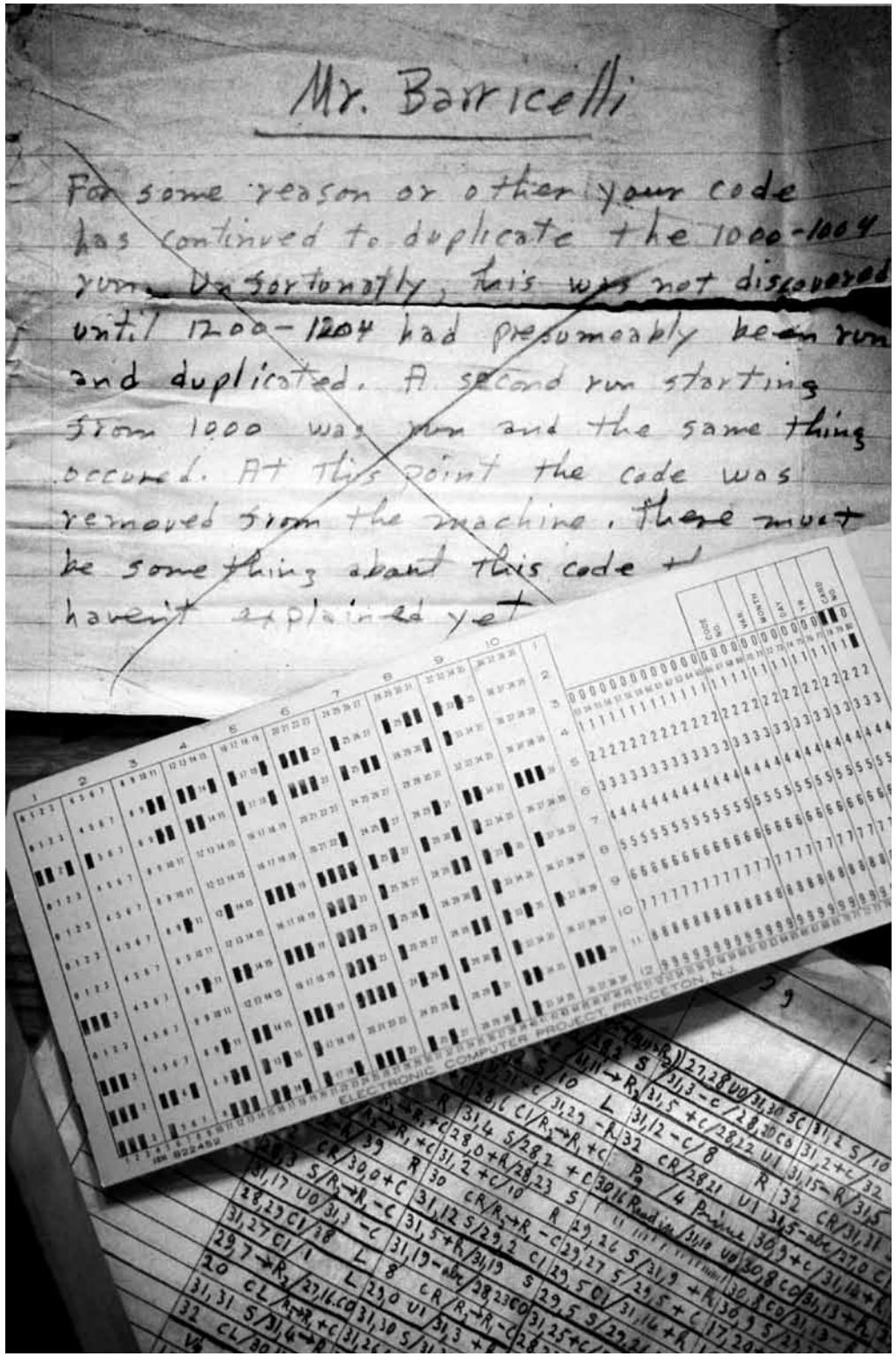
John von Neumann and the MANIAC in 1952.



The digital universe in 1953. A 32-by-32 array of charged spots – serving as working memory, not display – is visible on the face of a Williams cathode-ray storage tube (stage 36) in this diagnostic photograph from the maintenance logs of the Institute for Advanced Study Electronic Computer Project, 11 February 1953.



Barricelli's Universe, 1953. Five out of every 100 generations of numerical symbioorganisms sampled and the data transferred to punched cards, assembled into an array, and contact-printed onto blueprint paper, leaving the imprint visible here.



Relics discovered in the basement of the West Building, Institute for Advanced Study, November 2000. Below: source code for 'Barricelli's Drum Code'. Centre: output card, from one of the periodic samplings of 'numerical symbioorganisms' as they evolved. Above: Note to Mr Barricelli, concluding, 'There must be something about this code that you haven't explained yet'.

Stellar Evolution	10^{17}	Lifetime of the Sun (10^{10} years)
	10^{16}	
	10^{15}	
	10^{14}	
	10^{13}	1 Million Years
	10^{12}	
Biological Evolution	10^{11}	
	10^{10}	
	10^{9}	Human Lifespan (90 Years)
	10^{8}	
	10^{7}	
	10^{6}	
Meteorology	10^{5}	
	10^{4}	8 Hours
	10^{3}	
	10^{2}	
	10^{1}	
	10^{0}	
Shock Waves	10^{-1}	Blink of an Eye (.3 seconds)
	10^{-2}	
	10^{-3}	
	10^{-4}	
	10^{-5}	Williams Tube memory access time
Nuclear Explosions	10^{-6}	
	10^{-7}	
	10^{-8}	Lifetime of a Neutron in a nuclear explosion

Five main problems (left) addressed by the IAS Electronic Computer Project, 1946–58, with time scale in seconds (centre) and representative phenomena (right) for comparison. The human attention span falls exactly in the middle of this range of 26 orders of magnitude in time.

The Time of Roland Kayn's Cybernetic Music

Thomas W. Patteson

The year 1968 looms large in the social and political history of the twentieth century. Two symbolically significant events of that year suggest that 1968 was a nodal point in the aesthetic development of Western modernity as well. In November 1968, the Museum of Modern Art in New York presented an exhibition entitled *The Machine as Seen at the End of the Mechanical Age*.[1] As the name suggests, this was a pointedly retrospective view of the machine as a theme in the visual arts. Around the same time, the Institute for Contemporary Art in London presented a multimedia extravaganza called *Cybernetic Serendipity*, which featured an array of experimental ventures into a new aesthetic field informed by the then-cutting edge disciplines of information theory and cybernetics.[2] Between them, these two cultural phenomena signalled a shift in the techno-aesthetic order of the twentieth century. The machine, as the quintessential symbol of the technological order, gave way, both in the organisation of society and in the popular imagination, to the more abstract, conceptual, and relational field of computers, electronics, and communications networks.

The music of Roland Kayn (1933–2011) is among the most powerful and enigmatic products of what could be called the 'cybernetic moment' in twentieth-century culture. Kayn's unique and idiosyncratic approach to the problem of composition in the electronic medium represents a radical reconception of the creative role of technology and the limits of musical perception. What Kayn called 'cybernetic music' is a phenomenon of acute interest for the history of electronic music and has enduring relevance for contemporary artistic production. This brief essay is intended to outline the historical and intellectual conditions of Kayn's work, the nature of his compositional method, and the aesthetic categories that might inform the sympathetic reception of his music, with an emphasis on the peculiar sense of temporality manifested in his works. Because of the relatively few accessible sources of information on Kayn's work, this is by necessity a provisional study; may it help to inspire more foundational work on Kayn and his milieu.[3]

1. See Karl Gunnar Pontus Hulten, ed., *The Machine as Seen at the End of the Mechanical Age* (New York: Museum of Modern Art, 1968).
2. See Jasia Reichardt, ed., *Cybernetic Serendipity: The Computer and the Arts* (London: Studio International, 1968).

Colonize time. Why not? 131;

The cybernetic music project received its initial impulse in 1953, when Kayn, a young musician and university student, came into contact with the philosopher Max Bense, a professor at the Technical University in Stuttgart. Inspired by the seminal writings of Norbert Wiener, Bense became among the first to channel the primarily Anglophone disciplines of cybernetics and information theory into the intellectual bloodstream of the European continent. Bense was also among the first thinkers to extend cybernetic concepts to art and aesthetics. In addition to publishing a series of books entitled *Aesthetica* (1954–60), he was active as a curator of exhibitions of computer art and concrete poetry, and he became the guru of the 'Stuttgart School', an informal group of artists working in various media who shared a vision of a new, rationalised form of artistic expression made possible by 'systems thinking' and computer technology.[4] Kayn spent three years in the Bense circle and was deeply influenced by his teacher's project of fusing cybernetic and aesthetic concepts. He later recounted, 'At that time Bense's approach was an important point of departure, because with his method of analysis, whether one was an architect or a composer, one gained the ability to approach the creative engagement with the material in an objective way'.[5]

Bense believed that cybernetic notions of information and entropy could be normatively applied to the production of aesthetic products, what he called 'the programming of beauty'. He distinguished between two aspects of aesthetic work: the first is what he called 'analytical aesthetics', in which 'aesthetic information [is] described in abstract (mathematical) terms'. Bense called the second phase 'generative aesthetics', in deliberate (if imprecise) analogy to the 'generative grammar' developed contemporaneously by Noam Chomsky.[6] This, strictly speaking a *poetics* or technique of artistic creation, Bense defines as 'the artificial production of probabilities of innovation or

3. In addition to the sources cited throughout this essay, the reader is referred to the following article by Kayn: 'Komponieren zwischen Computer und Kybernetik', in *Melos / Neue Zeitschrift für Musik 3* (1977), pp. 22–27.
4. Elisabeth Walther, 'Max Bense und die Kybernetik', http://www.stuttgarter-schule.de/bensekybernetik.htm (accessed 19 April 2010).
5. Roland Kayn, liner notes, *Tektra*, Colosseum LP COL 1479.
6. Max Bense, 'Projekte generativer Ästhetik', in *Aesthetica: Einführung in die neue Aesthetik*, 2nd edition (Baden-Baden: Agis Verlag, 1982), p. 333.

deviation from the norm'. Through these methods, Bense believed that 'the improbability of aesthetic states can be produced mechanically through a methodical combination of planning and chance. In this way the demand that aesthetic objects have to satisfy – namely, to be unpredictable – is precisely combined with their planned construction'.[7]

In this idea of planned unpredictability we find the first crucial influence on Kayn's developing vision of cybernetic music. In the decade following the time spent with Max Bense, Kayn traversed the extremes of avant-garde musical production, from the rigorous order of serialism to the anarchic play of free improvisation. Soon after his first meeting with Bense, Kayn came into contact with Herbert Eimert at the Studio for Electronic Music of the NWDR (Northwest German Radio) in Cologne. Kayn was fascinated by the sonic potential afforded by the new technologies, but he found the studio's dominant serialist aesthetic too restrictive. He visited other studios in the following years, but was consistently frustrated by the technological limitations he encountered, and was unable to realise any completed works. For the next ten years, Kayn focused primarily on instrumental composition. In Berlin in the late 1950s he studied with Boris Blacher, whose mathematical approach Kayn credited with pushing him toward 'statistical composition'. Several of Kayn's works for piano, chamber ensemble, and orchestra would be premiered in Darmstadt in the coming years. Although he would continue to write for conventional instrumental ensembles, Kayn's focus was shifting elsewhere.

In 1964, Kayn became one of the initial members of the Gruppo di Improvvisazone Nuova Consonanza, a Rome-based collective of composer–musicians dedicated to improvisatory performance inspired by free jazz, aleatoric music, and extended instrumental technique. Nuova Consonanza was founded by the Italian composer Franco Evangelisti, who envisioned collaborative improvisation as an escape from the dead end in which the classical tradition found itself. Kayn's membership in the group signalled his

7. Bense, p. 337. The best English-language introduction to the potential musical applications of Bense's aesthetics is found in M. J. Grant, *Serial Music, Serial Aesthetics: Compositional Theory in Post-War Europe* (Cambridge: Cambridge University Press, 2001), pp. 146–49. Grant highlights the connection between information theory and serialism, but makes no mention of Roland Kayn.

at right angles to the flow of time 132;

growing dissatisfaction with the avant-garde 'composed music' scene. It also allowed for a deeper engagement with the question of how to implement cybernetic methods in music. The concept was certainly in the air at the time: Evangelisti even used the term 'cybernetic' to describe the dynamics of listening and reaction between the members in live performance. But Kayn became frustrated with the group's lack of a 'theoretical foundation', which led to its members falling back on musical clichés. He left the group in 1968 and later attributed his departure to his inability to introduce cybernetic methods into the group's improvisatory framework.[8]

Kayn's disillusioned departure from Nuova Consonanza was the passage from an earlier, exploratory phase of his career into the mature period in which his long-germinating notions of cybernetic music finally took shape. For Kayn, cybernetic music was nothing less than a new stage in the development of electroacoustic art. He presented the history of the medium in five distinct phases, beginning in the early twentieth century and culminating with his own contribution circa 1970:

– **Electro-instrumental music** Extension and multiplication of the natural instrumental sounds by means of electro-acoustic aggregates. Incorporation of new instrumental techniques of playing and articulation.
– **Concrete music** Studio processing of existing sounds and noises, also of instrumental and vocal origin.
– **Electronic music** Electro-acoustic sound synthesis, obtained from electronic oscillation elements. Discovery of new connections between material, time, structure, space.
– **Computer music** Automation, chance, program. Logical and mathematical operations.
– **Cybernetic music** Process planning, feedback loops, control processes. Suspension of the opposition of automatic ('dead') and anthropoetic ('living') systems.[9]

8. Roland Kayn, liner notes, *Infra*, Colosseum LP SM 1478.
9. Roland Kayn, liner notes, *Simultan*, Colosseum LP SM 1473.

By the late 1960s, of course, the first three of these phases were already historical. Ironically, given the strong association between cybernetics and the computer, Kayn defined cybernetic music primarily in opposition to computer music. Although computer-programmed processes allowed for a more precise control of sound events, this way of working was still based on the straightforward execution of directives, with the human performer more or less replaced by the computer. For Kayn, computer music represented nothing more than an extension of the essentially deterministic approach embodied in the classical electronic studio:

> There is still no computer music capable of achieving the high degree of artistic quality ultimately demanded of it, as existing programming languages are still too limited in their capacity to simultaneously synthesize the large numbers of individual operations implicit in the underlying 'aesthetic program'. […] Although it is the general aim of the composer to operate the computer in keeping with his own objectives, this situation is influenced by a feedback effect, i.e., a subliminal tendency on the part of the operator to think in mechanical terms. The tension between these two processes creates problems of the relationship between technology and creativity, which can only be solved by a systematic evaluation of aesthetic categories.[10]

Kayn's characterisation of computer music was something of an over-generalisation, ignoring the work of composers such as Iannis Xenakis, Herbert Brün and Pietro Grossi, who were pursuing non-deterministic compositional applications of the computer. But Kayn's critique of computer music served to highlight his own compositional programme, which he envisioned as a fundamentally new paradigm in the history of music. While computer music required the composer to formulate his thoughts in a programming language, which is then executed in a manner analogous to the performance of the traditional

10. Roland Kayn, liner notes, *Elektroakustische Projekte*, Colosseum LP SM 1474.

Roland Kayn, 1970s.

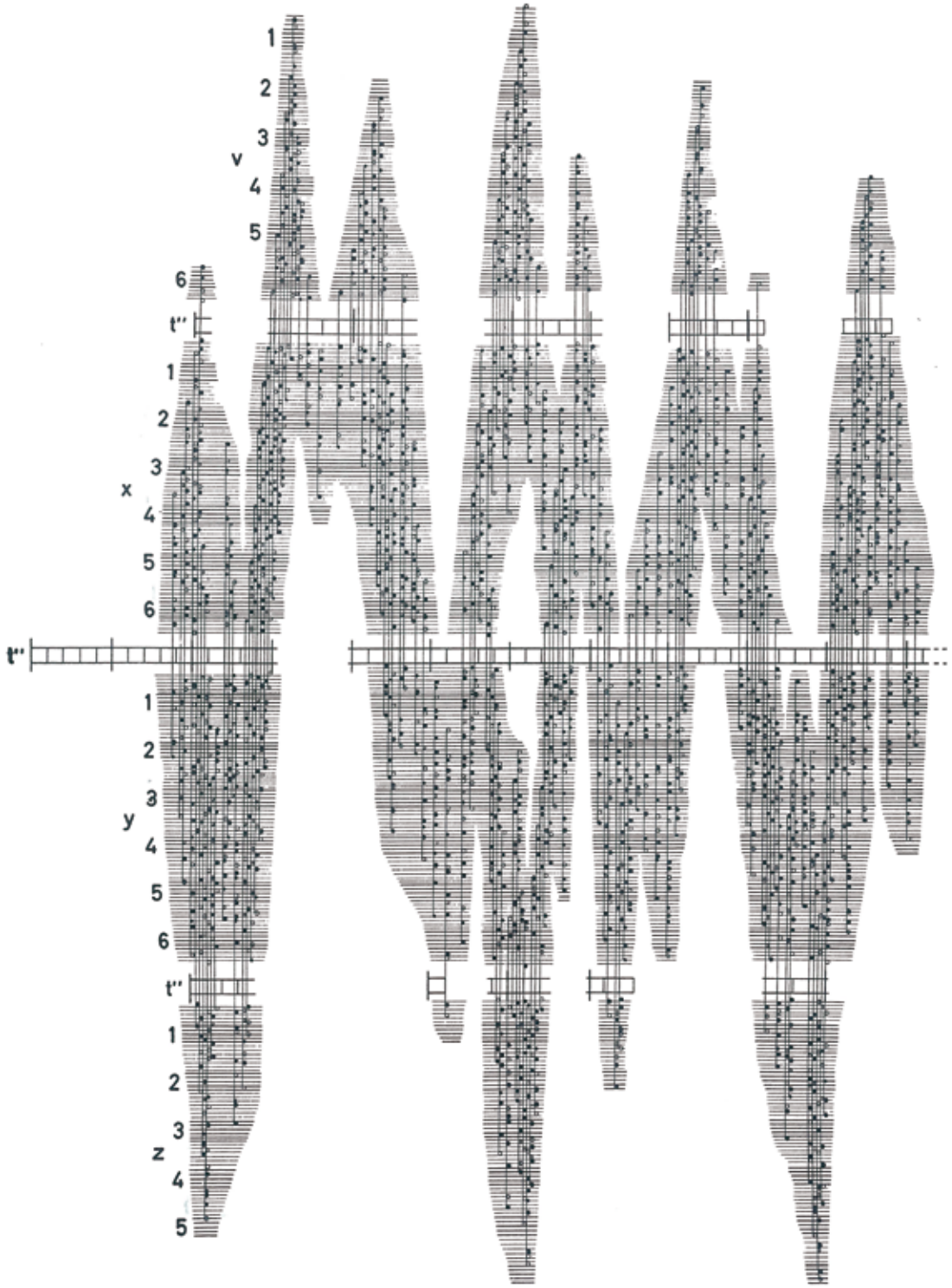
Roland Kayn, cover LP *Tektra*, 1984.

Roland Kayn, cover of the LP *Infra*, 1978–79.

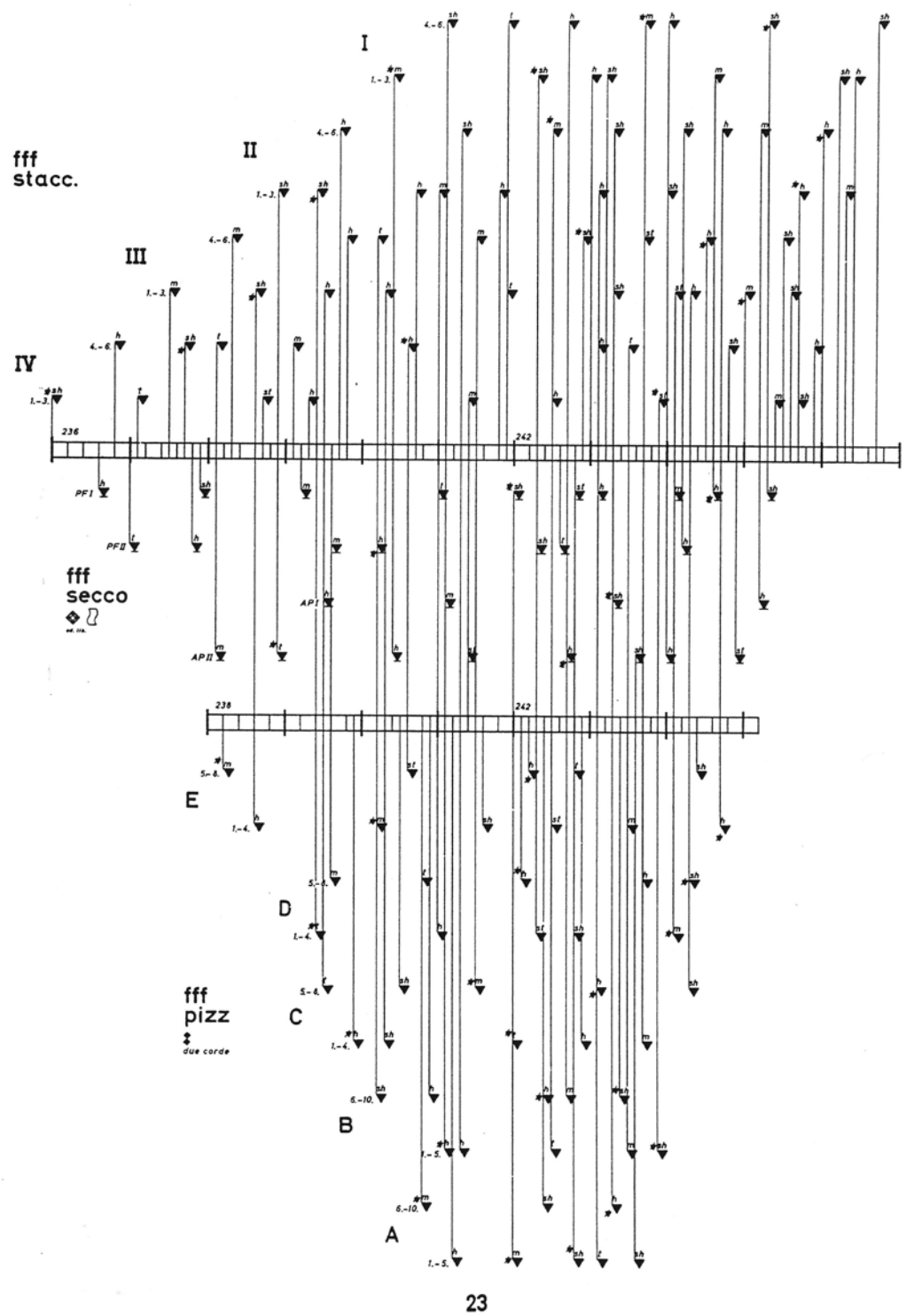
Roland Kayn, cover of the LP *Simultan*, 1970–72.

Roland Kayn, cover of the LP *Elektroakustische Projekte I, 1966–75.*

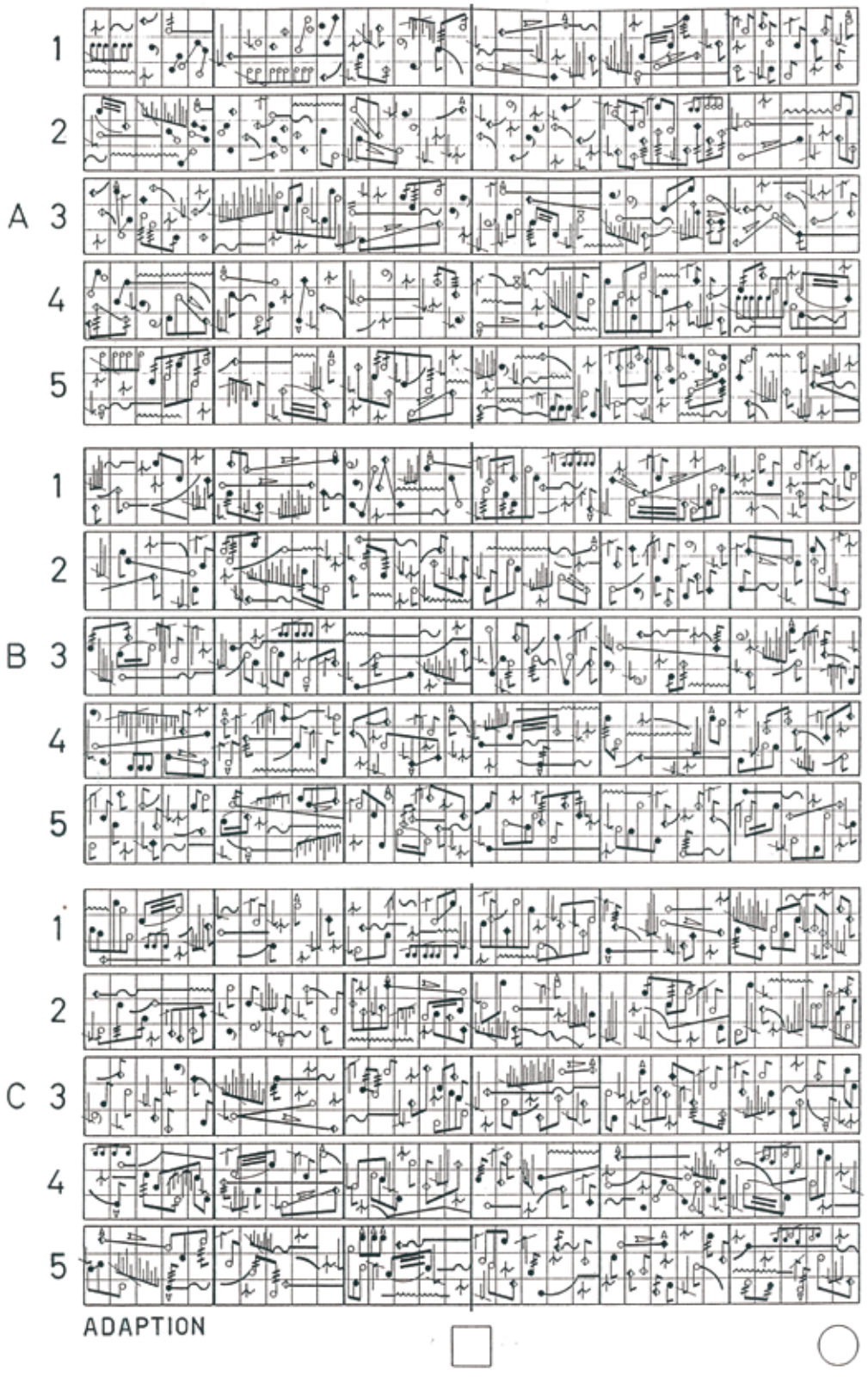
Roland Kayn, cover of the LP *Makro I-III*, 1977.
Images © courtesy of Ilse Kayn.



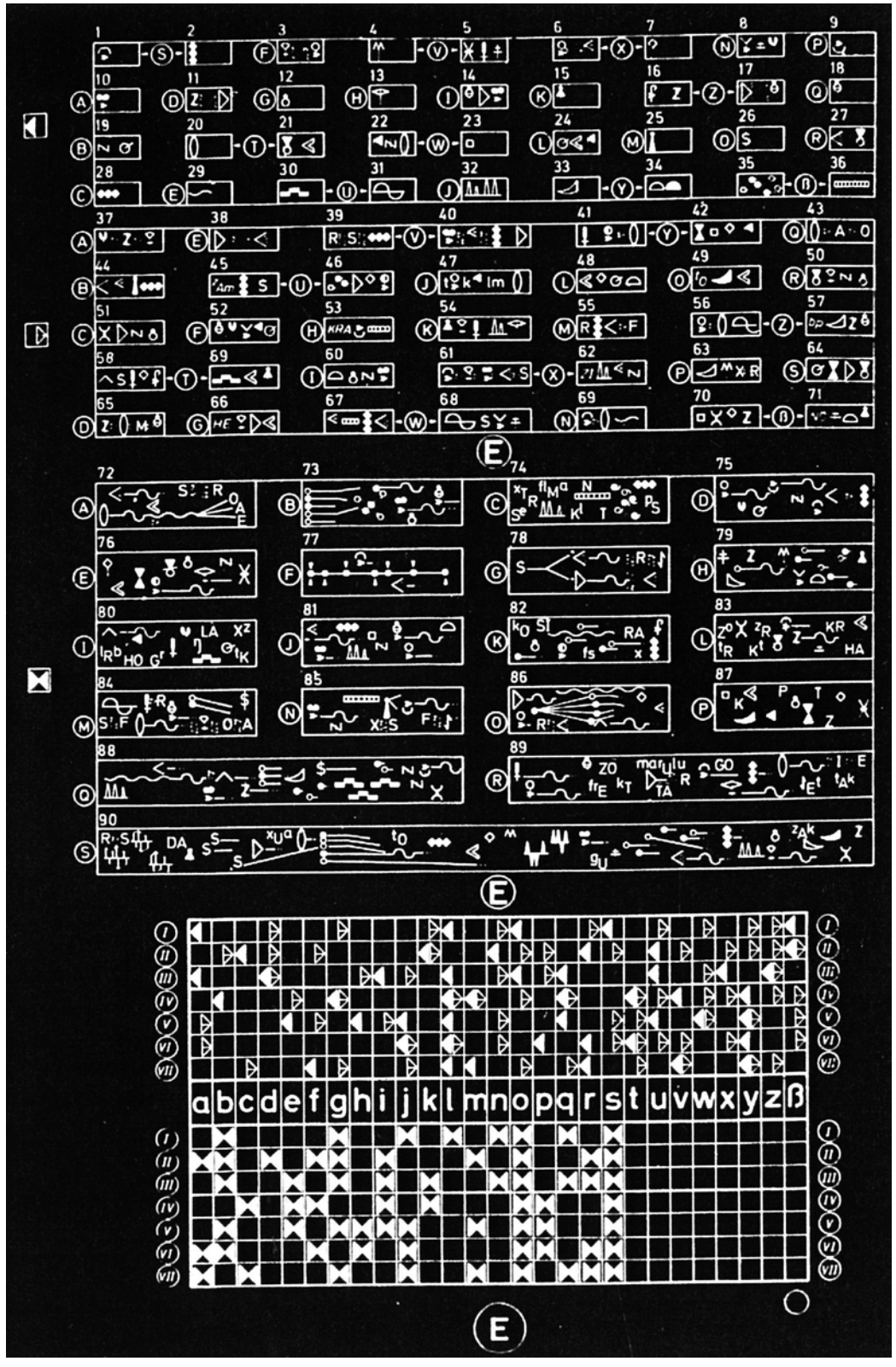
Roland Kayn, score for *Allotropie*, for multiple instrumental formations, 1962–64, reproduced on the insert of the LP issue of *Tektra*. Image © courtesy of Ilse Kayn.



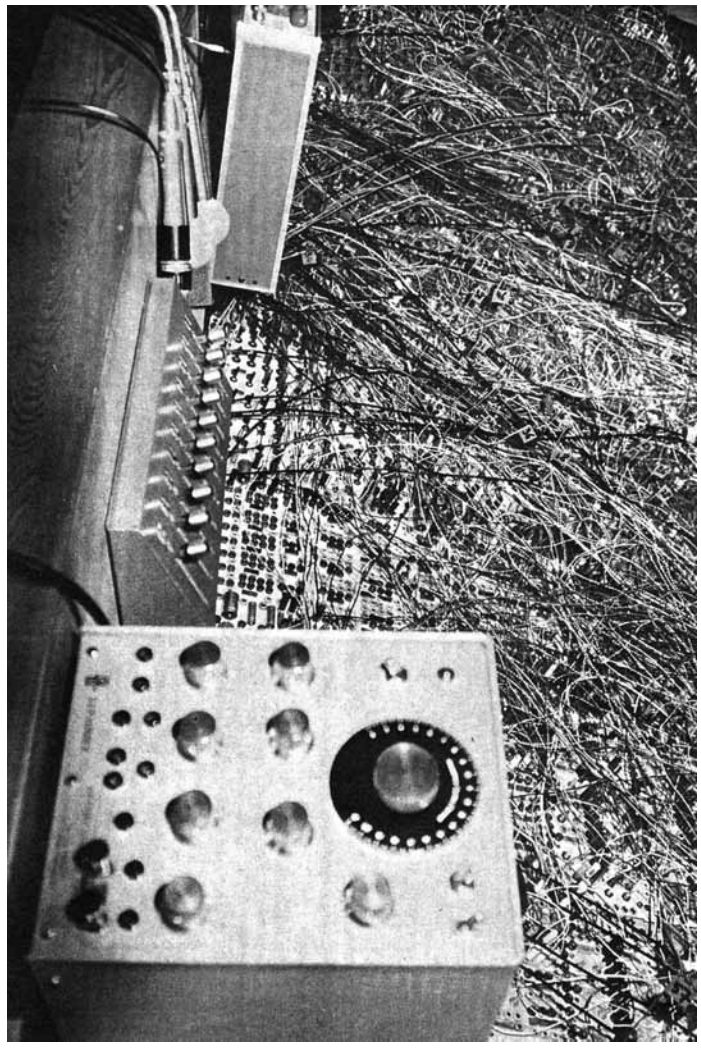
Roland Kayn, page from the score of *Allotropie*, for multiple instrumental formations, 1962–64. Image © courtesy of Ilse Kayn.



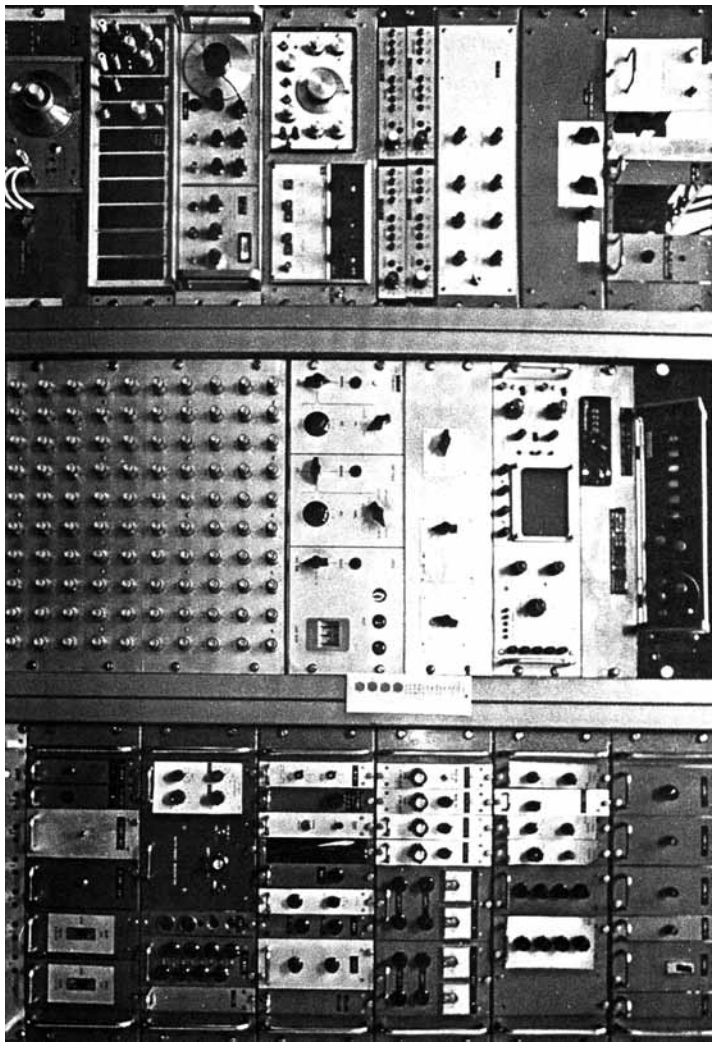
Roland Kayn, 'Adaption', page from the score of *Engramme*, 1972–74, reproduced on the insert of the LP issue of *Tektra*. Image © courtesy of Ilse Kayn.



Roland Kayn, score for *Cybernetics*, sign memory and control system, reproduced on the insert of the LP *Elektroakustische Projekte I*. Image © courtesy of Ilse Kayn.



Music computer, early 1970s. Photo on the insert of the LP issue of *Simultan*. Courtesy of Ilse Kayn.



Studio 2 (or 3), Institute of Sonology, Utrecht, late 1960s, early 1970s. Unknown photographer. Image courtesy of Ilse Kayn.

‘the electric current has no memory, is governed only by the present, and is thus in great measure authorised to unleash improbable phenomena’

musical score, cybernetic music is based instead on 'a generative process in which existing sound materials are fed back upon themselves in order to create deviations from that which came before'.[11] In its simplest form, this process begets only cyclical variation – 'negative feedback', which aims for equilibrium and stability, typified by the quotidian technology of the thermostat. But as more information is introduced into the system, the more unpredictable its behaviour becomes. The non-linearity of cybernetic systems allows the music to break out of regulated cyclical patterns and perform 'sudden jumps' from one state to another.[12] The interweaving of inputs and outputs creates positive feedback, as signals crisscross the system and redouble upon themselves, causing unforeseeable transformations: this brings about 'the immense expansion of the acoustic domain…which can neither be imagined nor attained through other than cybernetic means'.[13]

These rather abstract aesthetic postulates begin to make sense only in the context of their technological realisation. This requires a brief return to Kayn's biography. In 1970, he took a position as a programme director at the Goethe Institute in Amsterdam, relocating to the Netherlands, where he would spend the rest of his creative life. In the same year, he was invited to work at the electronic music studio of the Institute of Sonology in Utrecht, where he joined two other German expatriate composers, Gottfried Michael Koenig and Konrad Boehmer. Over the course of a decade of work at the Institute of Sonology, Kayn created a series of electroacoustic compositions in which he elaborated his concept of cybernetic music: *Monades* (1971), *Simultan* (1970–72), *Eon* (1975), *Makro I-III* (1977), *Infra* (1979–80), and *Tektra* (1980–82). Ironically, though the Institute would become well-known in the mid-1970s because of the computer programs for algorithmic composition and digital sound synthesis developed by Koenig, Barry Truax, and others, it was the studio's analogue equipment that made possible Kayn's long-awaited realisation of cybernetic

11. Kayn, *Infra*.
12. Kayn, *Elektroakustische Projekte*.
13. Kayn, *Tektra*.

music.[14] In the late 1960s, the studio had been outfitted with a sophisticated voltage-control system of modular units, such as oscillators, filters, envelope generators, and logic circuits. At the centre of this configuration was a 'variable function generator', essentially a primitive sequencer that could be programmed to store a series of voltages that were then used to control the various components in the studio. In Karlheinz Essl's words, with this equipment 'one could implement an algorithm that produced sound in real time'.[15] In the Utrecht studio, Kayn could map out sonic scenarios whose results would be neither fully random nor fully predetermined, but rather 'guided' or 'steered' in the etymological spirit of cybernetics. This was the technological basis of what Kayn called the 'programming of the unprogrammable': configurations whose temporal development was unforeseeable on the basis of their initial conditions, including everything from the fundamental sound material, which determined the sonic character of the music, to the interconnections and feedback loops, which governed in a general way how the piece would unfold. Musicologist Frans van Rossum described Kayn's method:

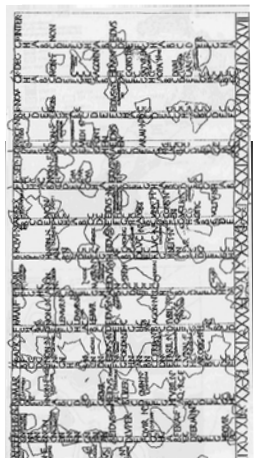
> [Kayn's] electronic pieces start by defining a network of electronic equipment. The nature of the network, and its inherent potential, play a large role in determining the audible result. Next, the composer collates the basic information about this network and develops a system of signals or commands that it can obey and execute. These have to be incorporated in a system of controllers, adjustments, and operations, which can realise the composition. This demanding work may take years of construction and tests, and when the system is activated, the resulting composition is recorded to tape only once from the beginning to the end. […] The composer presents his music as an

14. From 1967 to 1969 Koenig, who had become artistic director of the Institute in 1964, composed a set of works, namely his eight *Funktionen* (Functions), that likely have the closest genetic relations to Kayn's cybernetic music. Koenig used the function generator to automate the production of sound material by applying its control signals to various inputs and recording the results, which were later spliced together to form completed compositions.
15. Karlheinz Essl, 'Algorithmic composition', in *The Cambridge Companion to Electronic Music*, eds. Nick Collins and Julio d'Escriván (Cambridge: Cambridge University Press, 2007), p. 123.

> artifice which he constructs and sets in motion, but once he has done this, it is left to move through space, a 'free' music, which, like the fabric of the cosmos, follows its own internal laws and conditions.[16]

The product of Kayn's compositional work was not a symbolic set of directions, but rather a material–technological configuration of electroacoustic components and patch cables. The 'score' of the piece was identical to the particular configuration of units that generated the music. The instrumental apparatus of the electronic music studio is both the medium of the composition and its sonic source. Furthermore, the imperfections of analogue devices were the keys to a new kind of musical poetics, beholden neither to the control fetish of Western art music nor to its dialectical negation through Cageian indeterminacy. For Kayn, analogue electronics, with their 'integrally determined fluctuations' and 'relative instability in states of reciprocal interconnectivity', were aesthetically superior to digital components.[17] Speaking of his composition *Makro*, Kayn wrote that 'the instability of electro-acoustical systems is calculated as a generative principle, as it were, up to and including malfunctions'.[18] In this new paradigm, according to Kayn, 'The composer is entirely divested of his original function. He can merely decide whether to intervene, guide, and direct, or whether he is prepared to accept what emerges as an auto-generative procedure'.[19] Kayn's compositional technique, predicated on the unique generative properties of analogue components, thus constitutes a remarkable rejection of the implicit teleological arc of electronic music. At the very historical moment of the ascendancy of digital sound technologies, Kayn's music inaugurates the valorisation of the analogue that would become one of the most unexpected and characteristic tendencies in electronic music of the last quarter of the twentieth century.

16. Frans van Rossum, liner notes, *Roland Kayn: Tektra*, Barooni CD BAR 016.
17. Roland Kayn, 'Soziologische-, technologische- und aesthetische Aspekte akustischer Innovation am Beispiel eigener Werke', http://www.kayn.nl/publications.html (accessed 20 December, 2011).
18. Roland Kayn, album cover, *Makro*, Colosseum LP SM 1477.
19. Kayn, 'Soziologische-, technologische- und aesthetische Aspekte…'



Kayn's compositional poetics have direct implications for the audition of his music. According to Kayn, the generative self-formation of cybernetic music should be mirrored by the listener's act of perception:

> The characteristic impression made on the listener by sound events which arise in this way seems to be one of simultaneity or dependence between control structures and program structures – that is, the fact that the process of creation is integrated into the acoustic supersignal, and remains transparent. The control structure lies within the range of audibility, thereby forming an integral component of the generating process. The listener is thus able to follow the compositional process as it develops; the acoustic construct is hence made more lucid and more of a total auditory experience for the listener – the acoustic sphere is, so to speak, 'socialised'.[20]

Like American minimalist composers such as Steve Reich, Kayn intends the generative process behind the music to be apparent on the perceptual surface. But while minimalist music generally unfolds in a linear fashion from an initial temporal disjunction, Kayn's notion of process encompasses not only growth-like accumulations but also the 'sudden leaps' typical of nonlinear interactions. This difference is made clear in Kayn's distinction between two models of musical temporality: a conventional 'running down' (*Ablauf*) as the reservoir of potential energy contained in the score is converted into acoustic waves, and an inverted temporality unique to cybernetic feedback processes, which Kayn characterises as a 'winding up' (*Aufzug*), the before-your-ears unfolding of electroacoustic signal chains.[21] The cybernetic system manifests a capacity for negentropic rejuvenation, which for Kayn signals nothing less than the 'suspension of the opposition of automatic ('dead') and anthropoetic ('living') systems'.[22]

20. Kayn, *Elektroakustische Projekte*.
21. Kayn, 'Soziologische-, technologische- und aesthetische Aspekte…', and *Elektroakustische Projekte*.
22. Kayn, *Simultan*.

Kayn asserts that 'the electronic system develops a sort of capacity to think for itself, a capacity which in a sense can be described as artificial intelligence […] Existential Being, as it were, takes the place of a logically functioning consciousness'.[23] Music appears not as a means of subjective expression, but rather as a mode of knowledge, something like the act of epistemological 'unveiling' that Martin Heidegger identified as the essence of technology.[24] Kayn's cybernetic configurations could thus be heard as the Aeolian harps of the information age, instrumental means of channelling naturally occurring sonic forces. This metaphorical image corresponds to the typically slow and drone-like character of Kayn's music, resembling an eerily flowing stream intermittently disturbed by eddies and vortices. (Van Rossum describes Kayn's trademark sonority as a 'continually changing resonating structure', while Massimo Ricci refers to 'the tonal instability, that familiar slow oscillation that seems to be the *anima mundi* in Kayn's work'.[25]) This music lives in the *longue durée* of musical time, unfolding over vast temporal expanses, from the typically 20- or 30-minute length of a single work to the over five-hour duration of his 1982 magnum opus *Tektra*.

The peculiar sense of time articulated in this music has to do not merely with the sheer chronological spans it occupies, but also with its pace of information and its characteristic sonic gestures. The temporality projected in Kayn's music sometimes suggests macro-historical biological processes, as in *Eon* (1975), where the distorted song of circuits fluctuates between states of relative chaos and order, seeming to break down and reconstitute itself through the blind groping of a quasi-evolutionary sentience. In other pieces, such as *Apeiron*, the final part of *Infra* (1979–80), we are confronted with a sonic image of geological time, in which the epochal drift of millennia is suddenly riven by catastrophic blasts and tectonic stridulations. According to Kayn, 'the electric current has no memory, is governed only by the present, and is

23. Kayn, *Elektroakustische Projekte*.
24. See Martin Heidegger, 'The Question Concerning Technology', in *Martin Heidegger: Basic Writings*, ed. David Farrell Krell (San Francisco: Harper, 1977), pp. 283–317.
25. Massimo Ricci, 'The Significance of Roland Kayn's "Tektra" in the History of Contemporary Music and its Effect on Conventional Rules of Sound Perception', http://www.kayn.nl/literature.html (accessed 28 December 2011).

a single, timeless instant 143;

thus in great measure authorised to unleash improbable phenomena'.[26] Through the apotheosis of human artifice, Kayn's music aims to confront us with an experience of time almost beyond human conception: *kairos*, the unforeseeable and unrepeatable event.

Just as Kayn's music purported to reverse the entropic arrow of time, the flows of aesthetic influence in the Internet age promise to scramble all attempts at neat, linear models of artistic development, let alone 'progress'. Turning, in conclusion, from the short time span of musical perception to the long time span of reception, influence and dissemination, we must confront the fact that Kayn remains a musicological nonentity, in spite of his engagement with many of the major musical and aesthetic currents of his time, and the radical implications of his work for some of the basic categories of Western musical thought. He is nowhere to be found in histories of electronic music, and his recordings are unavailable, even in most university libraries. To some extent, this fate could be seen as self-imposed: Kayn made little effort to accommodate himself to the demands of contemporary musical life. He presciently believed that the future of music lay outside of traditional 'high culture' institutions such as orchestras and concert halls, and his invocations of 'environmental music' and 'house music' (*Hausmusik*, i.e., domestic music-making) demonstrate a striking affinity with the emergent discourses of soundscapes and ambient music that were percolating alongside his work in the 1970s. In response to the stultifying productions of mass media, whose deleterious effects he compared to environmental pollution, Kayn envisioned a '*musica nuova reservata*' created for the delectation of self-selected circles of acoustic initiates. Not surprisingly, then, Kayn's vision of the reception of his own music ultimately took the form of a rather extreme fatalism: he invoked the quintessentially Adornian notion of the 'message in a bottle' (*Flaschenpost*) to describe his work, 'which no longer knows of any recipients and perhaps reaches only those who possess the appropriate antennae for deciphering its message'.[27] And indeed, the metaphor of

26. Kayn, 'Soziologische-, technologische- und aesthetische Aspekte…'
27. Kayn, 'Soziologische-, technologische- und aesthetische Aspekte…'

the message in the bottle has proved strikingly apt for the reception of Kayn's music, which has emerged from oblivion into the ears of early twenty-first-century listeners (the author included) via digitised versions of out-of-print LPs made available on blogs devoted to forgotten artefacts of experimental music.

Kayn's enduring obscurity is all the more perplexing considering the undeniable links connecting his work with both contemporary and later trends, from live computer music based on algorithmic principles to the emergence of drone-based, ambient, and generative music. The sonic surface of Kayn's most understated pieces could be compared to the slowly morphing drone textures of French composer Eliane Radigue, created in parallel with Kayn's work in the 1970s. His technical vocabulary resurfaces, albeit in a very different aesthetic context, in the American 'computer network band' known as the League of Automatic Music Composers (1977–1983), and its later offshoot, The Hub. Perhaps the most intriguing affinity with Kayn's work, however, is found in the American 'live electronics' school that formed in the late 1960s around David Tudor, which shared with Kayn the project of exploring what Nick Collins has called 'the music implicit in technology'.[28] These demonstrable parallels with Kayn's work notwithstanding, one might reasonably share the composer's belief that, in the famous words of Gustav Mahler, 'his time will come'. Writing in the final years of the twentieth century, Kayn lamented the backwardness of music in responding to the technological situation of the information age and modestly framed his work as the foundation for later developments as yet impossible to predict. His own contribution was only 'the beginning of an evolution whose future course can at present hardly be foreseen'.[29]

28. Nicolas Collins, 'Live Electronic Music', in *The Cambridge Companion to Electronic Music*, p. 46. Certain of Kayn's works, such as Monades, betray a striking sonic affinity to the chirping menagerie of electronic sound in Tudor's contemporaneous works from the 1970s.
29. Kayn, 'Soziologische-, technologische- und aesthetische Aspekte…'

Affective and Effective Cultural Technologies Before the Media

A Minimal Encyclopaedia of Sound Apparatuses and Automata

Siegfried Zielinski

Introduction: basics

The fields of action and thinking of the arts, sciences, and technology constitute a relationship of tension, which comes together in the coupling of art and media. Internationally it has been propagated for the last 20 years under the label media art. Genealogically, it only covers a short period of time. A liberal interpretation starts with the period after World War II, with John Cage; the Fluxus pioneers Nam June Paik, and Wolf Vostell; as well as other early video artists. Other commentators draw a somewhat longer timeline, taking in approximately the last 150 years, since the art of technical images became established with photography.

Motivated by the anthropological deliberations of the Silesian physico-chemist Johann Wilhelm Ritter (1776–1810), some years ago I began to work with an operational anthropology.[1] Its objective is to keep open the possibilities of being active, of taking progressive action, for the time to come, both for scientists and artists who are deeply committed to experiment.

In principle this operational anthropology functions by reducing the complexity of the relations between the autonomous fields of knowledge and work of the arts, sciences, and technologies, and conceiving them as different historical qualities in the relationship between art and media. Art in this context means art that is affected by media, in the sense of an experimental aesthetic praxis that engages with science and technology. Otherwise the qualities of the relations, which are the issue here, would make no sense.

I differentiate between four qualities of relations: art *before* media, art *with* media, art *through* media, and art *after* the media. These qualities should not be understood as following each other in a chronological sequence, but as differently weighted priorities in the fabric of deep time that interests us here. Historically, the qualities overlap and at times run parallel. The easiest to grasp are the second and third relational qualities.

1. On Ritter, see Chapter 6 of my *Deep Time of The Media* (Cambridge, MA: MIT Press, 2006).

merciless foreswearing of Time 148;

Art *with* media considers the artistic utilisation of insights achieved by mathematics, arithmetic, and geometry, their application in mechanics and optics, and the pressure that results from this utilisation to generate artefacts and technical systems for communicating, instructing, illusionising, shocking, entertaining, and persuading/converting. Art *with* media implies an *instrumental* relationship. In this relational quality, flat or curved mirrors, pipes, funnels, rollers, magnetic telex machines, and mechanical combinatory systems serve as prostheses for art, but are not an essential precondition for art to exist. They expand artistic praxis, can potentially make it more effective, but they do not renew it, and do not necessarily change it. In a more narrow historical perspective this quality evolved in Europe latest since the geometrisation of seeing and the image in the Renaissance; it developed further with the innumerable models for ciphers and elaborately staged spaces for technical images in the sixteenth century, and attained its first highlights with concepts for the automation of composing music, the sequencing of harmonious melodies, and the invention of a multitude of visual special effects in the seventeenth century. All mechanical, optical, and acoustic innovations and inventions that followed in the Age of Enlightenment and in the nineteenth century – the founding years of the 'new' – use this instrumental relational quality. Technical rationality breaks into the world of the imaginary, into artistic production.

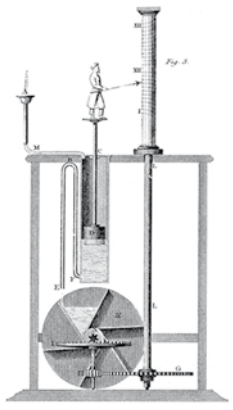
Art *through* media means that the artistic process, or the artistic work, is essentially realised by *going through* a technical medium or array of technical media. This became possible with the advent of the artificial generation of electricity. In the Enlightenment the forces of nature, like electrical storms, were tamed by technology. With the discovery of the physical and chemical principles of electricity, a rich culture of experimentation developed between London, Paris and St Petersburg. Scientific discoveries were demonstrated at spectacular performances in which weak electric current was sent through the bodies of heavy monks or lightweight boys and girls floating in the air. With the various models of the *tableau magique*, upon which electrical sparks described awe-inspiring figures, devices

were created for instruction and entertainment that generated images in a new mode; namely, in the mode of time.[2] The figures only became visible, or could be felt when touched, when the current was on.

At the beginning of the twenty-first century of the Common Era the mechanical, electrical and electronic media through and with which art is produced, distributed and received, are taken for granted. They are as much a part of everyday life as turning a water tap on or off as needed and without thinking much about where the content comes from, what it is made of, and how it will be disposed of after use.[3] In the industrialised parts of the world the infrastructure is oriented on technical media systems and is dependent on them. The generation of scientists, artists and engineers who are now learning, studying, experimenting, organising and directing have been schooled by their experience with technical media to a greater or lesser extent. The media do not hold any particular attraction for them; they have become self-evident areas of activity in everyday life.

Art *after* media does not refer to experimental praxis that dispenses entirely with technical media; this is no longer feasible in science, cultural studies, or the arts. Rather, this relational quality draws attention to the fact that we are seeking an art of experimenting, which no longer requires the application of media as a legitimisation or as sensationalism, but at the same time does not close its eyes, ears, and mind to the media. Just how art *after* media will develop is, at the beginning of the third millennium, already foreseeable in certain concrete cases, but is not yet a foregone conclusion. My anthropology, too, represents a modest attempt *to think historically the trends of art*, as Ritter formulated it for physics (as a comprehensive science of life).

2. In the early cabinets of physics these magic tablets were used to visualise the effects of electricity in dark rooms at popular demonstrations; cf. the detailed and illustrated account in: Louis Figuier, *La Machine Électrique*, *Le Paratonnerre*, *La Pile de Volta*, *L'électromagnetisme* (Paris, 1868), pp. 485–86, image: p. 486.
3. This comparison was made already in 1956 by Günther Anders in his book *Die Antiquiertheit des Menschen* [The Outdatedness of Human Beings], vol. 1: Über die Seele im Zeitalter der zweiten industriellen Revolution [On the Soul in the Era of the Second Industrial Revolution] (Munich: C. H. Beck 1980). See particularly the section 'Die Welt als Phantom und Matrize' [The World as a Phantom and a Matrix], pp. 97–211.



the invasion of Time into a timeless world 223;

Art did not manage without media before the ideas, concepts and notions existed which became the generalisation *media* that denoted a special area of theory and praxis. (This only happened over the last 60 to 70 years). In the two-and-a-half thousand years between 1000 BCE and 1500 after the Common Era, a multitude of optical, acoustic, magnetic, and combinatorial sensations were developed, which can only be subsumed under the umbrella term of media because of the coercion exerted by our contemporary perspective. In their own time they did not press for any generalisation; indeed they had no need of one. The modular grids and strings with which the ancient Egyptians calculated and constructed the ideal body proportions for their sculptures of the gods,[4] from which the Pythagoreans likely derived their geometry-based concept of harmony; the shadow optics of the Chinese Mohists of over 2300 years ago; the automaton theatre of Hero of Alexandria (20–62 CE), which corresponds wonderfully with the mechanical and hydraulic treasures of the engineer Ibn al-Razzaz al-Jazari (1136–1206) from early thirteenth-century Baghdad; the optical experiments of the Chinese astronomer Shen Kua (1031–1095) with their projections of flying birds and racing clouds in dark chambers in the eleventh century: such singular and isolated sensations from the deep strata of history I term phenomena of art *before* the media. For an archaeology that is interested in the emergence and development of technical seeing, hearing and combining, its iridescent diversity belongs to the most fascinating of the historical relational qualities.

We researched media *before* the media. With these words the eminent historian of mechanics and Einstein award holder of the Beijing Academy of Sciences, Dai Nianzu, neatly summed up the overarching questions of our work on the *variantology of art and media*. The phrase is certainly catchy, but it does contain a methodological trap. The conceptual generalisation 'media' is an invention of the twentieth century. All of our technologies of communication, of envisioning, of

4. In this context see Albert Presas i Puig, *Numbers, Proportions, Harmonies, and Practical Geometry in Ancient Art* (Berlin: *Max Planck Institute for the History of Science*, 2004).

generating knowledge, and providing entertainment are significantly older. To avoid falling into the trap of historicisation, for the time being they should not be subsumed under the collective term *media*. As artefacts and designs that have been constructed, they are singular and therefore resisting universalisation. Their investigation requires other approaches than those of mainstream historiography of the media.

Research on the deep-time relationships between arts, sciences and technologies does not seek to reinvent the concept of the media nor that of the arts. Rather, the aim is to open up both productively via their interactions with scientific and technological processes. Media scholars should be encouraged to comprehend their subjects of enquiry within a broader perspective than they have done so far, and include subjects in their media-related investigations that have hitherto been excluded, such as theology, Latin philology, Arabic studies and considerable parts of the history of science and technology. Parallel to this, although media studies has become an established academic subject in Europe, we question whether it really should be seen as an independent discipline, and we continue to understand 'media' as special inter-discursive events, also from a historical perspective.

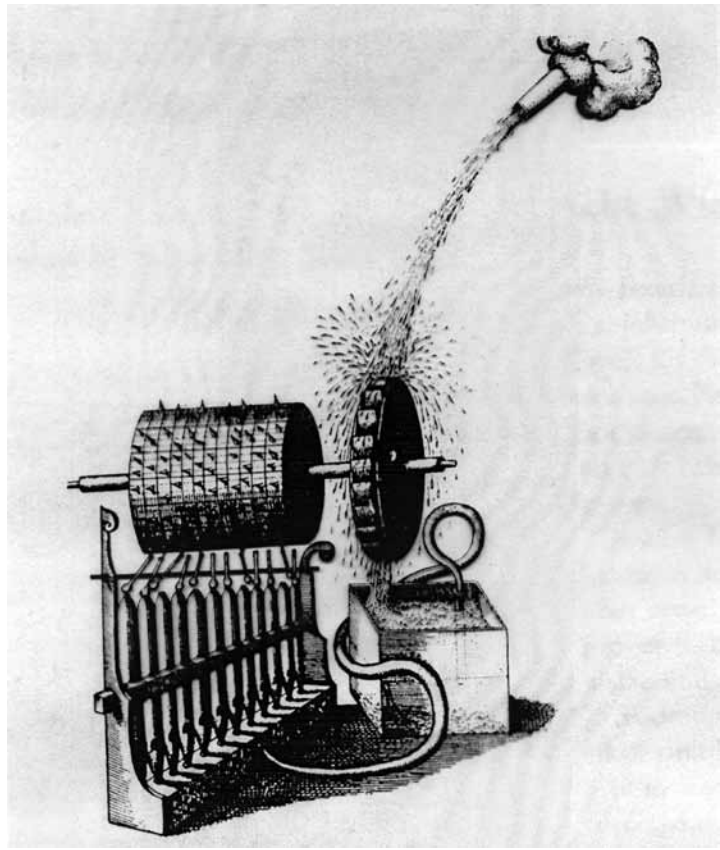
For the vertical probing of history and moving through academic territories other than the familiar ones, a geographical reorientation is indicated. Deep time cultures, such as those of Ancient China, Ancient India, the Arabic-Islamic world, and southern Europe play just as significant a role as developments in the US or northern and western Europe.

In the following I shall focus on the example of the world of sound. This minimal encyclopaedia of simple sound devices and automata has a two-fold goal. It presents an exemplary case study of a singular subject explored through media art-archaeological research, and at the same time demonstrates our methodology in the field of variantology with regard to the evolution of cultural technologies.

built into the nature of Time 227;

Gods and sounds

In the deep time of their richly variegated relations, art and technology generated highly distinct relational qualities including in the field of sound. Instruments, apparatuses and machines were constructed to amplify sounds that could also be heard without them; instruments, apparatuses and machines were built as sacred devices to pay homage to the ruling deity or deities of the time; they were also employed to break up existing natural means of expression. Technology, i.e., that which (according to Aristotle) is actuated from outside and not from within itself, imitates nature – , i.e., that which is in unceasing motion. Technology attempts to enhance nature's power and it effects or thwarts that which exists outside of itself and moves under its own volition – that which is natural.



Organ: Here, it looks as though God powers the organ by ejaculating directly onto the water wheel that drives it. This illustration comes from the second edition of Robert Fludd's great history of the macro- and microcosm: *Tractatus secundus. De naturae simia seu technica macrocosmi historia* (Oppenheim: Johann Theodore de Bry, 1618).

Like all simple comparisons this one is also merely a prosthesis replacing thought that one should jettison as soon as one has learned to navigate the labyrinth of the facts of the issue. Yet the comparison does help us to reach an important principle in a genealogy of media apparatuses and devices that enquires as to the provenance and development of sound machines as instruments of enchantment and not as to their origin, which is the classic archaeological approach.[5] Here we will focus on simple – from today's point of view – technical artefacts which fulfil all three functions outlined above but which are especially at home in amplifying what is natural.

In the beginning was the articulated sound, maintains the god of European avant-garde cinema, Jean-Luc Godard, like a good Catholic since the early 1980s when, after many years of working with the electronic notebook of video, he started to make films again for the cinema and ransacked his record cabinet for wonderful concertos, symphonies and songs, from Mozart's *Magic Flute* to Leonard Cohen/ Federico Lorca's bombastic and wonderful Vienna-kitsch *Take this Waltz*. The most widely accepted of the competing theories to explain how the universe developed is the Big Bang. In this cosmological model there are powerful echoes of archaic mythological material. With this violent event, structure came into being out of the unformed blackness of infinite matter, out of sound and light, out of waves that were so strong that they pulled everything apart. 'Both the creation myths of indigenous peoples and the cosmogonies of Afro-Asiatic cultures mention a dark overall sound as the mother of the demiurge.'[6] For the ethnologist and musicologist Marius Schneider – whose special field is hunting for sounds, rhythms, melodies and musical structures in stone structures and architecture – gods are 'pure sound'.

5. This preference for investigating the provenance and development of a phenomenon rather than its origin is primarily indebted to Michel Foucault and his adaptation of Friedrich Nietzsche's concept of genealogy; see *Nietzsche's Werke Band VII, Jenseits von Gut und Böse, Zur Genealogie der Moral* (Stuttgart: Kröner, 1921) and Nietzsche, die Genealogie, die Historie, in: M. Foucault, Von der Subversion des Wissens
6. Marius Schneider, *Singende Steine. Rhythmus-Studien an drei katalanischen Kreuzgängen Romanischen Stils* (Kassel & Basel: Bärenreiter, 1955) p. 12.

impervious to the passage of Time 231;

The first imaginings of angel-like beings, for example, as found in Brahman creation myths, were 'transparent and radiant beings that made sounds and flew above the Earth. But when they came down to Earth and began to eat plants, they lost their lightness and their luminescence. Their bodies lost their transparency and all that remained of their original substance were their voices.'[7] The heliotropic beings mutated into heterotrophs, who from that point onward had to ingest vast quantities of materials generated by the sun in order to survive. They learned to speak and to organise their rituals effectively. The word, the sound articulated in a proper form, became the most important means of expression for organised effects and, in this restricted sense, reality. Sounds were structured harmoniously and became music. As such what is audible is grammar: structure with recognisable rules – mathematical, geometrical, physical and physiological.

One-string harmony

In all cultures that utilise musical tunings and systematic intervals there are similar analogies of the fundamentals and their relations to each other to microcosmic and macrocosmic structures. Everything in the earthlings' small world corresponds to something in the vast universe and vice versa: the individual phenomena of the macrocosm, the universe in which we exist, and their interrelationships were projected onto the microcosmic world. The relations can be measured, there as here, they can be expressed as distances and their medium is numbers. This is the basis of the Pythagorean world-view that strongly determined European music theory up to early modern times. Its core is simplicity, the triviality of consonance, based on the intervals of octaves, fifths and fourths from which derive the complex relations of consonance and dissonance.

The master instrument and in a specific sense the *medium* for communicating the Pythagorean world-view is the monochord. A single string that produces a single note is stretched over a sound box. The string is fixed at both ends while a movable bridge is manipulated to divide the string in order to make different intervals audible,

7. Ibid., p. 14.

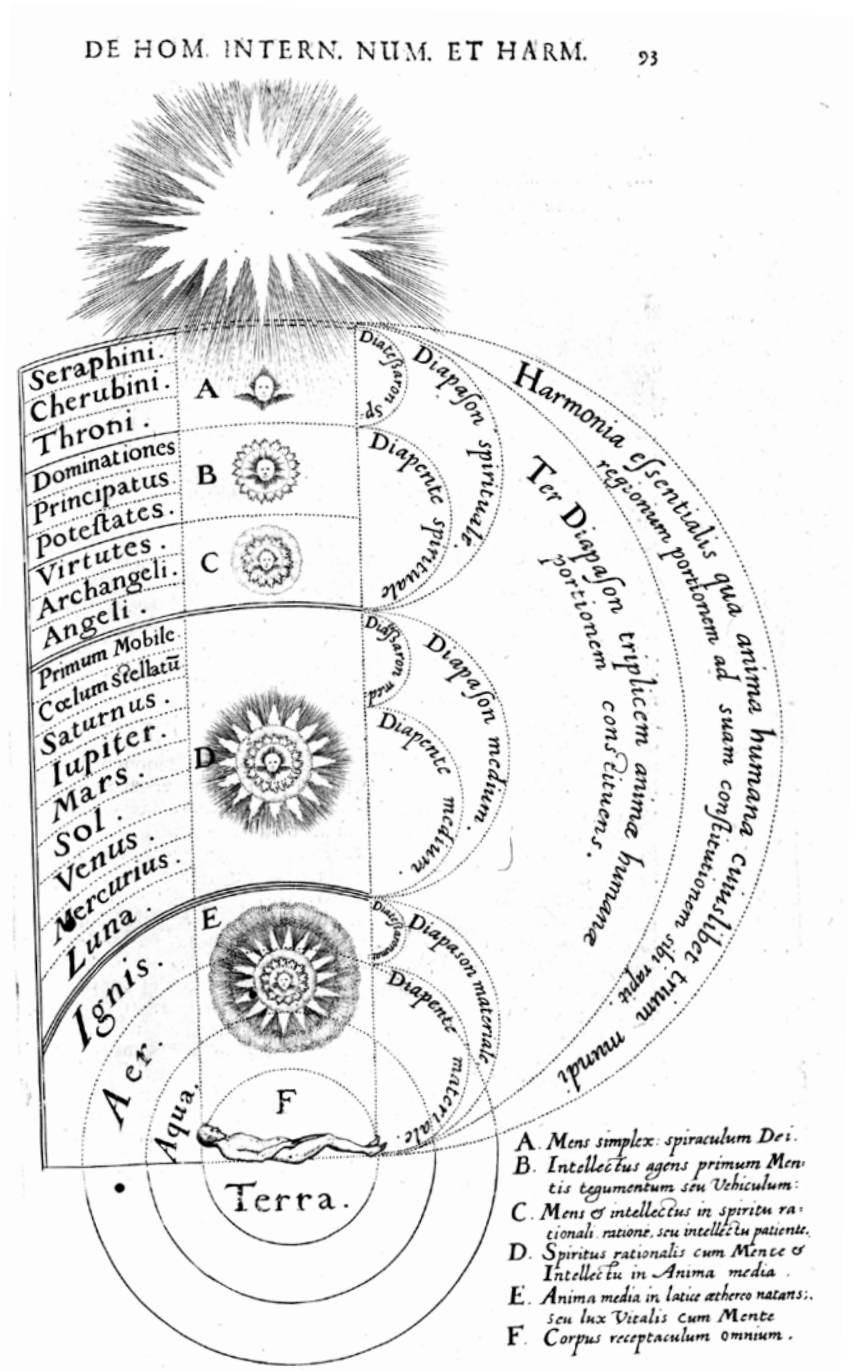
Pythagoras, probably calculating the musical intervals. Relief on the Royal Portal of Chartres Cathedral, 13th century.

which in ancient times were depicted as distances and not as vibrations as in the modern era. The English Paracelsian physician Robert Fludd (1574–1637), a devout Anglican, Rosicrucian and – like Mozart at the end of his far too short life – a professed Freemason, published in the years between 1617 and 1621 his *magnum opus*, the two weighty tomes of his history of the microcosm and the macrocosm.[8] The monochord is central to this work. It serves the physician, philosopher and specialist Fludd for the art of memory (*ars memoria*) and to translate his ideas of the infinite harmony of everything that exists into both technology and images.

In the second volume of this in every sense grand-format hermetic work, in Chapter IV of Book 4, 'Of Numbers and the Harmony of Inner Man', Fludd cites the Greek-Syrian philosopher Chalcidensis (ca. 245–325) and his idea that the human soul has the capacity to hear divine harmony, that the soul quasi remembers this structure because it antedates

8. Robert Fludd: *Utriusque Cosmi Maioris scilicet et Minoris, Metap(h)ysica, Physica atque Technica Historia. Two volumes: Tomus Primus: de Macrocosmi Historia in duos tractatus divisa* (Oppenheim: Johann.-Theod. de Bry, 1617). *Tomus Secundus: de Supernaturali, Naturali, Praeternaturali et contranaturali, Microcosmi historia in Tractatus tres distrubuta* (Oppenheim: Johann.-Theod. de Bry, 1621).

immune to time 231;



Robert Fludd's conception of the harmonious unity of the little earthling and the universe, of the micro- and macrocosm, superbly visualised by the copperplate engraver of Johann Theodore de Bry, his publisher from Frankfurt/Oppenheim.

Monochord, theologian and musicologist Guido of Arezzo and his pupil Theobaldus playing the instrument, miniature, 12th century.

the microcosmic world of the individual human being. In his interpretation of ideas, later characterised as Neo-Platonic, Fludd emphasises the corporeality of humans in connection with the functioning of memory. The biological body becomes a storage of information when he writes 'The human soul, its dark inner space once permeated by divine harmony, resides in physical man, who not only preserves the memory of a cosmic symphony within himself, but also the idea of the divine One; this is why humans are most wonderfully moved by simple, common music.'[9]

Here the metaphysical and the physical are understood as being in constant interaction. The body is not only the shell for the soul, it is also a repository for information (memory, divine idea), and it is a medium of resonance: the individual becomes a *person* in the direct sense of the word; they constitute themselves by virtue of the divine One sounding through them (*per-sonare*). The simpler and more fundamental the consonance, the stronger its effect on the

9. Fludd, op. cit., vol. II. (Tomus Secundus).

in a flow that Time will never touch 231;

person's state (of health), which naturally includes the constitution of the psyche.

'Affects are things of inner secretion and the sympathetic nervous system', wrote Carl Ludwig Schleich (1859–1922) in his book *Vom Schaltwerk der Gedanken* (On the Control Unit of Thoughts). By 'inner secretion' he understood in essence 'the juices formed by the action of the sympathetic nerve system winding around the organs in various organ systems which all have specific functions'.[10] The sympathetic nerve also lies beneath the diaphragm, the 'solar plexus', which the Ancient Greeks called the seat of the soul. Without the solar plexus there would be no glandular function […] One could term the glands juice-producing centres within the edifice of the body which are mobilised and controlled by the sympathetic nervous system.'[11]

Playing the audience like an organ

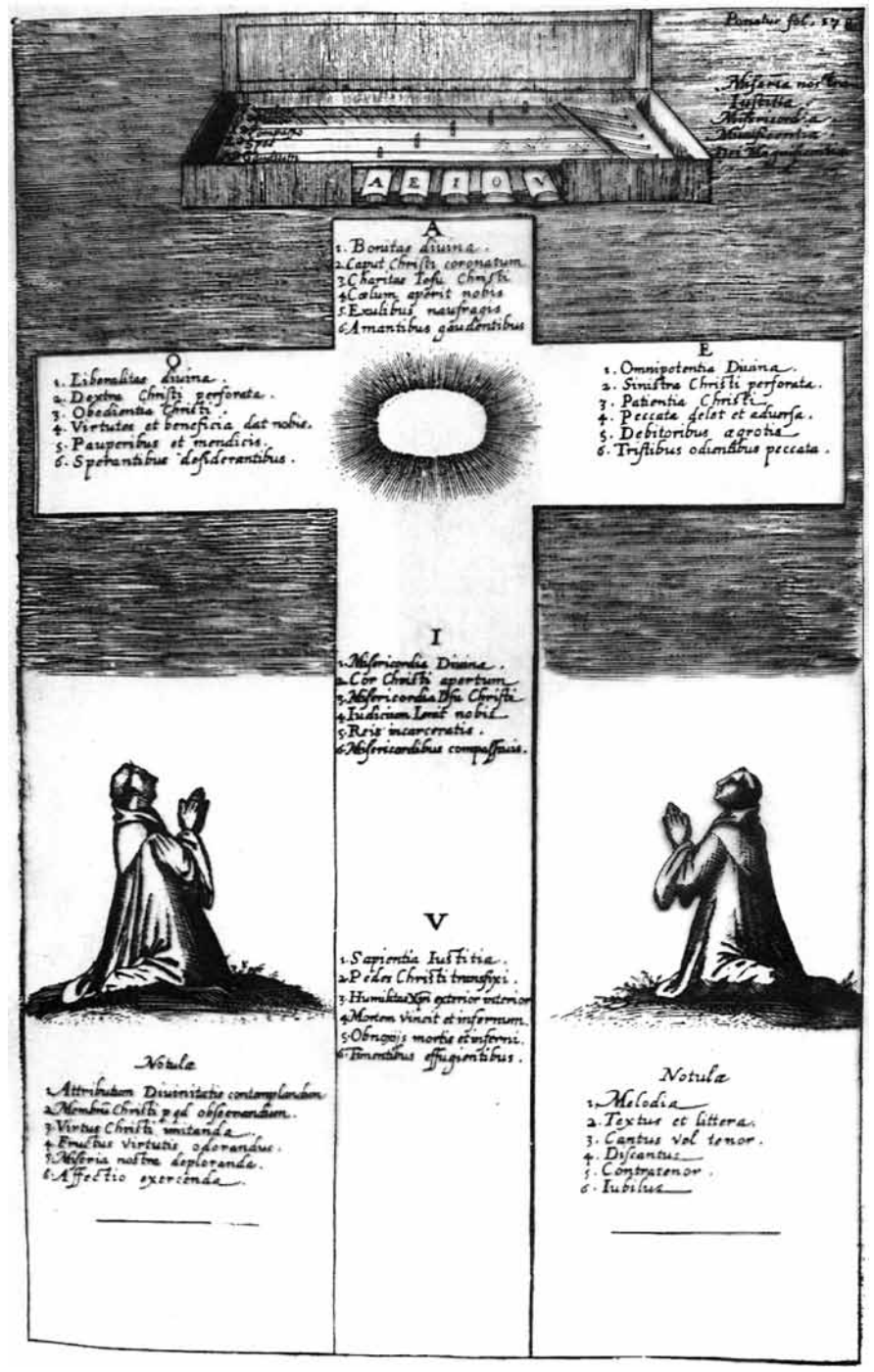
The intellectual father of affect-oriented and affect-charged media concepts at the transition from the Middle Ages to the early modern era – and later to European modernism – was Ignatius of Loyola (1491–1556), the Basque founder of the Jesuit order that embodied the quasi-militarily organised avant-garde of the Vatican. Loyola was their first General. His famous *Exertitia spiritualia*, the 'Spiritual Exercises', were only initially and superficially developed as instructions for self-martyrdom and self-castigation; they served – and still serve – primarily as a guide to immersion in prayer and meditation. As constructed fictions they are consummate Aristotelian aesthetics in the form of written instructions that read like the script of a thriller. The purification of the emotions is effected by imagining terror, torture, hell, and by ritualising these through making them recur in an elliptical loop – the most important rhetorical figure.[12]

10. Carl Ludwig Schleich: *Vom Schaltwerk der Gedanken. Neue Einsichten und Betrachtungen über die Seele* (Berlin: G. Fischer 1916).
11. Friedrich Leipoldt, *Stimme und Sexualität. Das Problem der inneren Zusammenhänge von Stimme und Sexualität in gemeinverständlicher Form dargestellt* (Leipzig: Dörffling & Franke 1926), p. 15f.
12. For a detailed account see Siegfried Zielinski, 'Modelling Media for Ignatius Loyola. A Case Study on Athanasius Kircher's World of Apparatus between the Imaginary and the Real', in: Eric Kluitenberg (ed.), *Book of Imaginary Media, Excavating the Dream of the Ultimate Communication Medium* (Amsterdam: NAi Publishers, 2006).

Jacob's ladder. Fresco by Klimaikos in the Horezu catholicon, Romania.

At least two sources can be identified as strong influences on St Ignatius' realm of perception. Both are spheres that are associated with sound and are replete with simple musical structures. The older source is the adaptation of the biblical Jacob's Ladder by St John Climacus (seventh century), abbot of the monastery on Mount Sinaï. His *Ladder of Divine Ascent* describes how the soul can be purified by imagining an arduous ascent on a steep ladder (*scala*), full of privation, to the highest point (*klimax*) of metaphysical experience: the encounter with God Almighty. Expressed in musical terms Climacus' *Ascent* is a dramatised scale (*sonorum gradus*). With their *Stairway to Heaven* (1971) Led Zeppelin created an affirmative monument to the scale in the history of rock music; Arnold Schönberg failed – but superbly – in his attempt to bend the ladder into an endless hamster wheel, and never finished his oratorio *Jacob's Ladder* in spite of the many years' work he had invested in it.

the flow of Time 252;



The canticord of the Flemish theologian J(e)an Mombaer from his work *Rosetum exercitiorum spiritualium et sacrarum meditationum*, etching from a late sixteenth-century edition; taken here from Alain Guillermou, *Ignatius von Loyola* (Reinbek: Rowohlt, 1962), p. 72.

The second source of inspiration for St Ignatius was certain currents of piety that were particularly prominent in the Flemish tradition of the Late Middle Ages. Jean, or Jan, Mombaer (d. 1502) was one of its most distinguished representatives. In his major work on spiritual exercises and religious meditations, published in the fifteenth century, there is a curious engraving showing a large crucifix with the divine light of God radiating out of the intersection of the upright and crossbar. Above this there is a depiction of a strange musical instrument:

The cantichord resembles a very simplified harpsichord. It has five strings that are presumably each tuned to a different pitch. Each string has a key showing a different vowel of the Greek alphabet. The cross depicted beneath it provides us with the solution to the code: the vowels correspond to particular attributes of God, which in the Roman Catholic faith are axiomatic. (We are familiar with such axioms being represented by letters of the Latin alphabet from the great art of combination described in his *Ars magna* by the Catalan monk Ramon Llull (1235/6–1316).) A is associated with God's goodness, *E* with omnipotence, I with mercy, *O* with freedom, and *U* with wisdom and justice. Linked with these in the process of prayer are qualities of emotional experience, which Mombaer summarised as follows: 'A is joyful and loving, E hopes, I shows compassion, O is afraid, U feels pain and hates [confronted by sin]: you must remember this!'[13]

Fold-away organ with bellows in the form of bibles for musical worship independent of location, 18th century.

It's not the way Time seems to work 252;

Since the Middle Ages such axiomatically founded aesthetics of commanding has been the basis of all apparatuses and devices that are bent on effectively catching souls unawares. The psyche has become malleable material. The grammar of the formulation is kept as simple as possible. The so-called colour organs of the nineteenth century, too, were based on this idea; besides notes they also worked with certain colours that had specific affective connotations. The young Arthur Rimbaud crowned this achievement poetically by composing 'Sonnet des voyelles' in which he assigned a different colour to each vowel. Today's discos work with substrata of such poetic concepts. Armies of designers develop standardised sound–image relationships as triggers for the soul (and as openers for the visitors' wallets).

Pneuma

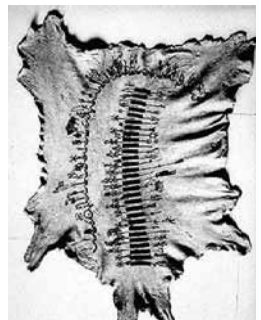
The renaissance is not an Italian invention. Five hundred years before European intellectuals began to liberate themselves gradually from the dictates of Roman Catholicism, and turned increasingly to the texts of the ancient Greeks, Egyptians, and Byzantines – not only the (natural) philosophy of Aristotle – which they reorganised in new complexes of knowledge, the golden age of Arabic-Islamic sciences was unfolding in cities in Andalusia, North Africa, the Arabian peninsula, and in others from Constantinople to Samarkand. Without this first renaissance, which began in the eighth century in Mesopotamia, there could obviously not have been an Italian variant. A large proportion of the ancient texts only survived because they had been translated into Arabic, and European scholars plagiarised the texts of Arab scholars mercilessly for every tiny scientific detail.[14]

13. '*A gaudens amat, E sperat, sed I miseretur; O timet Uque dolens odit: et ista notes*'. Quoted in Alain Guillermou's biography of Ignatius of Loyola, published 1960 in Paris and translated into German; it appeared in 1962 as one of the first volumes in the illustrated monograph series of Rowohlt Verlag, Reinbek (here p. 70).
14. In 2009 we published the fourth volume of our series *Variantology: On Deep Time Relations of Arts, Sciences, and Technologies* (eds. Siegfried Zielinski & Eckhard Fürlus) on this group of topics, which includes a chapter by Hans Belting on the invention of perspective by the Arab scientist Ibn al-Haytham and a contribution by George Saliba, author of *Islamic Science and the Making of the European Renaissance* which appeared in 2007 (Boston MA: MIT Press). In his chapter Saliba demonstrates how scientists who are so revered by Europeans, like Copernicus, shamelessly copied from Arab authors who they did not name.

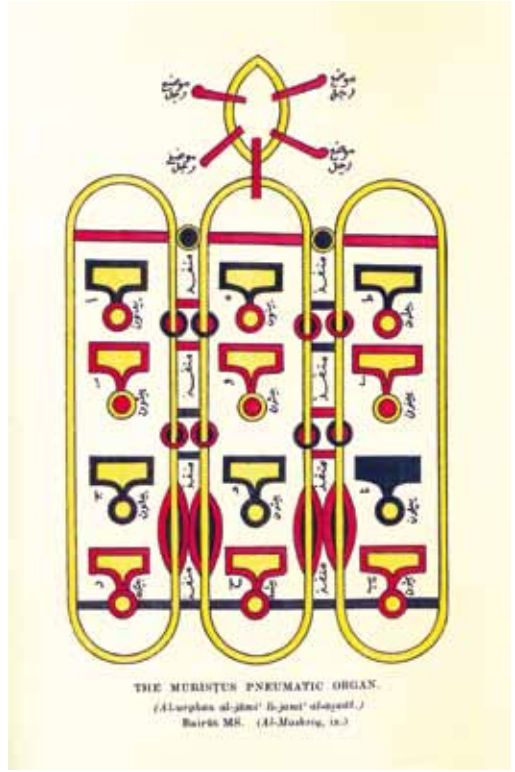
From the end of the nineteenth century to the 1910s the passionate antiquary and engineer Eilhard Wiedemann (1852–1928) painstakingly sifted through Arab literature on various inventions and also translated many important sections of the surviving works, including works on multifarious dazzling variants of music artefacts. Here, large hydraulically and pneumatically driven instruments play an important role. A mysterious author named Mûristos, who was probably from Greece and who literally wanders like a ghost through the translated texts of the ninth century, is attributed with inventing an instrument that Wiedemann refers to as a 'trumpet audible over a long distance' and, as a literal translation of the Arabic appellation, a 'trumpet organ' (*al argin al buqi*). According to Wiedemann the instrument could be heard 60 miles away. He summarises Mûristos' rather convoluted description of the instrument thus: 'This device consists of a tank that is partially filled with water [according to Mûristos the tank could hold up to 550 litres; therefore the instrument must have been gigantic]. A broad acoustic tube is inserted in the tank's cover. Air is pumped into the water through pipes in the sides of the tank whose ends are under water; this produces a very loud noise that escapes through the acoustic tube. When whistles etc. are affixed to this tube various notes are produced.'[15]

A further device that is attributed to the Greek Mûristos is called al *Argin al Gami* in Arabic, 'the universal organ', which was allegedly capable of producing 'all wonderful sounds'. Mûristos description begins 'In the name of God the All-merciful […] furnished with flutes […] the *universal* organ [my emphasis, SZ] … produces a wonderful sound that moves you to floods of tears; it enables you to hear a sound that will lull you to sleep, so that whoever is near it will fall asleep; it enables you to hear a sound that makes you rejoice or grieve, that excites and engages your thoughts; it enables you to hear a sound that keeps you awake [or enchants, translation is not clear, SZ] and robs you of your sanity.'[16]

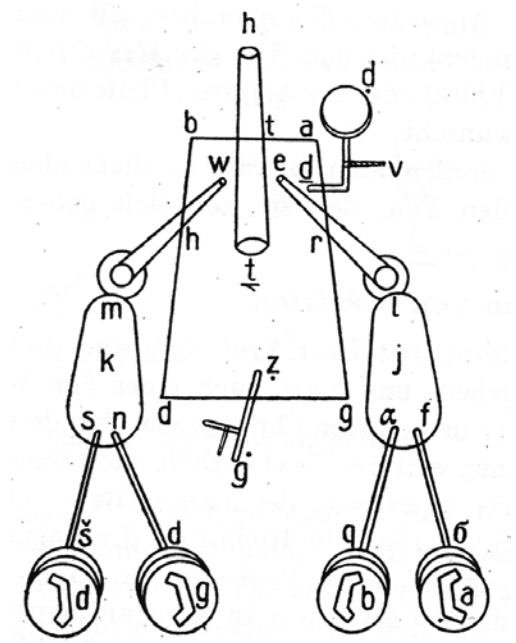
15. Eilhard Wiedemann, 'Byzantinische und arabische Instrumente', in: Archiv für die *Geschichte der Naturwissenschaften und der Technik*, no. 8/1918, p. 155.
16. Ibid, p. 161.



their gunners were abolishing Time 256;



Universal organ: Drawing of Mûristos' pneumatic instrument from an anonymous Beirut manuscript, before 988. Used as the frontispiece to George Farmer's *The Organ of the Ancients* (London: W. Reeves, 1931).



Universal organ: Diagram reconstructing Mûristos' organ whose sound carries over vast distances. Drawing by Eilhard Wiedemann, 1918.

Programmable mechanical heart

The geographical and political hot spot of knowledge culture during the *L'âge d'or* of Arabic-Islamic science was the *Bait al-hikma*, the House of Wisdom, in ninth-century Baghdad. Its founder, Caliph Al-Ma'mun (813–33), who died when he was only 20 years old, is credited with facilitating many translations of Ancient Greek texts in natural philosophy and encouraging young scholars who were hungry for knowledge to think for themselves and develop an experimental approach to the world.[17]

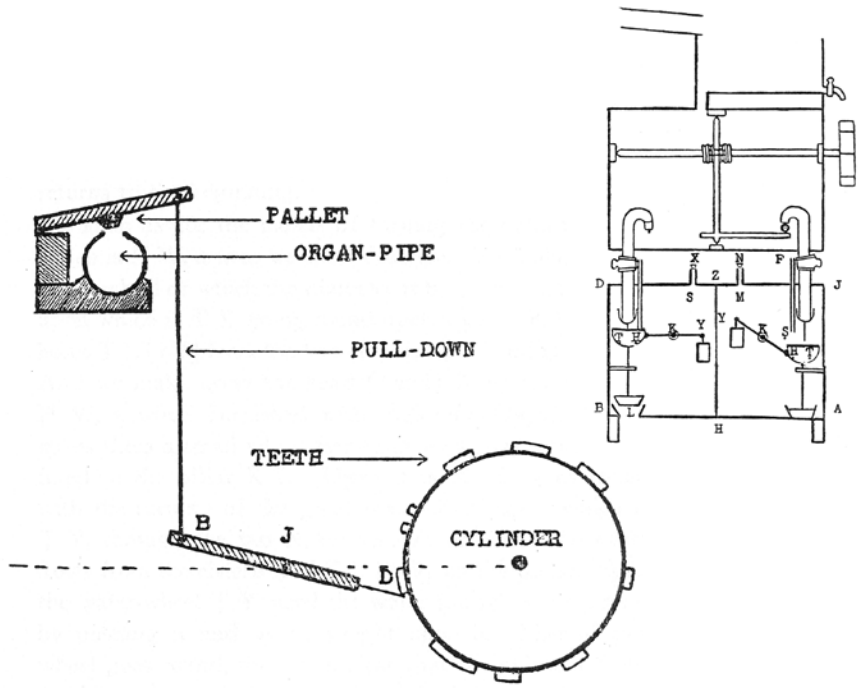
Among those who profited from this unrivalled institution were the brothers Muhammad (before 803–873), Ahmad (803–873) and Al-Hasan (810–873), sons of Musa bin Shakir, who formed a minimal cooperative that encompassed an entire universe of scientific qualifications: mathematics and geometry, astronomy, natural philosophy, medicine, music, and the engineering arts. These three brothers have gone down in the history of science and technology as the Banu Musa ('Sons of Moses'). They employed multitudes of translators who, amongst others, translated the works of the great automaton builder Hero of Alexandria from Greek into Arabic. Of these three princes especially Ahmad is considered an engineer of genius and he is surmised to be the principal author of *Kitab al-Hiyal* (Book of Ingenious Devices) of the mid ninth century.[18] This compendium is filled with sketches and exact building instructions for 100 models (*shakl*) of various artefacts, devices and their parts, kinetic sculptures and automata – automaton here meaning automotive artificial device: hydraulic and mechanical scooping automata and drinking fountains, pneumatically driven animals that make sounds, self-feeding oil lamps that automatically refill themselves and also move their wind shield so that the flame is protected and can theoretically burn forever.[19]

17. In this context, see Henry George Farmer's study *The Organ of the Ancients: From Eastern Sources* (Hebrew, Syriac and Arabic) (London: William Reeves, 1931), p. 55.
18. It is possible that he and Mûristos, who described the universal organ, are one and the same person.
19. Besides the texts by Eilhard Wiedemann the most reliable source on the work of the Banu Musa is still Donald R. Hill's translation and commentary, *The Book of Ingenious Devices (Kitab al-Hiyal) by the Banu (sons of) Musa bin Shaki*r (Dordrecht: D. Reidel, 1979). Hill's work also includes biographical notes on the three brothers.

I forgot the element or time 355;

That something can be in constant motion without a pause seems to have been very important to the Banu Musa. One of their masterpieces has this feature; it is not included in the extant copies of the *Book of Ingenious Devices*, but all the leading authorities on the history of Arabic-Islamic science attribute it to the prince Ahmad. The text was discovered by George Farmer in the *Three Moons* monastic school in Beirut, which belongs to the Greek Orthodox Church. It appears to be a solitary manuscript. First, it merely gives a description of a perpetually playing flute player. 'The instrument that plays by itself' (*Al-alat illati tuzammir binafsiha*) is what the Banu Musa called their musical device, emphasising its automatic character. The title also indicates that they ascribed a universal significance to the technology they outline in their description; clearly they wanted this invention to be understood independently and not only in conjunction with its implementation in the specific model of the flute player.

Hydraulically operated and pneumatically driven birds and flute players appear in ancient Chinese literature as well as in ancient Greek texts, for example, by Archimedes, Appollonius the geometer and carpenter,



Playing music automaton: The hydraulic-pneumatic part and a schematic diagram of the pinned cylinder's mechanism that opens and closes the valve, in this case of the flute. Drawing by George Farmer, 1931.

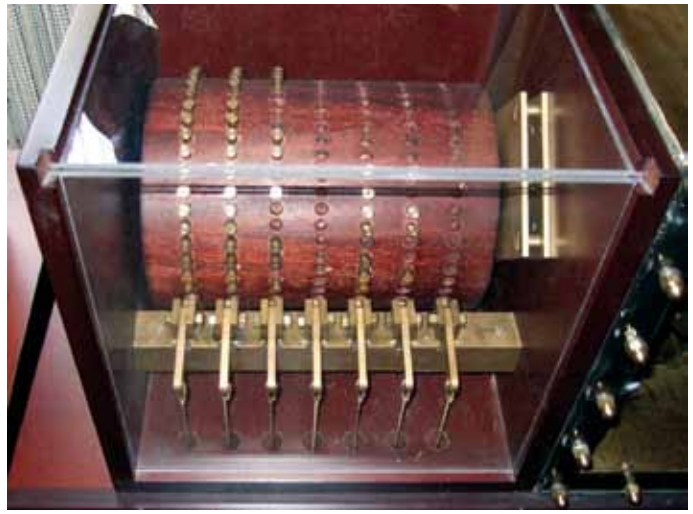
and Hero of Alexandria. The technically advanced solutions for propulsion are attributed to Appollonius. He developed an ingenious hydraulic pump system whereby his anthropomorphic figure plays the flute continuously as long as water flows into the mechanism. A kind of circular construction whereby a second water tank filled while the first emptied its contents and pressed out the air for the flute player ensured that the automaton literally had a constant supply of energy.[20]

The three princes from the House of Wisdom in Baghdad not only developed and improved on hydraulic and pneumatic mechanisms, they described and built a music automaton that was capable of varying rhythms and that could be fed with different melodies. The inventors' intention is cited in George Farmer's translation of parts of the manuscript: 'We wish to explain how an instrument […] is made which plays by itself continuously in whatever melody […] we wish, sometimes in a slow rhythm […] and sometimes in a quick rhythm, and also that we may change from melody to melody when we so desire.'[21]

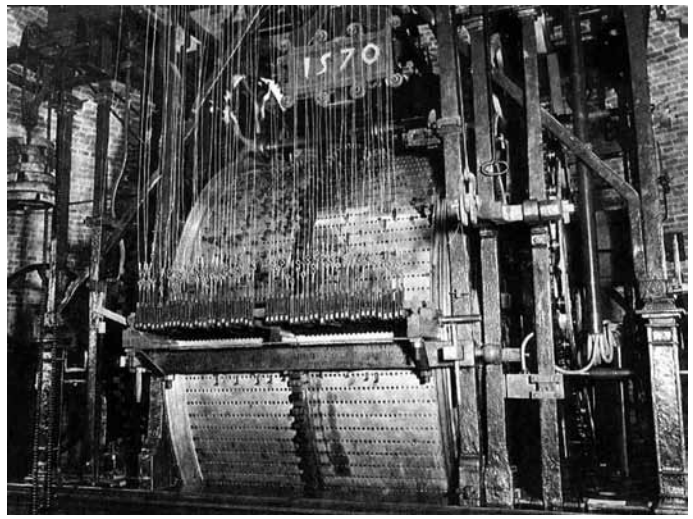
The heart of the automaton is a hydraulically driven cylinder. On the surface of the cylinder are bands made of wood or metal, which carry small protruding pins of different lengths. Depending on how these pins are positioned on the bands and how the bands are arranged in relation to one another, a mechanical translation opens or closes the valve of the flute, an organ pipe, or moves another sound-producing element. *Prographein* means to prescribe. The way the pins are arranged on the cylinder formulate the musical instructions, they are the *program* of the instrument; the pins and bands are notation translated into hard material. The hardware is virtually identical to the revolving cylinders with pins that were used 500 years later in the European glockenspiel of the late Middle Ages, and even later again in the mechanical organs of the Renaissance, as well as for the writing automata and automatic music instruments of the Age of Enlightenment.

20. See Eilhard Wiedemann, 'Über Musikautomaten', in: Oskar Schulz (ed.), *Sitzungsberichte der physikalisch-medizinischen Sozietät in Erlange*n, vol. 46, 1914 (Erlangen: Max Mencke, 1915).
21. Quoted in Farmer, op. cit., p. 88; the Arabic characters, which Farmer put in parentheses, are not included here.

All I need's d' toime machine 397;



Perpetual flute player: The programmable mechanical heart of the music automaton by the Banu Musa brothers (reconstructed under the direction of Fuat Sezgin at the Frankfurt Institute of the History of Arabic-Islamic Sciences), 9th century. Photo: Siegfried Zielinski.



Hydraulic organ: water-driven pinned cylinder to operate an organ. Engraving by Salomon de Caus, 1615. A design that was still being built in the eighteenth century.

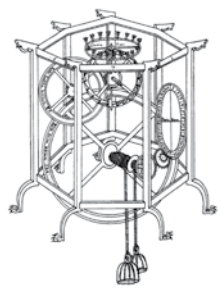
Time to hear and see

Due to the violent nature of the present historical juncture one of the most well-known broadcasters at the beginning of the third millennium CE is *Al Jazeera*. The Arabic-language news network's name means 'peninsula' and 'Al-Jazira' is also the name of a region situated between the Mesopotamian rivers Euphrates and Tigris in today's Iraq. On the upper reaches of the Tigris lies the city of Diyabarkir (Diyar Bakr), today in Turkish Kurdistan. It was

from here that the family of one of the most outstanding engineers of deep time Arabic-Islamic culture came, whose name al-Jazari reflects his geographic origins. At the end of the twelfth century he wrote a book that is unique in the history of mechanics and automaton construction. The copies with their illustrations are so magnificent that even 200 years ago they already aroused the commercial avarice of dealers in antiques. The few surviving manuscripts have been picked over like the valuable corpses of a bygone age; single pages are held in the collections of the Museum of Fine Arts in Boston, Harvard University Art Museum, Harvard University Center for Italian Renaissance Studies in Florence, the gallery of the Smithsonian Institution in Washington, and the Louvre in Paris. The oldest, also incomplete manuscript dates from the year al-Jazari died, 1206, and one of the most splendid and sought-after copies from 1354.[22]

The magnificent centrepiece in the automaton theatre of Ibn al-Razzaz al-Jazari is a hydraulically and pneumatically driven mechanical clock known as the Elephant Clock. In terms of its mechanics the automaton is quite complex; it both displays the passage of time and makes sounds to mark it. The ancient music automata can be viewed as mechanical objectifications of time that is audible: they fulfil the same function as the bells of medieval churches. In addition, al-Jazari's Elephant Clock had a deeply sacral function in that it can be understood as a mechanical symbolisation of the God-given ability of clever people to irrigate even the most arid landscapes and literally animate or ensoul the dry earth. 'If the servants of God but knew how well pleased God is when his Earth is made to come alive, not a barren spot would remain upon the face of the Earth.'[23] The old water-lifting machines also made a special sound, 'Al Hannana', the Sigher.[24] Cosmic sound and worship of God join forces.

22. This has been used by Fuat Sezgin and his colleagues for a leather-bound reproduction, which his Institut für die Geschichte der arabisch-islamischen Wissenschaften in Frankfurt am Main published in 2002. My admiration and sincere thanks go to Fuat Sezgin and his colleagues. The information cited here is taken from his Introduction to the volume. Although the individual sheets that are known were inserted into the facsimile edition, still no complete version of this extraordinary testimony to Arabic-Islamic knowledge culture exists.
23. Here Conrad Matschoß quotes an Arab scholar whom he does not name in his book *Geschichte des Zahnrads, nebst Bemerkungen zur Entwicklung der Verzahnung* (Berlin: VDI, 1940), p. 11.
24. Ibid., p. 10.



a little ramshackle for a time machine 402;

Clock: An air-powered metal bird sits chirping atop the water tank tower; below it at the front of the tank tower, flanked by two elaborate falcon heads, sits a kinetic figure moving its arms; two serpents are bound together on a central axis and turn their heads when a ball drops into the mouth of the upper one, thus shifting the serpent's weight; in the lower third of the tank tower sits a figure marking the passage of the hours on a circular metal disk; riding on the head of the elephant is the hour counter who beats time with a hammer. Drawing from a transcript of the manuscript by al-Jazari, ca. 1200.

Pathos and mechanics

One of the most powerful intellectual institutions of the early modern era in Europe was the Jesuits' Collegium Romanum in Rome. For several decades it was directed by a German from the ultra-conservative provincial town of Fulda, Hesse, who had been brought up a strict Roman Catholic: Athanasius Kircher (16012–1680). This polymath was one of the last scholars to attempt to depict in detail and interpret all that was known in his time about the world, God, and thinking.[25] On the basis of viewing mathematics as the primary discipline among the sciences of the seven liberal arts (*artes liberales*) and music, which were all subordinate to mathematics, people whose expertise spanned a significant number of different subjects were called 'polymaths', from Greek *polumathēs* 'having learned much'. They could not know everything but they represented, in a single individual, poly-disciplinarity. That they often helped themselves liberally to the written or published work of others, frequently without acknowledging their sources, they believed was compensated for by the originality of their exposition. They helped themselves especially freehandedly to the work of their theological and ideological opponents as they could rest assured that the central authority of the Vatican would not take any action.

Kircher's main work on the theory and praxis of music consists of two large format folios with ten books, his 'Universal Music-Making',[26] which was published shortly after the death of his Parisian adversary Marin Mersenne (1588–1648) and exploited extensively Mersenne's ideas about 'sounding algebra' as well as Robert Fludd's variations on the Pythagorean model.

In the context of the interactions between art and technology that interest us here two terms can be

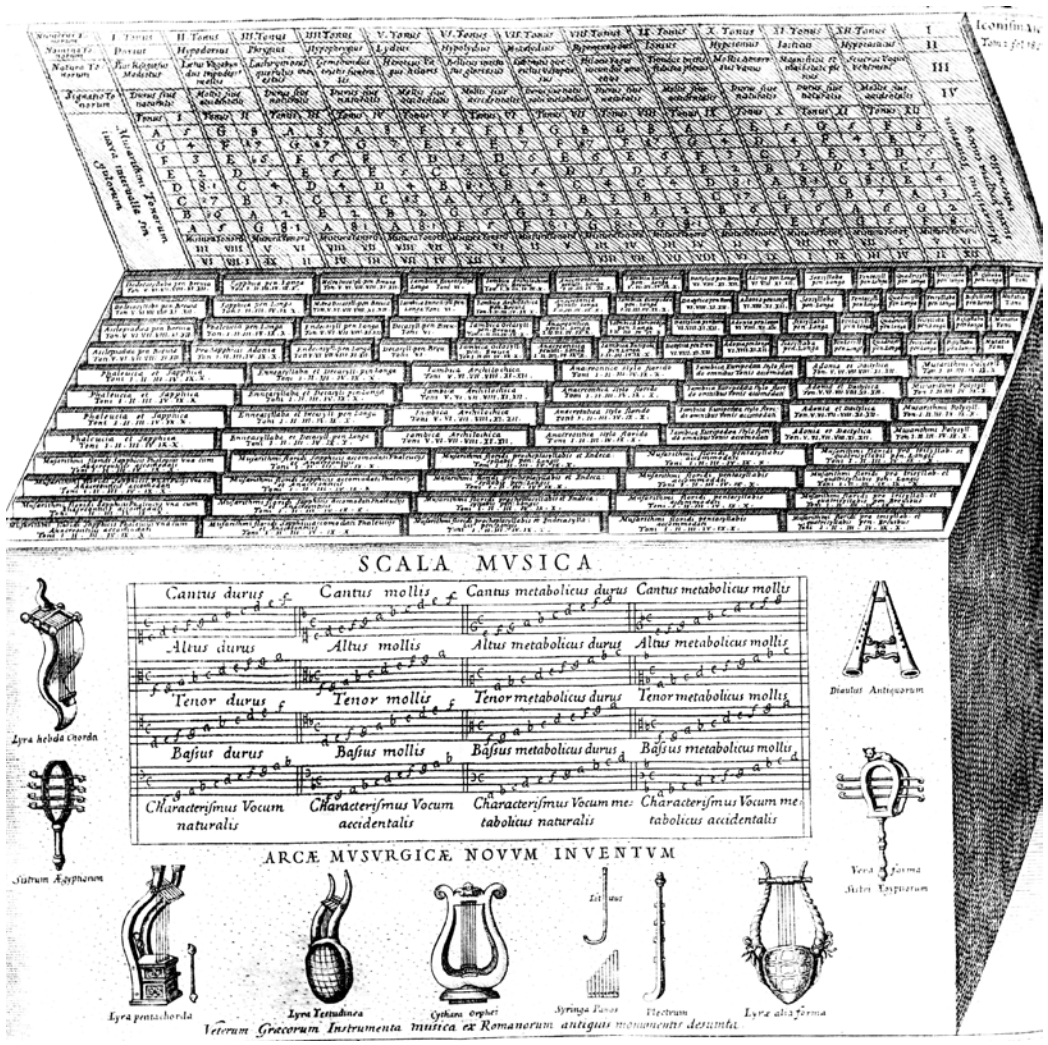
25. For more detail, see the chapter on Kircher in: Siegfried Zielinski, *Deep Time of the Media. Toward an Archaeology of Hearing and Seeing by Technical Means* (Cambridge, MA: MIT Press, 2006), the revised and expanded English edition of my *Archäologie der Medien*, which was published in 2002 by Rowohlt; the aspects of Kircher's work that are discussed in detail here are not yet included in the German edition.
26. All page references in this section are to Athanasius Kircher, *Musurgia universalis sive Ars magna consoni et dissoni in X libros digesta*., 2 vols. (Rome: Francesco Corbelletti, 1650). An annotated and indexed reprint edition has been published by Ulf Scharlau (Hildesheim: Olms, 1970). I wish to thank Eckhard Fürlus and Franz Fischer for their assistance with the translations from the Latin.

the First International Conference on Time-Travel 407;

considered the most significant in Kircher's musical world-view, namely, pathos and affect. Proceeding on the assumption that music can have a healing effect on mental states, he attributes to specific vibrations/keys the capability of producing mental effects (see particularly pp. 549–55) and unleashes a veritable fireworks display of various affective qualities (Book VIII, p. 680ff.), from the affect of love (*affectus amoris*) to the affect of joy/sensual pleasure/lust (*affectus gaudiosi*), the affect of pain (*affectus doloris*), and the affect of sorrow (*plangentium*). In this way musical composition becomes a curative for the soul; individual music fragments for the different states of suffering and passion can be retrieved like medicines from the appropriate drawer in a pharmacy.

From a media-archaeological perspective, Part 5 of Book VIII (*'Musurgia Mirifica'*) is one of the most intriguing segments of the Jesuit's musical and knowledge universe. It contains a text with the title 'On Mechanical Music-making' which centres on a peculiar artefact. Many references have been made to this artefact by commentators, but its detailed design and how it works remained curiously baffling: the *arca musarithmica*. I shall focus on its exact meaning insofar as Kircher's text offers the possibility of being exact, and work on translating the strange source code.

The Latin word *arca* means a chest, box, casket, money box, coffin, also a cell. Taking Kircher's description into account I would prefer a diminutive 'box' or 'casket'. *Musarithmicus* signifies measure and order in music: rhythm, cadence. Thus, rhythm chest, rhythm box or, in more general terms, composition casket would be possible names for this artefact, which definitely has the character of an apparatus. Before he describes how the object is constructed, Kircher begins by clearly stating his interest in the artefact: 'Mechanical music-making is simply a specific theory that I have substantiated and by which anyone, even unmusical people, using very different musical instruments can compose songs of a certain artistry.' (Book VIII, p. 185) Kircher emphasises that the addressees of his mechanical music-making project are laypersons (Greek *ámysos*) and not musical geniuses or professional composers. His device is a tool for the educated general public, not for specialists.



Rhythm box: The opulent device promised by this engraving of the *arca musarithmica* in Kircher's *Musurgia universalis* from 1650 was in reality a small portable cardboard box.

Next, Kircher describes the construction of the 'rhythm box' (Book VIII, p. 185) down to the exact measurements of its dimensions and inserts a stunning illustration in his manual that promises a large and ornately embellished chest, which the actual small and simple boxes of cardboard and wood in no way match. Kircher continues:

> By rhythm box I mean a small container for rhythm columns […] It should be a container that is as long as it is high; both these sides should measure a hand's width but the breadth should only measure half a hand's width. This side should be divided into 3 sections using slats to form three separate containers. The length of the box […] should be a hand's width; this should measure the same as the height […] Whereas the breadth […] should be half a hand's width. The empty space between AB and DC should be divided into three equal-sized compartments using centrally positioned slats GE and FH. Further, the first compartment HB–FC should be divided into twelve equal parts by small slats inserted into the concave centre. The twelve small compartments should be numbered clearly. The second large compartment GHEF should, as seen in the illustration, be divided into six smaller compartments. The third large compartment AGDE should be divided up into as many compartments as is shown in the illustration accompanying this book ['Ikonismus XIV', the illustration as engraving]. On the front of the box should be written the phonotactic system as well as the tonographic table. (Book VIII, p. 185).

Kircher then proceeds to describe the columns and rods upon which the composition fragments are inscribed. Like his description of the *arca*'s construction, discrepancies to its depiction in the illustration constantly crop up. Therefore I shall restrict my remarks to the instructions for its use. 'On using the rhythm box' is Kircher's title for this third chapter of the text.

> If one desires to compose a song, one sits down in front of the complete box. Then from the phonotactic compilation, which is arranged on the palimpsest one

selects a melodic theme as the basis for the entire song. For example, one selects 'Cantate domino canticum novum, laus eius in ecclesia sanctorum' – 'Sing the Lord a new song, His praises shall ring in the Church of the Blessed'. First, one divides the chosen theme into sections of several syllables as shown below:

VI. penul-timate short	V. penul-timate long	III. penul-timate long	V. penul-timate short	III. penul-timate long
Cantate domino	canticum novum	laus eius	in ecclesia	sanctorum

When one has divided up the theme on the phonotactic palimpsest and taken off the lid carrying the inscription '6-syllable penultimate short', one lays this down in front of one and then takes out the column marked 'VI–'. Next, one takes out the column marked 'V∼'; thirdly, the column marked 'III–'; fourthly, the column marked 'V∼'; and fifthly, the column marked 'III–'. These columns are then placed side by side in the order that corresponds to the divisions of the theme and how it is shown here. However, we have only printed the beginning of the columns here so that the complete columns would not take up too much space.' [N.B. ∼ = penultimate syllable short; – = penultimate syllable short]

If one arranges the columns in this way one can combine them in any way with each other; either along a horizontal row when they are all in the same position (as here), or when they are in different positions, pushed up or down: the horizontal rows always give a coherent phrase of a song [*intentam melothesiam*]. [See illustration on p. 100–101]

The obtrusively didactic character of the composition casket and its descriptions are blatantly obvious. Like all the other mechanical artefacts that Kircher constructed for practising the art of combination, the arca rigorously pursues a pedagogical goal; it is intended for private studies or as an educational aid. However, in his Conclusion I, (Book VIII, p. 188) the Jesuit suddenly waxes lyrical:

River of Time
410;

In all cultures that utilise musical tunings and systematic intervals there are similar analogies of the fundamentals and their relations to each other to microcosmic and macrocosmic structures.

MVSVRGIAE MIRIFICAE PARS V.

DE MVSVRGIA MECHANICA SIVE

De varia mobilium Musarithmicarum columnarum Metathesi siue transpositione.

MVSVRGIA mechanica nihil aliud est, quàm certa quædam ratio à nobis inuenta, qua quiuis etiam ἄμουσος varia instrumentorum Melotheticorum applicatione cãtilenas iuxta petitum artificium componere possit. Quam quidem mechanicam Musurgiam, qua fieri potest breuitate trademus, & ne præfando tempus teramus, à fabrica Arcæ Musarithmicæ ordiemur.

CAPVT I.

Fabrica Arcę Musarithmicæ. *Vide Iconis. XIV. huic lib. præpositum.*

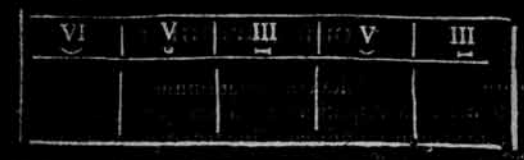
ARcam Musarithmicam vocamus receptaculum columnarum Musarithmicarum; Columnas verò Musarithmicas vocamus à Musarithmis pinacum in ligneis aut chartaceis virgis seorsim descriptas; Arcam igitur hac industria præparabis. Fiat receptaculum quoddam cuius longitudo altitudini æqualis, vtraque videlicet palmum integrum habeat, latitudo verò ½ palmi partem habeat. hanc latitudinem iterum in tria alia particularia receptacula alijs asseribus discriminabis. Sit Arcæ longitudo incit: Iconismo A D vnius palmi; cui respondeat altitudo A I vel D V. latitudo verò A B vel D C ½ palmi: vacuum verò intra A B & D C iterum in 3. æqualia loculamenta asseribus G E & F H per medium transactis discriminetur. Porrò primum receptaculum H B. F C iterum in 12. partes æquales asserculis per medium concauum transuersim transactis dirimatur, vt 12 cellulæ numeris suis insignitæ clarè demonstrant. Secundum receptaculum G H E F in 6. receptacula asserculis per medium transuersim transactis, vt figura docet, diuidatur. 3. verò A G D E receptaculum in totidem partes seu receptacula, vt figura siue Iconismus XIV huic libro præfixus ostendit, diuidatur, in facie verò Arcæ systema phonotacticum, vna cum mensa Tonographica describes, eo ordine quo in principio huius partis tradidimus, & hic apparet; è latere verò D C alia loculamenta fieri curabis, vt L M demonstrat, in hisce columellas tonorum Musarithmicas iuxta ordinem in mensa Tonographica descriptum impones. vt Icon. docet.

CAPVT II.

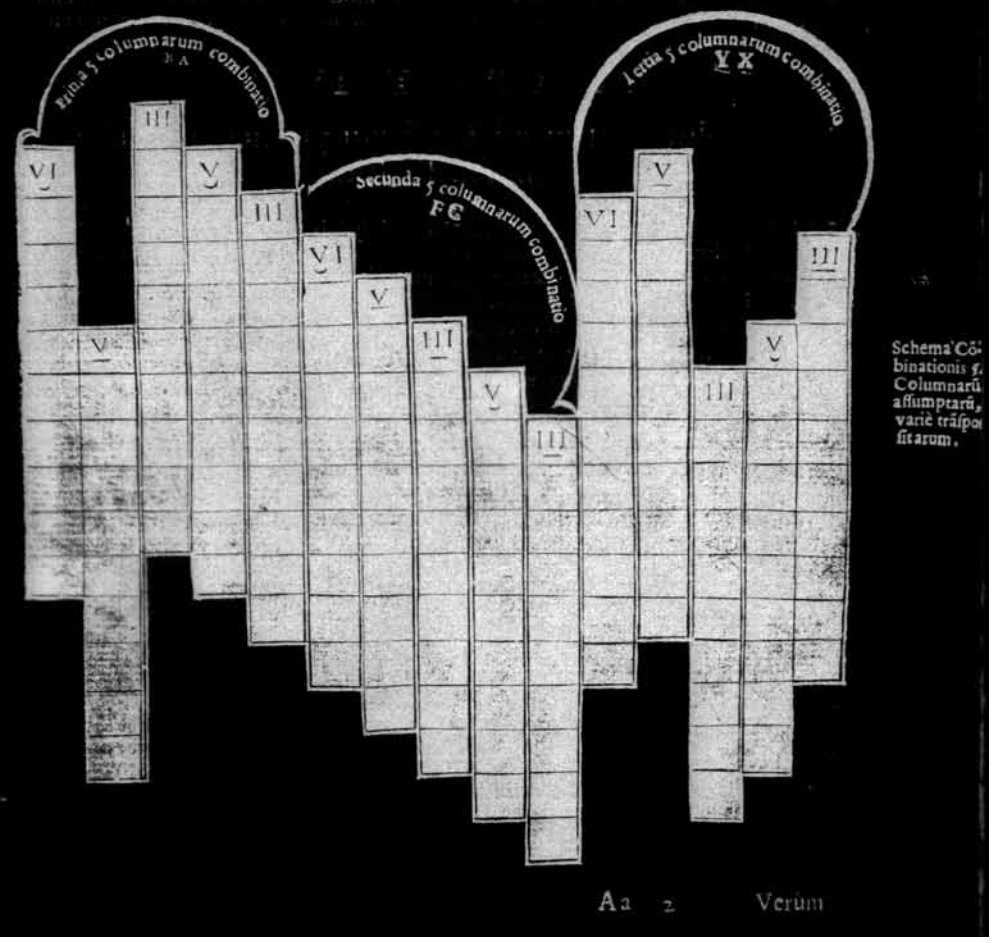
De columellis Musarithmicis, earumque in receptaculis præparatæ cistæ ordinatione.

PRimò accipe omnes ordine pinaces contrapuncti simplicis numero 12. horum pinacum columnas singulas seorsim in chartaceis aut etiam ligneis virgis aliquoties

inscriptionem habet VI. deinde ex eodem columnam huius inscriptionis V tertiò columnam huius inscriptionis III. quartò columnam huius inscriptionis V. quintò columnam huius inscriptionis III. Quas omnes columnas eo ordine quo thema digestum est collocabis, vt hic apparet. vbi tantum initium columnarum exhibuimus, ne integræ columnæ nimium spacium occuparent.

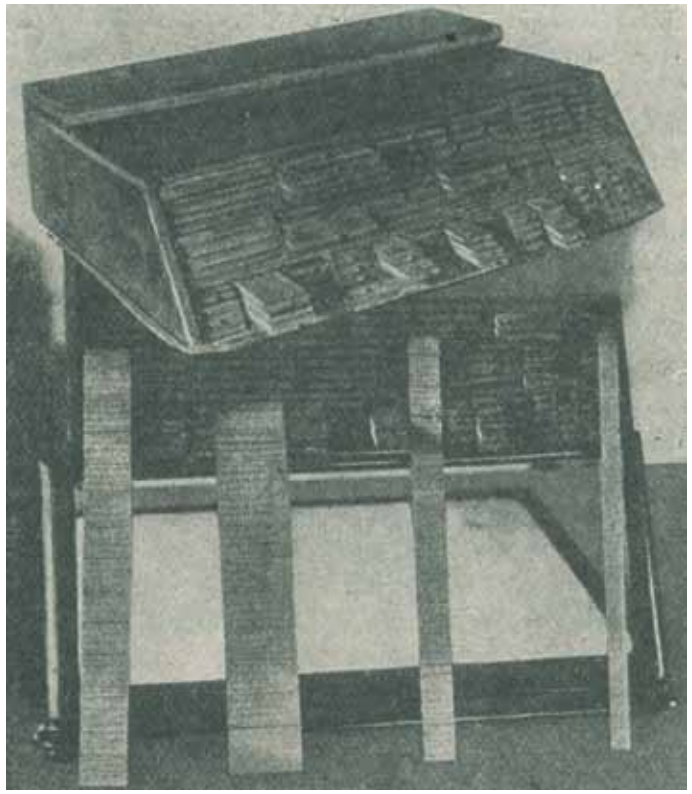


Dispositis hoc ordine columnis, eas quomodolibet inter se combinare poteris, siue enim quamcunque tran fueriam seriem dum æqualem situm habent (vti hic) siue dum inæqualem quemcunque situm habeant, id est, quomodolibet sursum vel deorsum promoueantur, transuersæ series semper intentam præstabunt Melothesiam. v.g.



Two pages from Book VIII of *Musurgia universalis* on mechanical musical-making with important passages about the construction and operating principles of the automatic composition machine, 1650. The image is reproduced in negative for reasons of clarity.

Page 187 shows the possibilities of combining columns, as cited in the text. Translation of the caption for this illustration: 'Schema of a combination of five columns positioned differently. First combination of the five columns BA – Second combination of the five columns FC – Third combination of the five columns YX.' The image is reproduced in negative for reasons of clarity.



Composition chest: Samuel Pepys' (1639–1703) replica of Kircher's device, which Hungarian histories of cybernetics often cite as the first mechanical composition apparatus; the source here is Tihamér Nemes, *Kybernetische Maschinen*, Budapest: Akadémiai Kiado, 1967 (German edition Berlin: VEB Technik, p. 257).

'From this array one can see the infinite multitude of possible combinations that ensue from the different arrangements of the five columns. Without doubt there are so many *that if an angel had begun with the combinations at the beginning of time it would still be continuing today*.' [my emphasis, SZ]

The infinite variability of the combinations of simple harmonious musical fractals could be put together time and again to form larger harmony constructs and could be produced by anyone, provided they had the cultural technology of the *ars combinatoria* at their disposal and knowledge of rhetoric, poetry and musicology. The pop music of the seventeenth century was the music compositions that were played and/or sung in churches and at Christian rituals in endless loops.

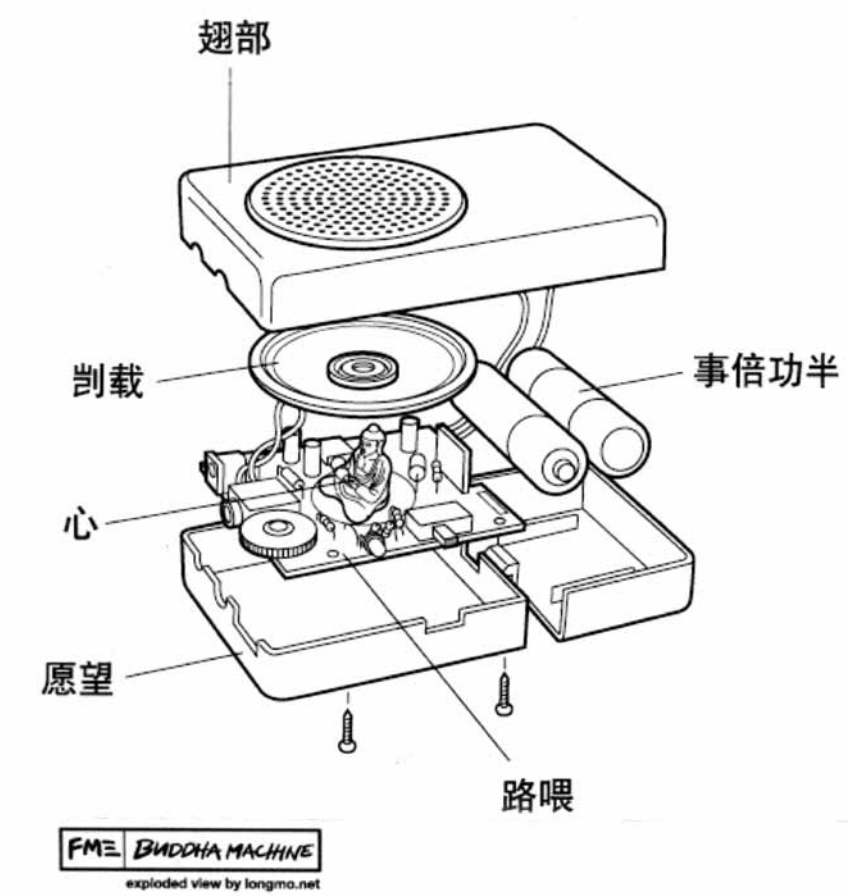
Time did not so much elapse as grow less relevant 412;

Believing machines

My current mechanical–electrical favourites are two special devices that originate from a religious context. The first I encountered for the first time a few years ago in Naples; in the meantime, it is found all over southern Europe. On a rectangular metal container, which looks like it might hold a keyboard, around thirty electric candles are mounted. With their spindly legs, from a distance these artefacts look like fragile, badly made Hammond organs. The electric offertory box produces a simple effect that is primarily of an optical nature (although the light bulbs of the candles also produce an interesting humming sound if on): when one of the buttons positioned in front of the candles is pressed, a candle lights up and becomes the visual representative of my soul in the house of God. After a while the candle turns off and is ready to be used again, without making a mess with molten wax, and without flickering or guttering like traditional cultic lights. These offertory boxes, which get their power from electric wall sockets, are part of an electrification campaign that has particularly taken hold of small churches and chapels in southern Europe. If one goes in, drawn by the sounds of singing, organ music, or litanies, the surprise is great to find that the church is completely empty of the usual church staff. The acoustic material comes from a cassette or CD player behind the altar or, rather, out of the loudspeakers. Technical reproductions completely replace everything that essentially constituted the aura of the Mass or of going to church.

Electric offertory, Naples 2005. Photo: Monokrom.

Battery-powered plastic Buddha machine from China, 2005. Photo: Monokrom.



Buddha machine: Accompanying diagram showing the mechanical inner workings, 2005.

the *existence* of Time as really to ridiculous to consider 412;

The nice thing about the electrical offertory boxes is that they are 'believing machines'. Between the rows of candles and the row of buttons there is a slot. On the Italian variants it is labelled 'Offerta'. This is where the visitor to God's house is supposed to buy the temporary representative of his or her soul. However, they usually work even without inserting a coin. The median section, the medium of the offertory box, is not connected in any way to the buttons and candles. The machine believes the users, believes that they have paid when they press a button, and the visitors believe in the effect and enjoy it.

Equally effective is a small technical artefact that is currently being produced in its millions in China. It is a small red plastic case with a loudspeaker that at first glance looks like a miniature transistor radio. However, if you turn it on, the same sound always comes out; the louder it is turned up the tinnier the sound, but the maximum volume is not very loud. An endless loop of religious chants (sutras) are heard, the text of which I cannot decode. It sounds as though there is a small Buddha sitting inside the box chanting. And in the small sketch of its internal structure that accompanies the tiny technical wonder there actually is a small Buddha sitting in the centre. One has to believe he exists. However, if one opens the device to see whether he really exists inside it, the fragile box gives up the ghost.

Back to the beginning

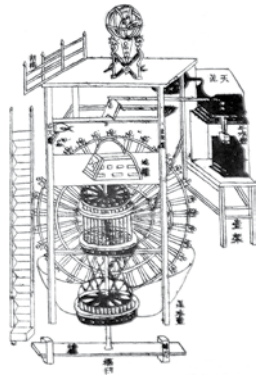
For the chemist and physicist Johann Wilhelm Ritter, physics, particularly experimental physics, was a praxis whereby the imperceptible inner states and processes of the motion of matter could be rendered audible, visible, and felt in his own body: to render what is intangible, yet nevertheless present, perceptible to the senses, to translate it into data, which could then be calculated and translated into technical artefacts. In Ritter's *Heterodoxies*, as he referred to his essays, sound and light are ultimately one: 'Hearing is seeing from within, the very innermost consciousness'.[27] Sound and light are merely different forms of expression of the one central phenomenon,

27. J.W. Ritter: *Fragmente aus dem Nachlasse eines jungen Physikers* (Heidelberg: Mohr und Zimmer, 1810). Facsimile edition with an Afterword by Heinrich Schipperges (Heidelberg: Schneider, 1969), item 358.

namely electricity, and its various states of charge and oscillation. For the experimental natural scientist this was above all a question of the distribution of quantities on an infinite scale. 'When bodies oscillate e*xtremely fast*, they *glow*', he wrote in his posthumously published aphorisms. The dynamic 'light figure' or 'fire-writing', which he enthuses over time and again, are for Ritter extremely high frequency oscillations where sound passes over into light, a phenomenon that is only visible, and which represents for him 'the highest degree of reality'.[28] When Ritter describes the opposite pole – the transitions to the low-frequency sounds that humans can barely hear or not at all – he chooses a curious comparison: 'The rotation of the Earth on its axis, for example, may make a significant sound; this is the oscillation of its internal conditions, which is caused by this; the orbit around the sun may make a second, the orbit of the moon around the Earth a third, and so on. Here one gets the idea of a colossal music, of which our own poor [music] is but a significant allegory […] As a harmony this music can only be heard on the sun. For the sun, the entire system of planets is *one* musical instrument. To the *inhabitants* of the sun its notes may simply appear as the zest for *life*; however, to the sun's *mind itself* it is the ultimate and truest sound.'[29]

This powerful image evokes associations with Georges Bataille's (1897–1962) idiosyncratic economy of the universe from the 1930s, which centres on our ceaselessly energy-wasting star, the sun, and it also appears in a modified form in one of Walter Benjamin's lesser known radio plays. Benjamin dedicated the play to the man who inspired the acoustician Ernst F.F. Chladni (1756–1827) to undertake the experiments that resulted in his sound figures: the physicist, philosopher and writer Georg Christoph Lichtenberg (1742–99), who in 1777 with his *Eidophor* captured the effects of positive and negative electrical charges as figures of light-coloured powder on a black background; light figures drawn directly by the electric fire. Benjamin's radio play was written in 1933.

28. Ritter, letter to Christian Gottlob Voigt, 26 March 1804, cited in Else Rehm, 'Johann Wilhelm Ritter und die Universität Jena', in: *Jahrbuch des freien deutschen Hochstifts* (Tübingen: Niemeyer, 1973), p. 206.
29. Ritter, op. cit., item 360.



to enter your time-regime 415;

In it the inhabitants of the moon observe Lichtenberg, the scientist from Göttingen, on Earth. The 'moon beings' possess three devices for investigating life on Earth: 'first, a *spectrophone*, through which everything that takes place on Earth can be seen and heard; an *oneiroscope*, with which the dreams of the earthlings can be observed; and lastly, a *parlamonium*, by which means the inhabitants of the moon, pampered as they are by the music of the spheres, can translate the often tiresome talk of humans into music'.[30]

Translated from the German by Gloria Custance.

30. W. Benjamin, 'Lichtenberg. Ein Querschnitt', in: W. Benjamin, *Drei Hörmodelle* (Frankfurt am Main: Suhrkamp, 1971). To accentuate the conclusion of my essay, I have taken the liberty of changing the order of the last two devices on Benjamin's list.

Innovation, Technology, or History

What Is the Historiography of Technology About?

David Edgerton

What exactly should the field Historiography of Technology consider, since the study of technology is clearly not confined to self-proclaimed historians of technology? How can we even begin to give a picture of its accomplishments? In this essay I ask an even bigger prior question: What is the history of technology – in many different guises, and in many different modes – the history of? What, in practice, is meant by technology in histories, and what is meant by history in histories of technology? Our thinking about technology, and indeed our thinking about the historiography of technology, is, I suggest, uncritically focused on some, but not all, novelties.

In the past 30 years, public policies in the US, Europe, and the rest of the rich world have placed enormous rhetorical emphasis on the need for increased 'innovation', which has been reflected in increased institutional support for implicitly instrumentally useful social and historical studies of technological change.[1] In the historiography of technology too there has been a strong focus on novelty, on radical breaks with the past. In the academy we are supposed to have moved beyond unreflexive progress-talk, and are now eclectic, playful with time, and open to the marginal. But, in historiographical pronouncements that introduce and summarise new work, a very old-fashioned and narrow progressivism is prevalent.[2] Authors invoke the spectre of a darkly ignorant past, an enlightenment in 'recent years' (embellished with a citation to a work decades old), and a contemporary revolution.

In the academy, as in technology and in politics, novelty-mongering does not necessarily reflect novelty, much less progress. During the 1980s historians of technology were invited to embrace, as a supposed novelty, applied sociology of scientific knowledge. This meant that although applying to science what was already known about technology, politics, history, as well as embodying

1. It is, however, a mistake to believe that this has been central to public policy (market liberalisation has been much more significant) or that innovation has in fact increased.
2. As an example see Mark Poster, *Cultural History + Postmodernity: Disciplinary Readings and Challenges* (New York: Columbia University Press, 1997). While this tone is evident in programmatic statements, it is not generally noted that this reflects a profoundly modernist mode of thought. An exception is Richard Evans in his *In Defence of History* (London: Granta, 1997), pp. 201–2, where he cites William Reddy noting 'postmodernism's replication of the eternally recurring pretension of absolute originality characteristic of intellectual debate since the Enlightenment' (p. 278, note 15).

the view – explicitly rejected by many historians of technology – that technology is applied science.[3] While this approach (Social Construction of Technology, or SCOT, in shorthand) did open up new questions for some historians of technology, others were already alert to alternatives, to paths not taken, to the reality that not all change is progress, and to an understanding that the invocation of theory is not in itself a sign of methodological or historiographical sophistication.[4]

We need to attend to meanings not just in relation to technology but in the work of historians of technology too. To understand what historians of technology are actually doing and how they do it, we need to look beyond the claims to methodological and historiographical novelty, implicit and explicit, and attend to what is said and done. Yet in the history of technology, analysis of what historians have argued, produced, established, assumed, and concluded is extraordinarily rare, whether in celebratory or critical mode. In meetings of the Society for the History of Technology (SHOT) and in the journals, it is surprising how few and far between critical references to specific historical arguments are: there is hardly any debate or even serious substantive disagreement.[5]

In what follows I make a particular assessment and critique of what is commonly done and made and how it is commonly done and made (to echo an old and yet, as we shall see, hardly ever observed definition of technology) in the historiography of technology.[6] I suggest that much history of technology has been concerned with illustrations, through historical examples, of the nature of technological

3. This was the argument of my 'Tilting at Paper Tigers', in the *British Journal for the History of Science*, vol. 26, no. 1 (1993), pp. 67–75.
4. 'The idea seems to be that if our findings or our arguments fit neatly into some widely accepted theoretical framework, then that will satisfy all the conceivable methodological concerns: theory provides that common language of argument… and it also provides as much social science as we might need to ensure that our statements are anchored in a plausible understanding of human nature and social being'. Peter Mandler, 'The Problem with Cultural History', in *Cultural and Social History*, vol. 1, no. 2 (2004), pp. 94–117.
5. There are partial exceptions – for example, the exchange between Ken Alder and Charles Gillispie in *Technology and Culture*, vol. 39, no. 4 (1998), pp. 733–54; Leo Marx's review of Stephen H. Cutcliffe and Robert C. Post, eds., *In Context: History and the History of Technology: Essays in Honor of Melvin Kranzberg* (Bethlehem, Pa.: Lehigh University Press, 1989), in *Technology and Culture*, vol. 32, no. 4 (1991), pp. 394–96; and 'Comment and Response on the Review of In Context', in *Technology and Culture*, vol. 33, no. 2 (1992), pp. 406–7.
6. Charles Singer et al., eds., *A History of Technology* (New York, N.Y.,: Oxford University Press, 1955) vol. 1, p. vii.

change. This is done by studying selected novelties, when they were new, in historically familiar surroundings, with the aim of illuminating the technology–society relation.

'Technology' in academic historical practice means a peculiar conflation of novelty and power.[7] It is indeed a 'hazardous term', to use Leo Marx's expression, which often seems to blunt analytical tools; sometimes it seems to make critical thought impossible.[8] As recent work by Eric Schatzberg makes clear, the term 'technology' is a much-changing, fluid concept; its widespread use in something like the modern sense dates only from the interwar years, and though it was closely connected to the idea of progress it was not then conflated with novelty.[9] It became identified with technological novelty after World War II, and this identification, I argue, has profoundly affected historical work.[10] In other words, the history of technology uses very particular definitions of technology and history, definitions that would need replacing should one want to inquire into the place of technology in history, to answer questions like, 'What technologies shaped twentieth-century America?'

My assessment is a particular and limited one, concerned mainly but certainly not only with outstanding general texts in the history of technology, concentrating on what they say about the twentieth century.[11] I show that key assumptions about technology and history to be found in this literature are also commonplaces in many different historical and social scientific literatures, in the best and

7. I have also argued there is an analogous problem in the history of twentieth-century science, which is focused on research, not science, and within that on academic research in subfields of physics and biology, while claiming to be engaged with questions of 'science and society' rather than merely the history of the academy. See my 'The Linear Model Did Not Exist–Reflections on the History and Historiography of Science and Research in Industry in the Twentieth Century', in *The Science-Industry Nexus*: *History, Policy, Implications*, ed. K. Grandin, N. Wormbs, and S. Widmalm (Sagamore Beach, Mass., 2004), pp. 31–57.
8. Leo Marx, 'Technology: The Emergence of a Hazardous Concept', in *Social Research*, vol. 64, no. 3 (1997), pp. 965–88. A revised version, which I have not seen, is Leo Marx, 'Technology: The Emergence of a Hazardous Concept', in *Technology and Culture*, vol. 51, no. 3 (2010), pp. 561–77.
9. Eric Schatzberg, 'Technik Comes to America: Changing Meanings of Technology before 1930', in *Technology and Culture*, vol. 47, no. 3 (2006), pp. 486–512; Ruth Oldenziel, *Making Technology Masculine: Men, Women and Modern Machines in America*, 1870–1945 (Amsterdam: Amsterdam University Press, 1999).
10. David Edgerton, 'De l'innovation aux usages: Dix thèses éclectiques sur l'histoire des techniques', in *Annales* HSS, vol. 4–5 (1998), pp. 815–37. The English version is 'From Innovation to Use: Ten [Eclectic] Theses on the History of Technology', in *History and Technology*, vol. 16 [1999], pp. 1–26.
11. I note here the following, in chronological order, though I do not discuss them all. Some I have discussed in my 'De l'innovation aux usages' (note 10 above).

arrange oneself in Time 426;

most celebrated works. It might be objected that such general texts in their very generality cut against the grain of recent developments, and that they therefore cannot stand for the field as a whole. My own view is that, for all the supposed incredulity toward meta-narratives, there is an often implicit credulity toward some meta-narratives in narrower studies, usually the familiar long-established ones, though often inverted into anti-progressive forms. But in this essay I make no attempt to assess the journal literature.

I should also say something about my own contribution to the big-picture genre. *The Shock of the Old* (2007) was written for the general reader, so I did not set out a full critique of the literature or label every novelty. The book was based on the idea, developed here, that accounts of the material constitution of twentieth-century society have been flimsy, yet have very great authority. *The Shock of the Old* seeks to present new historical arguments in relation to technology in history, about such

Arnold Pacey, *The Maze of Ingenuity: Ideas and Idealism in the Development of Technology* (Cambridge, Mass.: MIT Press, 1992; first edition, London: Allen Lane Press, 1974); Thomas P. Hughes, *American Genesis: A Century of Invention and Technological Enthusiasm, 1870–1970* (New York, N.Y.: Viking, 1989); Arnold Pacey, *Technology in World Civilisation: A Thousand Year History* (Oxford: Basil Blackwell, 1990); R. A. Buchanan, *The Power of the Machine: The Impact of Technology from 1700 to the Present* (London: Viking, 1992); Donald Cardwell, *Fontana History of Technology* (London: Fontana, 1994), known in the United States as the *Norton History of Technology* and more recently as *Wheels, Clocks, and Rockets: A History of Technology*; Carroll Pursell, *White Heat: People and Technology* (Berkeley, Calif.: University of California Press, 1994); Carroll Pursell, *The Machine in America: A Social History of Technology* (Baltimore: Johns Hopkins University Press, 1995); Carroll Pursell, *Technology in Postwar America: A History* (New York, N.Y.: Columbia University Press, 2007); Ruth Schwartz Cowan, *A Social History of American Technology* (New York, N.Y.: Oxford University Press, 1997); Thomas P. Hughes, *Human-Built World: How to Think about Technology and Culture* (Chicago: University of Chicago Press, 2004); Thomas J. Misa, *From Leonardo to the Internet: Technology and Culture from the Renaissance to the Present* (Baltimore: Johns Hopkins University Press, 2004); Mikael Hård and Andrew Jamison, *Hubris and Hybrids: A Cultural History of Technology and Science* (London: Routledge, 2005); David Nye, *Technology Matters: Questions to Live With* (Cambridge, Mass.: MIT Press, 2006); Robert Friedel, *A Culture of Improvement: Technology and the Western Millennium* (Cambridge, Mass.: MIT Press, 2007). For younger readers there is also W. Bernard Carlson, ed., *Technology in World History* (New York: Oxford University Press, 2005). See also Dick van Lente, 'Three Overviews of the History of Technology', in *History and Technology*, vol. 24, no. 1 (2008), pp. 89–96, which deals with *Leonardo to the Internet*, with Mikael Hård and Andrew Jamison, *Hubris and Hybrids: A Cultural History of Technology and Science* (London: Routledge, 2005) and with Harry Lintsen, *Made in Holland: Een techniekgeschiedenis van Nederland (1800–2000)* (Zutphen, Netherlands: Walburg Pers, 2005), which alas I cannot read. I would insist that many of my observations do not apply to the study of earlier periods, particularly the early modern (the historiography of which is addressed by Pamela Long in an essay in *Technology and Culture*, vol. 51, no. 3, July 2010, pp. 698–714.

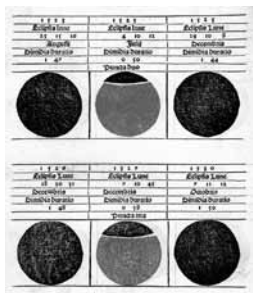
matters as production, nations and nationalism, war, and so on. It rests on a very general historiographical critique, rather than on a call to shift attention to under-researched aspects of technology. Although it has been interpreted as arguing for the study of use over invention/innovation, or for the small rather than the big, or for extending studies of users and consumers, or to shift attention from the rich to the poor, it is a call to rethink invention/innovation as well as use – to rethink the big as well as the small, production as well as consumption, and the rich world as well as the poor world.[12]

What is the history of technology about?

Reviewing the *Short History of Technology*, by T.K. Derry and Trevor Williams, Thomas P. Hughes lamented that 'influenced by prior scholarship they have generally written of the history of technology as if it were identical with the history of invention'. This, despite their very broad and non-innovation-centric definition of technology alluded to above.[13] Hughes's complaint notwithstanding, the identification of technology not with invention, but with some successful invention and the early histories of particular technologies, lives on powerfully, and is especially evident in (though certainly not restricted to) general texts.

Let us move from past observations by the last of the founders to the newest general text, Robert Friedel's *Culture of Improvement* (see note 11). Friedel's introduction tells us that the subject matter is the 'nature of technological change', why and how technological change has changed, and how the changes have changed. It promises to be a history of invention and innovation, usefully recast as part of a wider history of 'improvement',

12. *The Shock of the Old: Technology and Global History Since 1900* (New York: Oxford University Press, 2007). Furthermore, I had set out some of my general argument in relation to the existing literature in my 'De l'innovation aux usages' (note 10 above). I have added some reflections and elaborations on particular aspects in two papers: 'Creole Technologies and Global Histories: Rethinking How Things Travel in Space and Time', in *HOST: Journal of the History of Science and Technology*, vol. 1, no. 1 (2007), pp. 75–112, available at http://www.johost.eu/user/data/media/hostn1v1-a2.pdf (accessed 12 May 2010); and 'The Contradictions of Techno-Nationalism and Techno-Globalism: A Historical Perspective', in *New Global Studies*, vol. 1, no. 1 (2007): article 1, available at http://www.bepress.com/ngs/vol1/iss1/art1 (accessed 12 May 2010).
13. Thomas P. Hughes, review of T. K. Derry and Trevor I. Williams, *A Short History of Technology: From the Earliest Times to A.D. 1900* (London, New York: Oxford University Press, 1961), in *Isis*, vol. 54 (1963), pp. 417–18.



passage backward in Time 426;

avoiding the misleading and almost always post-hoc distinctions between radical and incremental inventions, which are still very prominent in the literature.

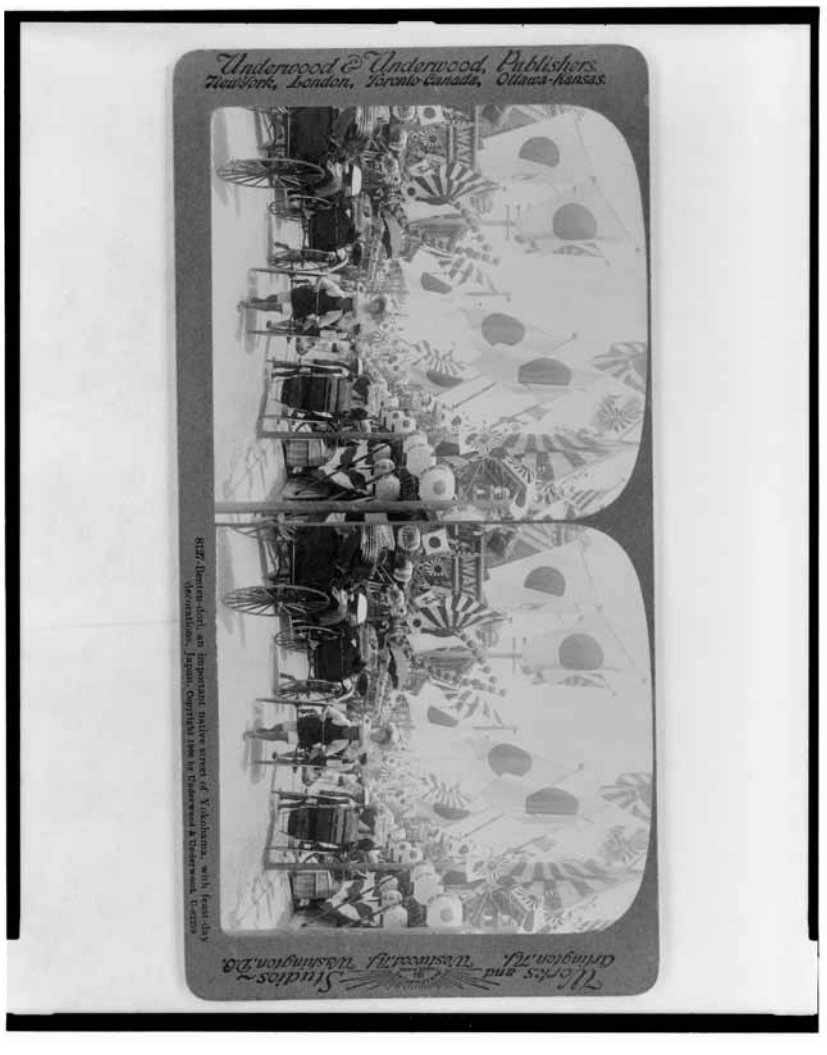
For Friedel, improvements can be small or large and apply to all technologies, whether old or new, an important analytical advance. Yet the book presents a familiar account of selected technologies at early points in their history. Agriculture thus appears in a chapter on the medieval heavy plough, the horse, and three-course crop rotation, and again in the nineteenth century with mechanisation and artificial fertilisers. The greatest-ever age of agricultural improvement in the rich world, that of the late twentieth century, is not discussed. The subjects of the four chapters on the twentieth century are the early histories of strategic bombing, the nuclear bomb, dams and electrification, computers, the Internet, jets and supersonic airliners, eugenics, television, and radio, with bicycles making a welcome appearance to provide some contrast.

Friedel's choice of technologies, and the focus on their early history, is perfectly representative of the field. For example, in Tom Misa's *From Leonardo to the Internet*, the period 1870–1930 is discussed in terms of research and invention in electricity and chemicals; 1936–90 in terms of the wartime (World War II, that is) history of the atomic bomb, electronics, and computing; and 1970–2001 in terms of the fax, hamburgers, and the Internet.

Because they concentrate on the early history of a small sample of technologies; such studies are not histories of invention or innovation. They are not concerned with the analysis of invention and innovation in particular historical periods. Were they to do so they would be largely histories of failure, and they would be much more broad-ranging in the technologies covered.[14] What we have in these texts is a conflation of stories of invention/innovation and of use. There is a focus on the early history of selected technologies which later came into widespread use, or which appear self-evidently important. They are neither a history of technologies in use at a particular time, nor yet a history of invention or innovation at that time. It is the

14. For clear evidence on this see Ian Inkster, 'Patents as Indicators of Technological Change and Innovation: An Historical Analysis of the Patent Data', in *Transactions of the Newcomen Society*, vol. 73, no. 2 (2003), pp. 179–208.

Anderson County, East Tennessee: Mrs Mary Faust seated by spinning wheel, 30 July 1910.



Benten-dori, an important street of Yokohama, with feast-day decorations, 15 May 1906, Japan.

We should beware of privileging the novel, not out of conservatism, but because we understand the power and influence of claims to novelty as a way to disguise a lack of novelty.

at the mercy of
time 427;

German Baghdad Railway. A mule hauling equipment on a track near Aleppo, between 1900–10.

Walla Walla County, Washington. Farmer and the mules that pull the combine through the wheat fields, July–September. 1941. Photo by Russell Lee.

conflation, not the focus on invention or innovation, that is a crucial problem with the literature if one is interested in the place of technology in history, or indeed the history of invention or innovation.[15]

There are, however, many significant general works that are less innovation-centric than the norm. There are also many studies of technologies in use, such as Ruth Schwartz Cowan's *More Work for Mother* and Paul Josephson's work on 'brute force technologies'. Important as the exceptions are, exceptions to the rule are not the same as critiques, nor do they necessarily even betoken awareness of the problem of innovation-centric conflation. In this light it is important to recall Svante Lindqvist's unjustly neglected article on mapping technological landscapes, which notes the focus on early history and the lack of studies of use and, most interestingly, disappearance.[16] Pursell has argued that 'the history of technology, as currently studied, privileges design over use, production over consumption, and periods of 'change' over those which seem static and traditional'.[17] But neither of these crucial articles address the central conflation I am focusing on.

15. It is for this reason that I have argued in *The Shock of the Old* not, as is sometimes suggested, for studies of use rather than invention, but rather for properly specified studies of each. I did not explain clearly enough in 'Innovation to Use' that innovation-centric studies were not typically studies of innovation or invention as such. In either case, the originality of the point resides not in the point itself – which is obvious – but in noting the systematic way the literature conflates innovation and use.
16. Among the histories to be noted are Ruth Schwartz Cowan, *More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave* (New York: Basic Books, 1983); Claude Fischer, *America Calling: A Social History of the Telephone to 1940* (Berkeley, Calif.: University of California Press, 1992); K. Jellison, *Entitled to Power: Farm Women and American Technology* (Chapel Hill, N.C.: University of North Carolina Press, 1993); Ronald Kline, *Consumers in the Country: Technology and Social Change in Rural America* (Baltimore: The Johns Hopkins University Press, 2000); and Andrea Tone, *Devices and Desires: A History of Contraceptives in America* (New York: Hill and Wang, 2001). An excellent recent example is Kenneth Lipartito and Orville R. Butler, *History of the Kennedy Space Center* (Gainesville, Fla.: University Press of Florida, 2007). Note must be taken of works on technology focused on use by those who were not primarily historians: Siegfried Giedion, *Mechanization Takes Command: A Contribution to Anonymous History* (New York: Oxford University Press, 1948); Cynthia Cockburn and Susan Ormrod, *Gender and Technology in the Making* (London: Sage Publications, 1993); Stewart Brand, *How Buildings Learn: What Happens After They're Built* (New York, N.Y.: Viking, 1994); Vaclav Smil, *Energy in World History* (Boulder, Colo.: Westview Press, 1994); Arnulf Grübler, *Technology and Global Change* (Cambridge: Cambridge University Press, 1998).
17. Paul Josephson, *Industrialized Nature: Brute Force Technology and the Transformation of the Natural World* (Washington, D.C.: Island Press, 2002); John McNeill, *Something New Under the Sun: An Environmental History of the Twentieth Century* (London: Penguin, 2000).

into the next dimension – into Time – our fate, our lord, our destroyer, 427;

However, the move among some historians of technology to studying users and consumption does not necessarily mean a move to the study of technologies-in-use. The central point still made is that studying users shows them to be active in the shaping of technology.[18] It is revealing, too, that the key concept of technological determinism has been routinely defined as something along the lines of 'technical change causing social change' rather than in terms of technology shaping society – the old, standard definition. It is also significant that it is criticised as a theory of technology, rather than what it classically was: a theory of society and history.[19]

Historiography from below

Historians of technology have stressed fundamental differences in the way they understand technology compared to the way they believe their publics understand technology. In particular, the historians emphasise their freedom from what they consider common public delusions, among them technological determinism, the linear model, and Whig history. However, there is much that is common to both once we look seriously at the non-academic and non-professional literature. We should take non-professional historical ideas seriously, not merely as objects of study, but also as contributions to our shared understanding of technology in history. What I call doing historiography from below reveals vast stores of accumulated knowledge that can be used by academic historians, as well as remind us that the popular understanding of technology in history is much more sophisticated than is often assumed.[20] It is a powerful way, especially if this knowledge is studied in time, of uncovering and understanding core assumptions in academic studies, particularly those that endure over

18. Svante Lindqvist, 'Changes in the Technological Landscape: The Temporal Dimension in the Growth and Decline of Large Technological Systems', in O. Granstrand, ed., *Economics of Technology* (Amsterdam: Elsevier, 1994), pp. 271–88.
19. Carrol l Pursel l, 'Seeing the Invisible: New Perceptions in the History of Technology', in *ICON*, vol. 1 (1995), pp. 9–15.
20. At the National Science Foundation workshop a participant criticised my optimistic view of the public sphere, stressing the lack of civic solidarity across age, gender, etc., and the consequent self-isolation that left people vulnerable to insidiously propagandistic notions. All I can say from my experience of the reception granted *The Shock of the Old* is that there is a public, of all ages and genders, for grown-up accounts of technology in history.

long periods. For example, it helps make visible key assumptions that underlie most academic accounts of the relations of science, technology, economics, and twentieth-century war, and indeed many other aspects of thinking about science and technology over the last century.[21]

Looking at non-professional accounts of technology in society and history can help us understand the depth of the commitment to the standard account of twentieth-century technology. In his 1934 text *Technics and Civilization*, Lewis Mumford celebrated the neotechnic revolution (the term was coined by Patrick Geddes, but rendered into English as 'new technology' makes its meaning and significance clearer) being brought about by electricity and new alloys.[22] Mumford was not the first or the last to think in this way. For example, Harry Elmer Barnes, a noted historical sociologist and exponent of the 'technological conception of history', thought in 1948 that the world had gone through three industrial revolutions: the first of iron, steam, and textiles; the second of chemistry and large industries, steel, and new communications; and the third, still occurring in 1948, was 'the age of electrification, automatic machinery, electric control over manufacturing processes, air transport, radios and so on'. A fourth was on the way, 'with the coming of intra-atomic energy and supersonic stratospheric aviation we face an even more staggering fourth Industrial Revolution'.[23] Barnes was known at this time for his 'revisionist' views on the United States and the world wars, and he would become a pioneering Holocaust denier; his views on technology were orthodox commonplaces.

The Left also thought in these terms. Marxism had long focused on what bourgeois propagandists took to be the most radical and novel forms of industrial

21. For examples see my *Warfare State: Britain 1920–1970* (Cambridge: Cambridge University Press, 2005), and *The Shock of the Old*. Raphael Samuel was a pioneer not only of 'history from below' but also of 'historiography from below' in his generous recovery of the contributions of industrial archaeologists and others to our historical understanding. The term is mine. See in particular Samuel's 'Unofficial Knowledge', in *Theatres of Memory: Past and Present in Contemporary Culture* (London: Verso, 1994).
22. For a recent very interesting statement of the significance of this work, see Mikael Hård and Andrew Jamison, *Hubris and Hybrids: A Cultural History of Technology and Science* (London: Routledge, 2005), p. 8.
23. Harry Elmer Barnes, *Historical Sociology: Its Origins and Development: Theories of Social Evolution from Cave Life to Atomic Bombing* (New York: Philosophical Library, 1948), p. 145.

travel backward or forward through Time 438;

organisation.[24] It was to be an enduring feature of Marxist thought. The Belgian Trotskyite economist Ernest Mandel, writing in the early 1960s, claimed the first industrial revolution had been based on the steam engine, the second on the electric motor and the internal combustion engine, and the third, of which the 'warning signs' first appeared in the 1940s, was based on nuclear energy and electronically controlled automation.[25] Samuel Lilley, a British Communist writing in the mid-1960s, who believed in only one industrial revolution, treated the period since World War II in terms of atomic power, computers, automation, and space exploration.[26] In the Soviet Union the idea of a 'Scientific–Technical Revolution', centred on automation, became Communist Party doctrine from the mid-1960s. The idea may well have been lifted from the earlier bourgeois idea of the 'Scientific Revolution' applied not to the seventeenth century but to the twentieth, and associated with airplanes, electronics, and atomic power.

The similarity of the short lists of technologies, along with the closeness of the point of innovation to the period of their supposed world-historical significance, add up to a striking consensus across political, ideological, and national boundaries. Also notable is the lack of empirical justification for the centrality of this or that technology to this or that historical period. We need to understand the content of such claims not merely for historical but also for historiographical reasons: such accounts remain profoundly influential in shaping our historical understanding.[27]

Contextual histories

The aim of many historical studies of technology in the SHOT tradition has been to think about technology by placing it in its historical and cultural context. What that context is or should be has not provoked much discussion, perhaps necessarily so.[28] An obvious limitation is that historians do not agree about history. There is a more

24. I owe this point to Gareth Stedman Jones.
25. Ernest Mandel, *Marxist Economic Theory* (London: Merlin Press, 1968), p. 605.
26. Samuel Lilley, *Men, Machines, and History: The Story of Tools and Machines in Relation to Social Progress*, 2nd ed. (London, 1965).
27. See, for example, Waqar Zaidi, 'Aviation Will Either Destroy or Save Our Civilization': Proposals for the Internationalisation of Aviation, 1920–1945', in *Journal of Contemporary History* (2010).
28. For an exception see Leo Marx's review of Cutcliffe and Post, and the responses thereto (note 5 above).

significant flaw in contextualism in that it assumes that the existing historical work used to establish context does not already include an account of technology in it. But it generally does, at least implicitly, resulting in a range of possibilities from contradiction to circularity. Circularity is more likely, in that general historical accounts have implicit accounts focused on the usual technological suspects in the usual periods.

One way out of these problems might be to write the 'history of content and context together', by emphasising 'co-production', a programme strongly influenced by the work of Bruno Latour and his critique of social construction. Andrew Pickering puts the case powerfully for science, but the argument applies equally to technology: he calls for work 'without regard for traditional distinctions between history of science and history more generally, and especially without centering research upon an archive demarcated by such distinctions'. Pickering continues: 'Such an approach would blur the disciplinary identity of historians of science, of course, but no one is better placed than historians of science to speak of the truly integral place of science in global history, and the end result might be a clearer view of global history itself'.[29] But in this kind of post-contextual history, there is always the Latourian temptation of seeing the world as being recreated from scratch in the laboratory, and of depicting it as described by scientists and engineers, without noting that their images are far from being original to them.[30]

A different kind of post-contextual history is possible. Let me give a concrete instance of how this might work. Imagine that we had a full account of global twentieth-century invention, innovation, and technologies-in-use, derived independently from contemporary commentary and our histories. Could we usefully contextualise this within existing global histories? I think this answer is no. An account of the material constitution of the human race in the twentieth century would stand as a rebuke to our understanding of the historical context; it would also stand as a rebuke to most theorising on modernity. For example, it would reveal the rise of a new poor world, which hardly figures in global histories or theories of modernity.[31] This is not so much the result of lack of interest in the poor world, but rather of seeing it as a deficient, behind-the-times version of the central model.

Indeed the astonishing power of the standard picture of twentieth-century technology is demonstrated by its centrality to studies of the colonial and post-colonial worlds. Thus Gyan Prakash notes that to 'speak of India is to call attention to the structures in which the lives of its people are enmeshed – railroads, steel plants, mining, irrigation, hydro-electric projects… and now, the bomb'.[32] The long list he produces hardly includes anything that did not come from outside India and was not central to Western accounts of modernity. Most studies of India and of colonial and post-colonial settings deal with just such machines and structures.[33] The same applies to the great majority of studies of 'post-colonial technoscience'.[34] There is nothing subaltern about technologies in post-colonial literature. This is all the more striking given that a central concern of studies of post-colonialism is to challenge the view that Western models of modernity

29. Andy Pickering, 'The Rad Lab and the World', in *British Journal for the History of Science*, vol. 25, no. 2 (1992), p. 251. Latour is of course right to warn against the use of context (given by existing social science or history) to explain other knowledge. We shouldn't explain (say) technology through sociology; fine, but Latour often confounds sociology with society. In order to understand society, and how it relates to technology, we need to understand sociology and criticise it in relation to empirical materials.
30. Gabrielle Hecht's *The Radiance of France: Nuclear Power and National Identity after World War II* (Cambridge, Mass.: MIT Press, 1998), is a very good example of this post-contextualist approach, as is Timothy Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity* (Berkeley, Calif.: University of California Press, 2002), chapter 1, 'Can the Mosquito Speak?' This chapter deals with DDT, Aswan Dams, and synthetic nitrate fertiliser in a proficient Latourian way of writing about the co-production of new material and technical forms, though the latter are high-profile imports into Egypt.

31. An important and honourable exception is Arnold Pacey, *Technology in World Civilisation: A Thousand Year History* (Oxford: Blackwell, 1990), which has a fair amount on poor countries in the twentieth century. Peter Worsley, *The Three Worlds: Culture and World Development* (London: Weidenfeld and Nicolson, 1984), is a rare example of a comprehensive account.
32. Gyan Prakash, *Another Reason: Science and the Imagination of Modern India* (Princeton, N.J.: Princeton University Press, 1999), p. 3.
33. See, for example, the papers covering the twentieth century in Morris Low, ed., 'Beyond Joseph Needham: Science, Technology, and Medicine in East and South East Asia', in *Osiris*, 2nd ser., vol. 13, special issue (1998); Roy MacLeod and Deepak Kumar, eds., *Technology and the Raj: Western Technology and Technical Transfers to India, 1700–1947* (New Delhi: Sage Publications, 1995); David Arnold, *Science, Technology and Medicine in Colonial India* (Cambridge: Cambridge University Press, 2000); and, to a considerable extent, Mitchell.
34. See the special issue of *Social Studies of Science* from 2002, and one with the same title in *Science as Culture* in 2005, both of which contain studies dealing with the recent past in Tibet, Australia, Peru, Brazil, Mexico, French Africa, and French Guyana, mostly not post-colonial cases. The examples of 'technoscience', with maybe two exceptions, are the reassuringly familiar 'Western' bioscience and medicine, uranium mining, rockets, and computers.

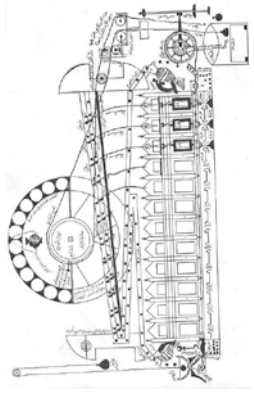
apply to the non-Western world, as Francesca Bray has done.[35] There is a more general challenge to be made than 'provincialising Europe': the problem is not just the so-called Eurocentricity of our account of technology and global history, but that our picture of the Eurocentre is of very dubious merit. Looking at the poor world is a challenge not merely to the universality of standard models but of their applicability anywhere.[36]

Toward material histories

Rosalind Williams has called for a history of technology 'whose ultimate goal is understanding how history works'.[37] But we are a long way from it. Technological determinism – the potentially interesting notion that society is determined by the technology it uses – is at present untestable because of the weakness of our material explanans compared to the social and historical explanandum. We simply do not have a picture of, say, the complete matériel of an army, let alone of a society as a whole.[38] Indeed, appreciating the sheer weakness of our account of the material constitution of the past and present seems to me to be a critical point. We do not even properly understand the large-scale production technologies of the rich world. The history of technology-in-use and the history of invention have barely begun to be written.

Getting to a better account of technology means counteracting what Australians usefully call the 'cultural cringe'; the term is used as a criticism of local intellectuals who underrate the cultural production of their locality and overestimate foreign high culture. The very lowness and ubiquity of technology make it significant in history but suspect in the academy. Yet there are other unfashionable areas of history, such as business, economic, and military

35. Francesca Bray, 'Technics and Civilisation in Late Imperial China: An Essay in the Cultural History of Technology', in *Osiris*, vol. 13, pp. 11–33.
36. This is the argument of *The Shock of the Old*. See also my 'Creole Technologies and Global Histories' (note 12 above), and David Arnold, 'Europe, Technology and Colonialism', in *History and Technology*, vol. 21, no. 1 (2005), pp. 85–106.
37. Rosalind Williams, 'Opening the Big Box', in *Technology and Culture*, vol. 48, no. 1 (2007), p. 104.
38. See the wonderful critique of the military-historical literature, and the way it deals with technology, by George Raudzens in 'War-Winning Weapons: The Measurement of Technological Determinism in Military History', in *The Journal of Military History*, vol. 54, no. 4 (1990), pp. 403–34. Raudzens notes that 'we have assertions, images and impressions of technological decisiveness in war, but we have no detailed measurement, analysis or consensus' (p. 432).



so-called linear time 452;

history, that need to be engaged with rather than going down the now traditional path of seeking respectability by applying novel high theory to low subjects. Indeed, we need to reach down the food chain, to the amateur specialists on ploughs, tractors, airplanes, rickshaws, aircraft, small arms, and electric toasters.

Worthwhile historical studies of technology are likely to, and might be directed to, challenge not what we take to be popular misconceptions, but rather the best academic work, its substantive content as much as its methodology. Taking seriously how a wide range of scholars treat technology opens up a powerful site of critique, not least of self-consciously advanced modes of historical analysis and other analyses, many of which assume very limited models of the material constitution of society and its development.

Understanding what the founding members of SHOT got wrong (let alone right) about modernity might well be more significant than finding a new way of bashing technological determinism, and more interesting than a ride on the latest novelty in the academic fairground. We should beware of privileging the novel, in both history and in historiography, not out of conservatism, but because we understand the power and influence of claims to novelty as a way to disguise a lack of novelty, and indeed sometimes to suppress it. Novelty-mongering is itself profoundly unoriginal, but old-fashioned futurism, that despite being *passé*, is still surprisingly effective. As the Uruguayan engineer (stretching both definitions), Comte de Lautréamont quipped a long time ago, progress implies plagiarism; but, we might add, not all plagiarism is progressive.

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The Knowledge of Musical Time

Interview with Joel Ryan

Arie Altena

Joel Ryan, composer, inventor and scientist is a pioneer in the design of musical instruments based on real-time digital signal processing. Starting from a scientific rather than a musical education, he moved into music by degrees from physics via philosophy. He came to STEIM (Studio for Electro Instrumental Music) in Amsterdam in the 1980s, and currently works there. He also tours with the Frankfurt Ballet and is a teacher at the Institute of Sonology in The Hague. Joel Ryan seeks to bring concreteness to digital electronic media through the intelligent touch of the performer. He regularly performs live in improvised duos, and with Evan Parker's Electro Acoustic Ensemble. The interview was conducted over Skype, early January 2012, when Joel Ryan was temporarily in San Francisco.

Arie Altena There are at least three reasons why I wanted to have some of your ideas in this book. One is the way you deal with improvisation. You have built computer-systems to improvise with live musicians, and I know that in your opinion timing is crucial. So I'm interested in your ideas about time and timing, as informed by your performance practice and the design of your set-up. Then there is your knowledge of physics, and the notions of time used in contemporary physics. I wonder how that informs your ideas about music. And finally, let's start with this: I remember that during a conversation you said how much split-second timing in improvisation relies on muscle memory, instead of rational decisions in the choice of notes, let's first play a B-flat, followed by two low A's slightly out of tune.

Joel Ryan First of all, I don't like using those terms. Talking about reflexes seems to me to be something from the nineteenth century, or referring to Pavlov. It's just about the meat-side; I think such an approach misrepresents the cognitive situation of making music. It makes it seem as if improvisation in music is just based on some brutal instinct, on some sort of unconscious, irrational process, that it happens unthinkingly, instead of being what it is: one of the primary references that we have to actual knowing anything intelligently about time and timing. You can have a rational theory about rhythm or timing, but that's not enough to account for the amazing thing that musicians do with time. Only musicians know this, and it is knowledge that to a large extent is not accessible to intellectualisation, certainly not within continental philosophy. I have read a lot of books recently about time in Western music and most, if not all of it is incredibly unsophisticated and simplistic when you compare it to what neurologists are doing with time, or what mathematicians are doing with numbers. A Greek from 2000 years ago would be embarrassed by the way time is approached in Western conservatories, it is shockingly primitive. Most of the writing about musical time is either about the relations of simple numbers or about *rubato* as traditions of interpretation. *Rubato* seems to mean that when you have all these wonderful times happening, you just adjust it a little bit to make it more 'expressive'. It doesn't represent how music happens, obviously, and it doesn't represent how composers invent music. *Rubato* is not a concept to quantitatively capture the richness and complexity of music. It is not a rich enough representation of what time in music is. It's difficult to have a good conversation about this with musicians – though they are interested – because they don't have the language. Things are very different in the study of harmony. A lot of research has been conducted, some of which is very 'recherché' stuff that only string theory physicists can understand. It's quite impressive in its ambitions. But there isn't anything like that for timing and rhythm.

AA It seems as if a lot of Western music has derived its idea of time and timing from the metronome and the clock. What you're saying is that real time as it happens for a musician is way more complex. In what sense is clock-based time and rhythm not even scratching the surface of time?

JR There are two issues with clock time. The first is the objectification of time. Clocks have given us the ability to agree on what time is. Clocks are really a social invention, and very practical ones at that. Before the 1880s, every town had its own local time, but when trains started travelling longer distances it became necessary to agree on one time. This notion of objective time is extended to music, though what we really look for in music is something else, something personal and local. The flip side of this, related to musical time, is the issue of synchronisation. How to synchronise 30 or 40 musicians? It isn't the most important thing in music, and neither is rhythm, but it has had a huge influence on Western perceptions of music. Clearly synchronisation is something that is already sought after and achieved between two or three musicians, but there the sync is totally intuitive – it's not about tracking some objective notion of time. A string quartet doesn't need a conductor. The feeling for time in a quartet is so tight – it's in microseconds – that it's amazing. You watch a string quartet and you think: how do they do it? This kind of synchronisation has nothing to do with clocks or simple rationalisations of time, it has everything to do with feedback, perception and the direct cognition and intuition of time. It is a knowledge of time that cannot be improved by any of the rationalisations of time we currently employ.

You can say, time is only what can be written – the time indicated in the score – but when you look at this as mathematics, as form, it doesn't capture what goes on in music. Talking about interpretation, about how a little *rubato* really makes a piece, while reverencing virtuosity, is still really about diminishing the role of performance as the primary source of knowledge of musical time. This seems very similar to the way physicists used to talk about 'transient' behaviour when they were unable to get to grips with the real complexities of dynamic systems. So while a great deal of time is 'constructed' in modern music, in the end, when it comes to performance, this can only act as a kind perturbation or testing of our internal sense of time. Compare it to pitch: you cannot say an A is 440 Hz in the key of C-sharp – that's just not going to happen. It is what it has to be for *that* musical instrument, for *that* singer, and at *that* moment. To say someone is off pitch is not about whether or not the pitch is objectively correct, it is about whether or not it sounds *right* to the person, a performer. It is intuitive knowledge. The mistake in European music history is the belief that systems are always superior to individual idiosyncrasy. But for me music is about trusting mere individual minds, instead of promoting pedagogical approximations as law. But good musicians are always doing their music, regardless of this.

AA You mentioned that research into harmony is much further developed...

JR You could certainly make that argument. Harmony is an algebra, which needs a prior rationalisation. Once you have the rationalisations, you can begin to experiment. You can go back to Brahms, or Haydn to see how this works. They did harmonic experiments within the algebra, within the conceptualisations of harmony, which led to music that they would never have come up with if they had just been singing along by themselves. I am not 100 per cent sure about this. You have to ask a musicologist to get a really good answer to this question. It's connected to the argument that writing is necessary for creating harmony. Writing music has enlarged the possibilities for harmony, but I don't think that writing has similarly improved our ability to *make* time in music. It has produced synchronisation and the richness of synchronisation that happens in a symphony, but it doesn't seem to have produced more interesting rhythms than a Cuban band, a band from Tajikistan, or a jazz band produce. Notation doesn't seem to have contributed significantly to our knowledge of time in music.

AA But that is especially the case for classically composed music.

JR When you listen to Alban Berg or Pierre Boulez – who is very proud of his rhythmical stuff – it doesn't really sound that spectacular as time. Rhythmically, it isn't anywhere near as interesting as a jazz big band can be. Maybe it's because it's too difficult for musicians to play, maybe not difficult enough. I think we are at a low tide in European music: there is too much discourse without actual reference to the knowledge and skills of musicians – which were still central to composition until at least the late nineteenth century. Now we have amateur musicians aspiring to be composers. This is even encouraged and considered 'cool' at conservatories. You are a 'neo-primitivist', 'conceptual', and you can

be as unskilled as you want. It isn't the same in the jazz departments where it is all about the reproduction of historical skills, which is equally uninteresting.

AA All that might be true for academic classical music, but you can also argue that over the past few years the subtlety of using time in music has increased, especially since musicians and composers are much more exposed to music from non-Western traditions, and also to strange computer-generated rhythms... This might not reflect in the classical department at the conservatory, but it does in music...

JR Yes, and there are also composers – like Richard Barrett, for example – who do greatly respect the special talents of musicians.

AA Could you imagine neurological or mathematical models that come closer to a representation of what time is in music than the notation systems we have now?

JR It sounds a little bit ambitious. I'm not a musicologist, and I do not really think they don't understand musical time, but I would suggest that the *representation* of musical time is still primitive, and perhaps something else, something new, wherever it comes from, would be more useful. There is no question that we try everything in music. It is the nature of music to embrace new approaches, from new materials to new rational systems. Musicians are sluts for tech and new crazy ideas – almost everything that comes along seems to be incorporated in a musical experiment. I'm not convinced that the idea of rhythm is *better* advanced using representations such as those in mathematics, but it's an enormous stimulus to invention. In the West there is a great desire to find unity in music, and mathematics offers an image of that. Western musicians are Pythagoreans, because they fall for the rational models. But while musical Pythagoreanism explains what we share, it doesn't account for the great diversity. Music is more heterogeneous than we like to admit, its structure is intuitive, but we want to simplify it in a rational way. There was a famous music conference in Cairo in the early twentieth century which brought together people from all over the world (including a lot of French and German musicologists), and they tried to agree on a universal tuning system for 'Arabic music'. What the motivation was for doing this, I don't know. It resulted in tuning systems for each of the representative Arab states: one for Syria, one for Lebanon, one for Iraq and Pakistan and Turkey, and three for Egypt. That was the reality. The problem with theoretical music is this desire to be universal. It is confusing the map with the territory. This belief is so robust that it can almost only be explained as a religious thing. It isn't accounted for by practice. Practice shows that in music there are lots of solutions to a problem. The idea that you can have a mathematical model, representation or understanding of rhythm... if you have that, how then do you deal with music as a construction and as being based on human choices? Perhaps this just reflects a philosophy of mathematics that has been adopted by music. It's completely different in the other arts. We see poets freely inventing language and grammar, and we value them for their taking liberties with language, our language. Today we're all aware of how street language changes the way we speak. And we feel free to accept or reject that change. I think that this is a better model for music than any Pythagorean system.

I talk so ardently about this because I have a guilty conscience: in computer music you are constantly faced with strong but simplistic representations. You have no other choice than to work with these representations, or devote your time to making instruments, which turn those representations back into something you can play with.

AA You have a guilty conscience because a computer cannot be as subtle, malleable and elastic as a human being...

JR Not by itself at this point.

AA In working with computers, you start with representations and then you deal with them in a way so that they become flexible?

JR Yes, you listen to what is happening, not what your text (score or code) says it is doing. One of the most important things is that I never wanted to look at anything when I was listening to music. It shouldn't be visual.

AA Mark Fell relates in another interview in this book that he has an issue with the timeline. He says that he cannot come up with interesting music when he puts notes on a timeline. That's one of the reasons for writing process-based music.

JR I like to think of time as an elastic system. Maybe that's because I was a physicist. I like my system to have a kind of natural, rhythmical, flexible quality, a time of its own, with a physical nature, not a formal time imposed on the system, not a Cartesian time. I tell students: try and find the time *in* the system. A system can be quite large. It doesn't have to be a device, or software, it can be a band too. The power of a lot of great quartets is that they understand how they work as a rhythmic system. The members understand each other's limits and abilities, and they can push and excite that system. That's an interesting type of process-based music too: based on communication between people as systems. Such a system would be the ideal for me. I think that it's also socially interesting because in a way it's a model of what we have to achieve politically as well, how we have to integrate into, well, a society – *system* is such an ugly word for it. We have no good vocabulary for this; maybe we have to keep checking with the biologists to see if they can come up with better words to describe it.

AA You have terms like the hive, the dynamic unstable network...

JR But none of these words capture the complexity of it in an operational way, they don't include the flexibility that I'm after, the elasticity of time. The time of the system is made out of the pieces of the system– you can never say that the system imposes the time on its pieces. The point of a system is that there is no whole, no centre. Time emerges from the pieces. I have been reading a lot on turbulence and the weather. How do you determine the velocity of a packet of air? There is no absolute velocity, you can look at one small piece and say that it is moving West at ten m/second past this fixed point, but that piece is also within a slightly larger chunk that is currently moving North, which is itself part of a larger front which is rotating and drifting East and so on. That is analogous to the problem of absolute time in music. Music consists of so many independent processes, all of which have temporal expression, some in close harmony, some autonomous. It becomes problematic once you try to describe it as if time is one objective thing. Your left and right hands keep a different time, your left foot is again doing a different time, the reed player is in a different time from the guitar player... this is not a talent, it is a given.

AA Is there something like absolute time?

JR That was the great dispute between Leibniz and Newton in the seventeenth century. It was about whether time exists independently of us. Leibniz claimed that time was relative, Newton believed in absolute time. There was a deep-rooted belief in the eighteenth century that we could discover the clockwork of the universe. It implies that the universe works regularly and everything about it is knowable in some sense, which was reassuring in an age of doubt. We have had to give up on that idea; we know things are much more complicated. But at the moment music is ideologically very backwards looking. The idea of absolute time in music reflects an ideological issue, that of centralising, authoritarian concepts.

AA You like the material side of music, even though you work digitally...

JR I like mechanical devices, not for any clockwork idea, but for the material aspect. Some time ago I tried to find out more about ancient metallurgy, because it must have such a huge impact on the sound world and on sound perception. Metals make sounds that do not occur in nature. It must have been quite amazing for Neolithic people when they started realising the sonic possibilities of tin and copper, silver and nickel, and started making bells. These

new materials also made standardisation possible, because they were more stable and reproducible. After the invention of metallurgy the Meso-Americans changed their cosmology to include metal: their gods chose to make humans out of metal. This could be because metal is responsive, it is reciprocal, metal echoes, you give it something, and it gives you back something else. That's a musical observation, and it is the wonder we look for in music. We want to tap on our computer and have it do something surprising, something we cannot do ourselves. It is an old dream, a magical, animist desire. Electronic music is historically based on seeking new sounds and new possibilities for sound organisation, but to get that from the material itself: that is the great wish. Musicians have great respect for material objects, which is why they stick strange pieces of shaped wood and metal in their mouths. Musicians love their instruments and look for improvement in the otherness they represent. Music has a strong quest for the connection to otherness, to the non-human part of existence and the universe – more so than other artforms. The embracing of materiality and the agency of things is intrinsic to music. The problem for computer music is that this agency is very poorly developed, because it derives from late twentieth-century hyper-rationalism.

AA Which is a problem?

JR When I got into the Institute of Sonology in 1987, there was a recently retired professor who had been teaching students Bertrand Russell's sentential calculus as a path to making music with computers. This is a horrible notation that renders even the relations of logic itself obscure. Of course this was a long time ago but a belief still persists that composing should look like an opaque language rather than reflect or enable what musicians know. Technology trumps music every time.

AA Your quest has always been to make the computer into something that allows you to interact with 'materiality'.

JR Perhaps it's because my education is in physics. In physics it's normal to think this way. It is okay to think in physical models, because we believe in the reality of the physical world. The models are always seen as models of something larger than themselves, and you don't confuse the model with the physical reality. You don't confuse the calculation with the thing you are calculating. You would never confuse a model of the weather with the weather, or a model of a 747 with the actual aircraft. But in music nowadays, the simulation seems to be just as good as the music. No youngster today doubts that a synthesiser or a sampler is a musical instrument, nor do they distinguish between music made purely with samples in a tracker, and its precursor made by people with instruments in a storefront in Detroit. For most people there is no difference between a *stimulated* sound and a *simulated* sound. I believe you have to constantly refer back to nature and to people (musicians) to see and hear time, and not surrender to some simplistic representation.

AA That also relates to the major issue in early synthesiser design, the Buchla versus Moog thing. Buchla tried to invent new sounds, Moog added a keyboard to the synthesiser, and hence it was promoted as a technology to emulate existing instruments.

JR And it sold. I just saw Buchla's latest synthesiser. It's huge, it's everything he tried to do combined in one machine for 40,000 dollars, and it makes beautiful sound. Don Buchla is interesting because he was a super smart engineer. My astronomy professor who was Buchla's classmate at Berkeley, told me that he was the most brilliant engineer he'd ever met, he was intuitive, a Nikola Tesla type. He didn't have to finish his degree. They just dragged him into the physics lab. His gear is really different from other synthesisers. It does weird things. It has ideas in it that you don't find anywhere else. Even the sequencer is much more complicated that any other sequencer I've ever seen. Instead of trying to simulate existing music, a Buchla gives you unique behaviour.

I like to think of time as an elastic system.

AA But doesn't some contemporary computer music try to retrofit exactly something like that into music again, to program 'weird things' into the Max/MSP patches, to produce surprising sounds and strange behaviours, which were in the first place made impossible by the packaging of technology they work with?

JR The cool thing about Max/MSP is that you can make huge mistakes and it still works. It isn't a brittle language, unlike SuperCollider, my personal language, which is – alas – very unforgiving. If you violate the grammar of SuperCollider, it doesn't work. Max/MSP is the opposite, you can make dozens of mistakes, your whole patch can be a mistake, you can misuse, misunderstand, and it could still work. That's great. I wish I had the patience to work with it, but my mind is not vague enough for Max/MSP [laughs]. I can't handle maintaining code in Max/MSP. I can't read my patches. It drives me crazy, so I prefer to negotiate with SuperCollider.

AA Artists and musicians who use Max/MSP often run the patches they are working on constantly to hear the effect of what they've just changed. That's one way of programming music.

JR I think of it as forgetting. When I got my Apple II, at the end of the 1970s, I wrote a sound program and it was so simple – because it was a simple computer – that it took me a year to get over it. I had to forget how it worked before I could actually listen *through* it. Then I realised it was great. But as long as I thought about what it was doing, I couldn't help thinking, ah, it's just primitive shit. I started using that as a rule of thumb: you have to try to forget how it works. Again this is the issue of representation, in music the representation is not 'it', the 'it' part is what happens perceptually.

AA What sort of computer music did you make around that time?

JR My earliest digital music relied on acoustic sound. I was compensating for a dislike of synthetic sound. I liked the idea of synthesisers, but I wasn't a Moog-guy and I didn't really like sine waves. I didn't find the timbre compelling enough. I'd taken a summer course from Andy (James A.) Moorer, the original Stanford DSP (Digital Signal Processing) guy. He showed us how much work it took to make a sine-wave simulation of a single violin note. It took updates of 16 harmonics, which amounted to something like 4000 numbers a second. That was a lot of data for a composer to come up with, especially using a small computer. I figured I needed to take a real acoustic reference to create sounds that interested me, so I started using cassettes. It was primitive. I had a 4-track cassette recorder, so I could have four sound sources and mix between them, then run that through as the 'excitation' of my DSP-stuff, my 'live processing'. This was way before physical modelling, but I had a similar data flow approach. I never knew exactly what I was going to encounter, because I made these long mix tracks, and some sounds, like dog barks, worked wonderfully, while others didn't. My DSP really messed up the sound, so the music had to be really relaxed rhythmically.

This was before I started working with live musicians. I never thought of working with live musicians in those days because the sound quality was so poor. I didn't like the idea of having a distant electronic ambient background of cassette quality with live musicians playing along. It wasn't something that I found musically interesting. It was only after I started at STEIM in 1986 that I achieved a sound quality I thought was good enough to use with live players. By then I had a 68000 Mac with Digidesign hardware made for ProTools. I went to Digidesign, they took me to lunch, they offered me a job, and they gave me the operating system for their sound card. I thought that was totally friendly. I didn't take the job, I went back to STEIM, and because I had the keys to their sound card, I could write software for the very first DSP cards made for personal computers, the Atari and the Mac.

At the time the violinist Malcolm Goldstein was visiting Amsterdam so I invited him to STEIM. I think he was working with Pauline Oliveros, and he was the perfect partner for me, because he is such a great improviser and very acoustically oriented. He really listens to what is going on, he could hear what was happening to his violin in the loudspeakers and immediately adapt to that new situation. I suddenly had a virtuoso who was willing to experiment. In a way he was a perfect model for me. He whips the violin up into a crazy state and then, while listening to what is happening, starts piloting it. He treats his violin like an elastic emergent complex system. He could immediately embrace in his playing the behaviour he was hearing in the process. Musicians like Evan Parker have this ability too. Through working with Malcolm I realised that you could create a new instrument by playing through my system, and it would be a really dynamic thing. My interactive computer sound set-up wasn't a top down design; it was a slowly evolving realisation of what was going on in electronic sound, live performance, and improvisation.

AA Do you only perform live with your system, using the input of a live musician steered through your instrument?

JR I have a secret life: doing late night improvisations on my own. I made an album of some of this, *OrAir*, using material from Evan Parker, which is not live, or it is live, but performed at home alone. I feel a bit strange doing this stuff in public. It seems one of the characters is a ghost. I travel very, very far from the original sound and paradoxically wouldn't be able to do this with the *source* hovering near by. But it's so much more enjoyable to work with live musicians. For me making a concert is about the reality of a musical time. But maybe when my equipment becomes too heavy for me to drag around I will do more solo work just on a laptop.

AA What other stuff do you need in your set-up?

JR I need a good mixer (non-digital, don't get me started on headroom and cheap digital mixers), a flexible compressor and my Eventide Harmonizer, which I have hacked with my own DSP code. It has an incredible, high-quality sound and considerable computing power but it weighs far too much. I guess, apart from me, only Laurie Anderson drags them around, and she has three.

AA A final question: can you describe what happens in your systems when you're playing live with a musician?

JR I think there are several ways to think about it without getting into the mathematics. It is folding up and twisting a stream of sound, a kind of one-dimensional origami. This folding can thin or thicken a texture, add polyphony, and change timing and pitch. There is also a kind of time projection chamber where incoming sounds are split up and sent on a large number of divergent paths so that when they arrive together they create a distorted image of the time of the original sound. This is applied across the musical time scale, processing waveforms and processing phrase forms...

‘I generally work with milliseconds, not beats per minute’

Interview with Mark Fell

Arie Altena

Mark Fell is considered to be at the forefront of extreme and independent computer music. His projects range from minimal electronic music, to audiovisual and sound installations. He works with synthetic sound, light and experimental technologies and brings together interests in computational technologies, non-musical sound synthesis, oppositional aesthetics, and irregular encounters with time and space. In *Attack on Silence* (2008) for instance, he explores sacred geometries and sound as a tool for meditative practices, technologies of mind control, and neuro-aesthetics. The installation *Matter-Space-Motion* (2010) is about the movement of subatomic particles and sound; and in *it Hz* (2010) he uses high power white laser light and multichannel sound to produce a simultaneous sonification and visualisation of mathematical functions. His music compositions are mostly process-based, as can be heard on *Multistability* (raster noton, 2010), ul8 (editions mego, 2010), *Manitutshu (editions mego, 2011), and *Periodic Orbits* of a Dynamic System Related to a Knot (editions mego, 2011). I interviewed Mark Fell by e-mail, and focused on his approach to time in music.**

Arie Altena Most pieces on *Multistability* and *Manitutshu** come across as very rhythmic in the sense that they are made from short pulses. These pulses are not arranged in a metronomic way; the music is rather fractured and sometimes the order seems random or chaotic. This leads to a completely different sense of time than that created by, for instance, techno or classical music.

Mark Fell One of the things I wanted to try – initially with *Multistablity* – was to focus on timing structures and make this the central feature of the work. Perhaps you could say it is very rhythmic as it doesn't contain much else, or that nothing else is as elaborate as the rhythmic feature of the work. You mention short pulses, but actually one of my main concerns with making *Multistability* was to explore the duration of sounds. For example, often a piece is little more than a variation of a sound's length relative to the start of one sound and the onset of the next. I think my interest in duration, particularly the duration of chords, is derived from the organ stabs found in house music of the early 1990s. In *Multistability* I try to isolate and expand that characteristic. In terms of the arrangement of the sounds it's hard to quantify what might count as fractured, random or chaotic. Sometimes the order goes from longer to shorter sounds, sometimes from louder to quieter. For me it is quite organised. The rhythm according to which the order of sounds is played is definitely non-regular. Perhaps it could be argued that this invokes a different 'sense' of time, but I think music's temporal form can be compared to sculpture's spatial form. In sculpture various spatial structures of differing kinds still inhabit a common spatial universe. My music inhabits the same temporal domain as all other music – it's not outside time, or in a different time. The different sense of time comes about from the way different types of music modulate the temporal field – how they divide up time, how they deal with repetition, change and so on. For me it's almost a spatial experience, like moving around a very complex climbing frame, for example. Just as sculpture constructs an experience of spatial form, so music constructs an experience of temporal form.

AA While listening to *Multistability*, I was struck by the fact that at first there seems to be no flow to the music, yet after a while a strange breakbeat-kind-of-flow does start to emerge...

MF It's interesting that we can speak about 'flow' in music, just as we do with time. Some theorists have suggested that there is no such thing as the flow of time in nature. The sense of flow is a feature of our human experience of time. I'm trying to consider the place of music in this experience, how music is related to the experience of 'flow' of time. On another level, my concern as a music producer is to make music that, although it is rhythmically quite unusual, still has a kind of human trajectory. My music can be enjoyed in the same way that highly metronomical club music might be enjoyed. Recently I have become quite obsessed with Indian classical music and how the various instruments in this music fit together in temporal configurations. After I did a performance in New York, an audience member told me that the timing structures in my music reminded him of Indian music.

AA Can you explain how you deal with time in your music, in both a musical and a technical sense?

MF Mostly I work with quite simple algorithmic processes to generate rhythmic structures. None of my music, or only an extremely small amount of it, is written in a timeline. In the vast majority of cases I build a system with three or four parameters that I can change to create rhythmic changes. These systems reject the notion of a bar that is of a more or less equal duration, and which is subdivided into notes related to one another by various ratios. In my recent music the duration of the bar is completely changeable, and the divisions of the bar cannot be thought of as halves, quarters and so on. I generally work with milliseconds, not beats per minute.

AA How does composing with computer processes influence timing and the sense of time in your music?

MF The most important way in which composing with software and computational processes changes my relation to the temporal (as a composer) is that it enables me to reject the timeline/score paradigm. For me a program that asks the user to place notes onto a grid (a timeline composed of bars) too closely follows a very outmoded understanding of time as a linear sequence of events. In fact I cannot work that way. I find it completely impossible to make interesting music using a timeline onto which I place notes.

AA What is exactly the problem with the timeline?

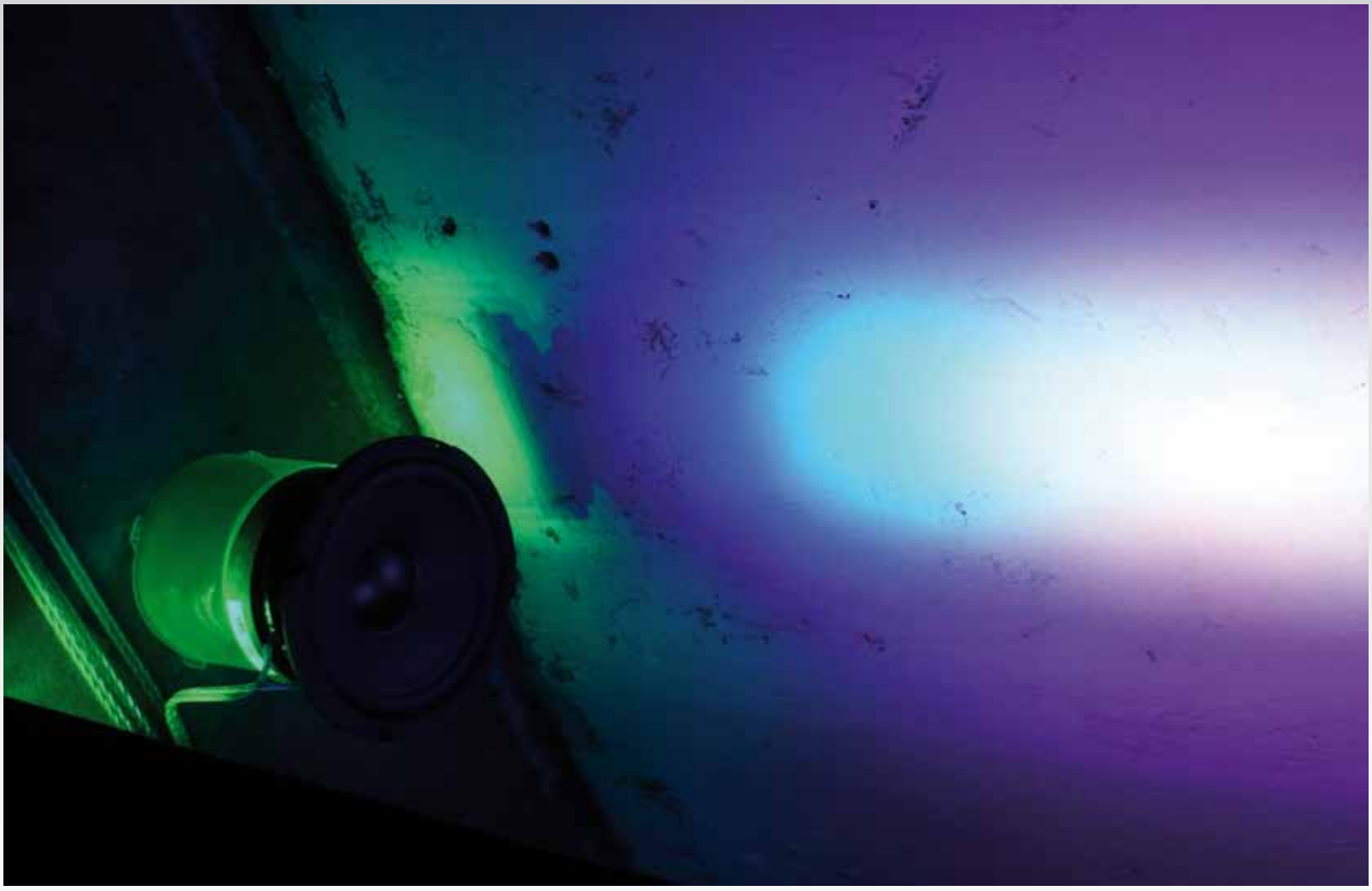
MF The problem is that the timeline is outside real time. The idea that you can stop and rewind time to change things and 'get it right' also means that the results sound totally dead – at least for me. The results are too directly determined by my personal tastes and habits. In this scheme the composer is placed outside the time of the music and is unable to engage with the music in its own temporal field. Basically it separates the composer from the music. I dislike the metaphysical implications of this scheme and also the music I make within it.

AA I can imagine that some people would say that it's rather the use of algorithms in music composition that completely separates the composer from the music and that such a divide is only absent in live performances. For you composing with processes is actually a way of engaging with the music. How do you see this, and how important is performing live in this respect?

MF I take the position that no single way of making music is more direct than others. All music-making means engaging in some kind of process, whether it's singing in a group, playing a piano, composing a score on paper, or composing with algorithms. All these processes have different characteristics, conventions and parameters. Actually, 'process' is just another word for 'making' or 'doing'.

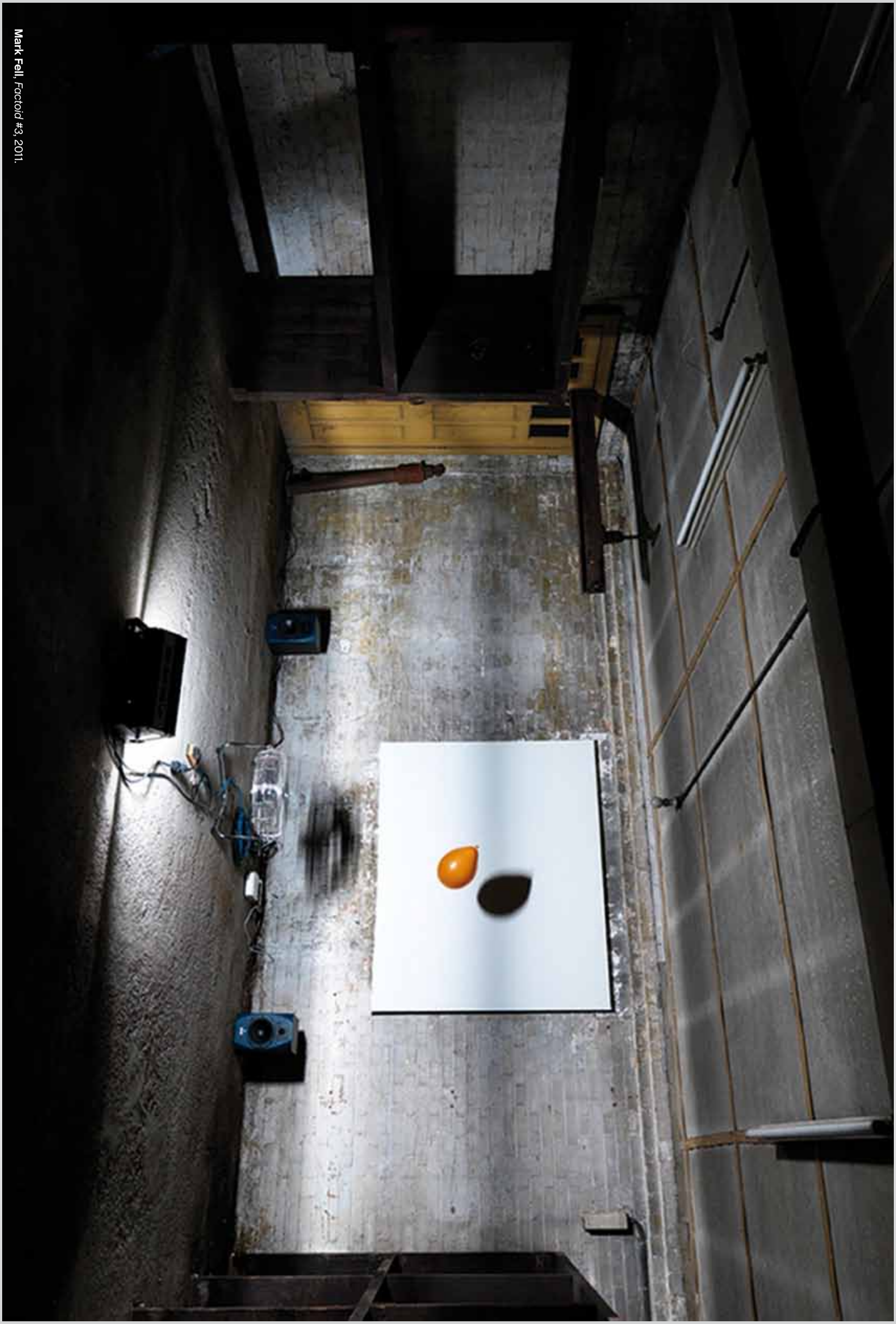
A few months ago I was talking about composing to a colleague. He asked me to describe the interaction between the machines I was using and myself while making a piece, but I couldn't do it. The interaction – if any – that takes place is between the machines and myself on the one hand, and the ideas, patterns and sounds on the other. The process is the arena where that interaction occurs; it constructs the possibility of that interaction. Making music in real time is important for me. By this I mean not stopping and starting, not working on patterns that are put onto a grid. Performing 'live' – in the sense of being in front of an audience while doing this – is not that important, although it's often very enjoyable. I don't see performing live in front of an audience as adding some additional, essential quality to the music.

For me performance in the studio is just as valid, if not more so. I described my last album as 'sort of live' or 'almost live' for this reason, because I wanted to take away the special privilege that live music is often believed to have.



Mark Fell, *64 Pixels and 240 Sine Waves* (detail), Big Bang exhibition Hong Kong, China, 2007.

I find it completely impossible to make interesting music using a timeline onto which I place notes.



Mark Fell, *Factoid #3*, 2011.

AA How do you know, or decide, if a piece is good or not?

MF For me all aesthetic judgments are merely tribal behaviours. This is the case when making music and when assessing its merit. If we try to answer questions about 'why one likes this and not that', we get drawn into endless re-descriptions of the same basic premise. It's only when we stop trying to qualify our aesthetic prejudices by recourse to aesthetic explanations that we can say anything meaningful. In making music I aim to deliberately engage with those behaviours, prejudices and explanations. Basically, my position is, if you want to find out why you think something is beautiful, don't talk about beauty, but talk about the context within which that beauty is constructed. In this sense the more successful pieces are the ones that more effectively engage with those behaviours, prejudices and explanations, and which place an emphasis on the context in which those behaviours, prejudices and explanations occur.

AA Could you give an example of the processes or algorithms you use in composing music?

MF I use MaxMSP to generate pattern data, which controls synthesis algorithms that I have developed, and also commercially available plug-ins. The patterns are recorded into a sequencer as MIDI for editing and mixing. I like recording as MIDI for practical reasons. You don't end up with huge amounts of audio data. Most of the processes I build tend to derive from my earlier encounters with drum machines, sequencers and analogue synthesis – for example a combination of the Roland TR808 and the Roland SH101. Although this is the case I think that the patterns are quite different from those I might make if I used an actual TR808 and SH101. To give an example, I built a simple sequencer with which I could vary the duration of each step and how many times each step was repeated. I found it much more interesting when the durations were specified in milliseconds than as fractions or multiples of a bar.

AA The introduction to an interview in *Factmag* states that you 'apply academic techniques to elements of rave culture'. Would you see that as an apt description of your work?

MF I wasn't really into rave culture – but I was very interested in techno and house music from the period 1987 to 1992. It's probably true that most of the music I make refers to that period. The sounds I use in my music reference forms of techno and house music, though the patterns do not. I am very suspicious of academic music, but around the mid-1990s I became aware of the tools produced by academic institutions, and I wanted to use them. My hope was not to make techno and house music more intellectually credible; it was simply because I wanted to use a whole bunch of approaches and tools to make music I like to listen to. I find the division between academic and non-academic practices very problematic. Three things that worry me about academic approaches to music making are, firstly, that if you think about things in a theoretical way you get better music; secondly, that if you use more complicated technology you get better music; and thirdly, that academic music is truly experimental, as it is free of the constraints of popular styles, software and technologies. None of this is actually the case. For me the best music is made outside academic institutions. In fact academic institutions are struggling to keep up with independent producers.

AA While listening to the podcasts on generative and process-based composition that you made with Joe Gilmore for Radio Web Macba in Barcelona, I sensed a similarity between some of the older process-based compositions and your recent work...

MF Most of my music is derived from process-based composition, although I'm not aware of any works that directly relate to mine. My main influences are house and techno, industrial music and synth pop. I'm not really interested in early electronic music or experimental electronic music. I think the exception is Yasunao Tone's music, some of which could qualify as early electronic music.

AA Sometimes it's almost as if you can 'feel' the algorithm while listening to your work – not in terms of guessing or being able to analyse which process or processes you use to generate the sounds, but rather in the sense of feeling close to the sounds. Is such a sense of tactility important for you?

MF You can actually hear the process, as that is all there is. Maybe you cannot reverse-engineer the process, or give a logical description of what is happening, but that does not undermine the fact that you absolutely are hearing the algorithm. Hearing the algorithm, understanding it and explaining it are different modes of encountering the algorithm; none are superior to any of the others.

AA What effect are you hoping to achieve with your light installations?

MF I would like to feel immersed in an energy that is neither visual nor aural.

AA What do you mean by 'multi-stability', the title of your 2010 raster-noton release?

MF I was drawn to this term for lots of reasons. I don't really mean anything by it, but I like the way it refers to a rapid and ongoing switch in how we perceive the thing that is right in front of us. I also like the sense in which a thing has no fixed state. Finally, I like it as a kind of description of the way we, as human beings, shift between stability and instability as we go about our daily lives.

Slightly different versions of this interview have been published in *Neural*, issue 40, Autumn 2011, and in a Dutch translation in *Gonzo Circus*, # 107, January–February 2012.

‘There is no physics of experience’

Interview with Pauline Oliveros

Nick Cain

Composer, performer and humanitarian Pauline Oliveros is an important pioneer in American Music and electronic music. She has explored sound for five decades, breaking new ground for herself and others. Through her Deep Listening Pieces and earlier Sonic Meditations Oliveros introduced the idea of incorporating all environmental sounds into musical performance. She has created a body of work – using improvisation, electronic music, ritual, teaching and meditation – with such breadth of vision that it profoundly affects those who experience it. Music critic John Rockwell wrote in the *New York Times*: 'On some level, music, sound consciousness and religion are all one, and she would seem to be very close to that level.' In performance Oliveros plays an accordion, which has been re-tuned to two different systems of just intonation, and uses electronics to alter the sound of the accordion and explore the individual characteristics of each room she performs in. Nick Cain interviewed her online in January 2012.

Nick Cain At Sonic Acts you're performing *Occupy Music*. I'm assuming it links to Occupy Wall Street?

Pauline Oliveros I'm very interested in the Occupy movement, and feel that I want to relate to it however I can. I have written a couple of pieces for the Occupy movement based on the 'people's microphone', and I really feel like that was a very creative way of working together. I liked it a lot and so I made a piece based on that for the Occupy movement. It's very simple. Basically the microphone check is called and everyone begins to sound using their voices, or whatever, and it moves throughout the entire crowd. So that's part of the inspiration for using the title *Occupy Music*. They are forbidden to use any amplification. That's why the people's microphone is not amplified at all, but the people themselves are amplifying by reverberating. Occupy Music will be an improvisation. I always have a title, and the title somehow inspires me. I will be playing my Roland V-accordion, which is a digital instrument.

NC We have a similar thing in London, with the occupation of the area next to St Paul's Cathedral. It's an incredible swelling of public protest.

PO Absolutely. Then there's Occupy LA, where there are a couple of women artists who have started to elaborate a lot on my Deep Listening work. They did a beautiful thing: they showed up with placards in the shape of ears. Big ears. And then they had what they called a 'listening parade'. [laughs]

NC One of the things I wanted to ask you about was time, time travelling being the theme of this year's Sonic Acts. How do the systems you have developed in the past – the delay systems you created in the 1960s and the more recent Expanded Instrument System – how do they relate to time? They often cause a hall-of-mirrors effect – did you conceive of them as a way of changing the listener's perception of time?

PO Of course what I hope is that people enter into a state of timelessness, where they're not thinking about time, where they're feeling space.

NC The recordings use sophisticated electronic systems but have a natural, organic flow to them. Accordions are like a big lung – they have a very breath-like rhythm to them, they flow very organically...

PO That's what I work with. Breath rhythm is very important to me; the accordion is an extension of my own lung, as I feel it. The thing you said that I really liked is about the natural, organic flow. That's the essence of the kind of the so-called 'time' – but it is really space-time – that I'm interested in bringing about, especially through these complex delay systems that I've used and am still using and developing. Right now I'm very involved with a project that uses artificial intelligence, and it is beginning to be able to play very intelligently. [laughs] But the algorithms that I use for my Expanded Instrument System were specifically designed to create that kind of organic feeling. The algorithms themselves really come from the Sonic Meditations I did in the 1970s.

NC How does the process of your Sonic Meditations work?

PO First of all, Sonic Meditations were a real break from the kind of work that was going on around me at the University of California San Diego at that time. There was a lot of interest in post-Webern-sounding work, and so on. And I started to do these kinds of meditations that came from my own exploration of listening to a long tone, and beginning to hear a whole universe of sound in a single tone, which you don't hear when you're thinking about sequences of tones. That was very important to me.

And then I wanted to create experiences for people who didn't have any musical training, because I had a large class of students, 150 of them, who weren't musicians. They were just general students. I began to compose Sonic Meditations. These are recipes for making a sonic experience. A recipe is a group of instructions that produces a result. We know this in cooking – if you combine the ingredients in a certain way, you'll get food, and hopefully it'll be good. But we also know that the recipe and the cook can make a great difference. And so can the ingredients: where they come from and how fresh they are. There are a lot of variables. But nevertheless I think of recipes as algorithms, and then moving into or interacting with electronic systems or tape delay systems, whatever you want to call them.

NC One of the fascinating things about your music is this tension or contrast between its natural flow, and that to some degree it's created using artificial systems of sound manipulation.

PO I've always been interested in creating an organic flow. And it's been fairly natural to me, all my life, to be interacting with electronic systems. As a matter of fact I'm currently completing an article called 'Music Technology Trails: Eight Decades – Reverberations' (to be published in the *Jefferson Journal of Science and Culture*). I've discovered in the writing of this article the kinds of things that influenced me as a child. Of course there was radio. Radio was not very old when I was born, in 1932 [laughs]. There had only been 25 years of broadcasts. I used to listen to the radio in a lot of different ways. One way was to listen to the artefacts, the static and the shortwaves on my father's shortwave radio. I used to play with it, turning the dials, hearing the whistles and pops, thing like that.

I discovered that I had listened to the original *Buck Rogers* radio serial and seen the movies in cinemas on Saturday mornings along with episodes of the *Popeye Club* and the *Buster Crabbe Show*. There was Wilma Deering, who was Buck Rogers's co-pilot. One of the main characters was Doctor Huer, the genius scientist. I was introduced to all these futuristic ideas very early. And I also wrote a piece for Merce Cunningham in 1969, which was called *In Memoriam Nikola Tesla, Cosmic Engineer*. I had read John O'Neill's *Prodigal Genius: The Life Of Nikola Tesla*, and was basing the piece on the infamous experiment in his house and lab in New York, where he caused a kind of minor earthquake, testing for resonance with a mechanical oscillator – this was the core of the piece I wrote for Merce Cunningham.

What I discovered in writing that article was that Nikola Tesla was the prototype for Doctor Huer in *Buck Rogers*. So all of those ideas were with me from that time. Inventions and technology have never been foreign or unusual to me, and I've always been curious about people who are technophobic. Now I understand why I am not. As a kid, I got all of that information.

NC Apart from being an investigation into the nature of hearing and into the idea of removing the participants from their everyday context and placing them in a new physical space, are the Deep Listening workshops you conduct also about giving the participants the time to hear in a different way?

PO If you have the right space, [laughs] then you're going to have the right time to work together. I have a hard time separating space and time. I have to pick up on one thing you said, that I was teaching about the nature of hearing. First of all, hearing is one thing, but listening is another. I do teach about the difference. Hearing is the process of taking in sonic information, through our ears. Listening takes place in the brain. More and more now with neuroscience, we are

Pauline Oliveros with John Baldessari's sculpture, *Beethoven's Trumpet (With Ear) Opus # 133* at Kunstverein Bonn, Germany, 2007.

Of course what I hope is that people enter into a state of timelessness, where they're not thinking about time, where they're feeling space.

learning a lot of new things about listening. As far as I'm concerned the experience of listening is rather mysterious. You can measure all kinds of things about hearing, physicists can measure the physics of hearing, but you can't measure the physics of experience. There is no physics of experience. So the scientific community has had a very hard time with it. [laughs] That's why some artists are doing this kind of thing now, and it is time for us to work together, so that a greater understanding can come about. And I think it is. I'm actually very excited about it.

NC Are you referring to the project you mentioned involving artificial intelligence?

PO Yes. It is based on the Expanded Instrument System. There's a post-doctoral research association working with me, and another colleague who is an acoustician. There's another one now on this particular project because the funding has been ongoing, from the National Science Foundation, actually, creative IT. This project started in 2008 and Doug van Nort, who was the research associate, was my student at RPI [Rensselaer Polytechnic Institute] in 2002 and 2003. He was interested in the Expanded Instrument System, and created his own system based on it called GREIS. He's working on this project at the moment and has created a new system that goes by the acronym FILTER. It can listen to our trio improvising, and then begins to play back with us. It hears the timbres and the densities, and the kinds of phrasing and so on, and it's doing pretty well.

NC I think of the Expanded Instrument System as an evolution of the systems you used in the 1960s. It sounds like FILTER is an evolution of the Expanded Instrument System.

PO Yes, it absolutely it, but I keep developing it further. I don't see any end to it. [laughs]

NC I was very sorry to hear of the death of David Gamper last year. Will you be continuing the Deep Listening group as a duo with Stuart Dempster?

PO Stuart and I are continuing, but we don't know exactly how it's going to play out. We did a memorial concert for David in Wisconsin a couple of months ago. We'll also perform together at my 80th birthday concert at RPI on 10 May. We're going to be performing in a simulation of the cistern we played in for Deep Listening in 1988. Stuart introduced me to this incredible cistern at Fort Worden, Port Townsend, Washington State. It used to store the water supply for the army there when it was a port. It's 14 feet deep and about 50 feet in diameter, made of reinforced concrete. The only entrance is a manhole cover. The reverberation time is 45 seconds, and when you play a sound, the direct sound and the reflected sound are equally balanced. So this space is definitely a hall of mirrors. Not only do you get that reflected sound, the indirect sound, sound travels around the cistern. Anyway, we made a recording there in 1988. That's where Deep Listening was born. It was where I coined the term 'deep listening', partly as a pun, and partly because of the way we had to play. Performing in an environment like that obviously means you have to listen in a different way.

NC One of the things that interests me about your drone-based compositions is the way that they collapse time. Can you say something about the relationship between continuous sound and time in your music?

PO In *Variations For Sextet*, from 1960, for flute, clarinet, trumpet, cello, horn and piano, I was working out a very complex rhythmic structure that would defeat any sense of metre. And yet there would be that collapse you were talking about. Then there was a piece I wrote in 1961 called *Sound Patterns For Mixed Chorus*. Again, it was a really complicated rhythmic structure, and I was beginning to relinquish control of pitch – people following a contour rather than specific notated pitches, breaking that down, deconstructing it. There's a deconstruction of pitch and time throughout those works, from the end of the 1950s into the 1970s. I was always interested in not having militaristic or metred time. This kind of time is time I don't want. I don't want to be marching. [laughs]

NC Does this relate to just intonation?

PO Just intonation is a beautiful sound, and it gives you wonderful consonant shifts. But the shifts I'm interested in are unequal intervals, when they get closer together and cause lots of very beautiful beat phenomena. People are interested in just intonation for the consonance and the rhythms, which I am as well, but I'm interested in those parts of the system that give you a very different kind of sound.

NC When did you first start using just intonation?

PO I had my accordion tuned to just intonation, I think in 1985.

NC How do you use it on recordings like *The Roots Of The Moment* (2006) and *Primordial Lift* (1999)?

PO It's by ear. If it sounds good then you play it. [laughs] I'm not working systematically. I'm really not.

NC How flexible a system is it for improvising?

PO It's as flexible as any system. Any system imposes limitations on what you can do. And so my strategy has always been to defeat the system as best I can. I can have a lot of different kinds of tunings on my V-accordion. I've been using Arabic tuning recently.

NC It sounds like you're working against these systems of tuning as much as with them.

PO Exactly. I remember I was playing in my trio The Space Between. Dana Reason was playing piano in equal temperament, I was playing my just intonation accordion, and Philip Gelb was playing shakuhachi. So there were three systems. And we had a great time improvising together with these three systems, working out how we could reconcile them and make interesting music. But you're right – working against the system is what I do. [laughs]

NC But your music, particularly Deep Listening, also has a very powerful positive energy. It's essentially a sharing music.

PO Yes, that's right, that's what it is for me. It is about the embodiment of sound, the sentient nature of it, the way you feel it. It's different from a hardcore intellectual approach to music.

NC But there is an intellectual grounding to it.

PO There is. But what I'm looking for or trying to do is to have homeostasis, to have an integration of both, so that you don't leave out the sentient part. I'm still very enamoured of sound, and listening. There's always more.

‘Sound must work as more than just a signifier’

Bill Dietz in conversation with Catherine Christer Hennix

The following conversation took place on 7 and 8 December 2011 at Catherine Christer Hennix's studio. The four hours of recorded dialogue were edited down to 82 minutes by Bill Dietz, transcribed by Arie Altena, and then further edited by Bill Dietz and Catherine Christer Hennix. Throughout the conversation, as is usual in Hennix's studio, her composition *Soliton(e) Star* was running, and every once in a while her cat Myobō no Omoto made her presence known.

Catherine Christer Hennix is a composer, philosopher, mathematician and visual artist. In the 1960s and 1970s she worked with illustrious figures such as La Monte Young and Pandit Pran Nath who were very important for her own work. She has also frequently collaborated with the American anti-art philosopher, composer and violinist Henry Flynt, and drew inspiration from Japanese Gagaku music and the early vocal music of Perotinus and Leoninus. She was affiliated with MIT's AI Lab in the late 1970s, working with Marvin Minsky, and with the Institute for Language, Logic and Information of the University of Amsterdam. All her major compositions, including *The Electric Harpsichord*, (1976, re-released on CD by Die Schachtel in 2010) are regarded as part of an ongoing, endless cycle. She lives in Berlin, where after a long hiatus she has recently started to perform in public again.

Much of Bill Dietz's recent work addresses the performance of listening and the genealogy of the concert. He studied composition and cultural studies and has lived and worked in Berlin since 2003, initially as Peter Ablinger's student and assistant. Subsequent collaborations include working with Christian von Borries and Chris Newman, and with Maryanne Amacher until 2009. He is the artistic director of Ensemble Zwischentöne. Along with Seth Josel and Chris Newman, he is MISS MOTH.

The crisis in composition

Bill Dietz What is a composer? I think we did approach quite specific things about that, last time we spoke.

Catherine Christer Hennix My concept was that the role of the composer has changed dramatically since the 1960s with the introduction of electronic music and the computer. That basically the composer is involved with what might be called abstract architecture[1] in the sense that the major activity is writing a program or having ideas for algorithmically generated sounds. Very few people have done this in an original way. I can only think of La Monte Young and Iannis Xenakis having done this coherently. I actually never really got going because I had another career. But I do have ideas about this and I might do something with them now if I continue to work as a composer.

BD In an odd way, what is so interesting about your work is that the gap between when you were initially composing and now allows you to connect more directly to a radical moment in the music world which, in the time when you were focused on maths, has totally vanished. A connection to a much more exciting moment than the one we are in now...

CCH My impression is that people have a very casual relationship with the term composer. For me, what defines a composer is not a 'feeling' but a formal requirement, which defines the act of composing. The question for me is whether a composition is an active or passive object. I have recently been involved with people in Berlin discussing the notion of a 'co-composer'. In particular, I don't understand why improvised music has to have a notion of co-composing. I know in jazz, from time to time it happens that people play something in the studio, and it sounds okay, and afterwards they decide, 'Hey, this is a composition, and we all did it', so all the musicians are listed as composers. But this is very exceptional. In any other case... well, you never have McCoy Tyner claiming co-composership on John Coltrane's records, not on any track.

BD After a hundred years of people trying to ask – also outside the context of improvised music – in a very basic way what composing means, what it is, what it is to be a composer – and then suddenly you have these strange casual claims...

CCH That means to me that the identity of a composer is very shaky. In other words, what defines a composer? It can't just be that I say I am a composer. That doesn't work. Then anybody can say they are a composer.

BD But this is exactly the kind of confused reception of ideas from the 1960s that we seem stuck with. 'The death of the author', for example. Instead of seeing an idea like this in the sophisticated context from where it emerged, today it's reduced to, 'Well, anybody can be a composer if they say they are a composer'.

CCH You're right. In the late 1960s in Sweden we had a very bad case of this at the Museum of Modern Art. They had an exhibition called *Poetry is Made by Everybody* (although it was never implied that poetry could be made by *anybody*).[2] Still, people went for it and thought that anybody could come up with a poem, and that it was poetry. Of course you can claim that, but then you've changed the whole concept of poetry. In other words, poetry is no longer a thoughtful way of expressing something, but it's something anybody can do. There were opposite traditions in, say, China or Japan, where the culture dictated that you had to send a poem in order relate to somebody, even in administration, what was going on. And in turn, the choice of words used, not to mention the calligraphy, made a great deal of difference.

BD But in that case the function of poetry, in that totally different cultural paradigm, is entirely different from what poetry is for us now. It is also very different to do this show in Sweden in the late 1960s and to make a similar claim today.

CCH But it is still the same ridiculous claim: the idea that we have to democratise the arts. There was a performance of *Aus den sieben Tagen* in the Netherlands which caused Stockhausen considerable angst when someone in the audience claimed, 'You guys on the stage, you can't just sit there and play your instruments, we in the audience have the right to bring our own instruments and we'll play with you whatever we feel like'. Had the musicians on stage said, 'Okay, we'll be an audience then and listen to what you do', then they [the audience] would have been offended and become confused about whether to make any sounds or not. The musicians, however, were not able at that time (nor now) to say this. This just means there is no identity as to who is a composer. There is no unique answer to it – as opposed to if you ask, for instance, who is a mathematician? This is very easy to check: is the person proving a theorem or not? If you are, you're a mathematician and if you're not, well, we're still waiting for that first theorem. And if it happens, that's where your identity as a mathematician starts. But here, the radical idea is that as soon as you have something out there in public and you think it is your sound, you claim composership. I do not see that as a coherent idea. I mean in this field of recording music and in... what was that music that Oliver [Schneller] was talking about?

BD Spectral music.

CCH I mean, ach, I don't understand what they think it is about.

BD Well, in spectral music you have a kind of positivist reduction of science to their assumption of what music can be. You have whatever actual research is done being projected onto this odd grid of the classical work. But more generally, the

1. See H. Zemanek, 'Abstract Architecture', in *Lecture Notes in Computer Science*, no. 86, Proceedings from the 1979 Copenhagen Winter School: 'Abstract Software Applications', edited by D. Bjørner (Berlin, Heidelberg, & New York: Springer Verlag, 1980).

2. *Poesi måste göras av alla! Förändra världen!* ('Poetry Must be Made by Everybody! Change the World!'), Moderna Museet, 15 November 1969 – 18 January 1970.

fundamental misunderstanding is that music is reduced to the arrangement of discrete frequencies… 'other men's notes',[3] as Maryanne Amacher would have said. Rather than a very basic reflection on sound, or on the different relationalities implied in music, it's reduced to this kind of indeterminate rearrangement of pitches or noises.

CCH That's baffling to learn, not least because it's a whole new idea that is completely divorced from the premises of modernity. Modernity was not about 'anything goes', although that's what it became when it became post-modernity. But that is a clinically hopeless case. It seems to me to have almost no positive value, or actually no positive value at all. Because it's incoherent, there's nothing to build on, it's so schizophrenically split. There is a quicksand-like quality to its assumed foundation.

BD But, for example, let's differentiate this from something like Cage's music – because I can imagine people saying that Cage also tried to reduce music to just this play of sounds. But I think what is important to remember with Cage is that his work was done with an eye to a horizon of the total disappearance of the arts and the artist, to a kind of potentiality, toward a fundamentally different state of things in which art would become unnecessary.

CCH And beyond that, the premise was that the 'scientific' lifestyle would replace the obsolete pre-scientific culture, the hegemony of which was broken by World War II. And beyond *that*, the idea basically was that the border between art and life was supposed to be dissolved.

BD Which is the classical idea of the historical avant-garde.

CCH Oh really?

BD I would have thought so, yes.

CCH I thought it was specifically American?

BD I don't know. I'd say in post-revolutionary Soviet art this was also very much the case. Tatlin designing an oven, Rodchenko working with Mayakovsky making advertisements, Popova's dresses and patterns. This was in the early years of the Soviet Union, before the repression of such efforts. In that period, these artists saw their everyday – or what we might now call design activities – as a consequent continuation of their artistic projects.

CCH But this is not what Rauschenberg meant when he said the border between art and life was dissolving. That is what his work was representing in the 1950s. To begin with, this period promised new paradigms for 'life', and art was considered an integral instrument for the development of and experimenting with new lifestyles. Russian culture remains pre-scientific today…

BD Well, that may be more true now than it was in the twenties… at that point, I'd say the Russian efforts were much more radical than what Rauschenberg was doing. Rauschenberg just ended up making a lot of prints.

CCH But what he did before that was, at least for me, extremely inspiring. I mean, what's the difference between dresses and patterns, and prints? For Öyvind Fahlström prints were a new and low-cost medium for his ideas. In other words, I thought of art as totally boring before these Americans came around. I became interested in art only after seeing people like Rauschenberg, Jasper Johns, and Warhol – and Fahlström, of course. Because there was a narrative in these works that was interesting, but which had so far not been registered by modernism. For example, Surrealism is somewhat boring, and Dada, well it's hard to figure out what it is, so before these people I did not see any attractive narrative in paintings, really for hundreds of years. Narrative in painting came around in the Renaissance when they were using mainly religious subjects and they painted with tempera. It was more like a comic strip aesthetic. But even more captivating.

BD And at that moment you also have the emergence of perspective.

CCH Not only that, you also had the concept of the self-portrait, which before that was inconceivable. You may consider this event as the birth of the 'subject' and its fictions. Anyway, suddenly there appeared this anarchistic style by Johns and Rauschenberg, on the canvas and even beyond the canvas. And you had the monochromes by Klein, and also Fahlström's work. All these artists were trying to marry art with life. To make the distinction vanish. You had basically the same aesthetics with the Living Theatre, with La Monte Young's Theatre of Eternal Music, with Henry Flynt's Concept Art. Even Fluxus was supposed to be that, up to a point at least. But then in the 1970s and 1980s a new force, seemingly coming from nowhere, just divorced art from life again. It happened very suddenly. Overnight basically. The way the Euro will disappear overnight. No announcement in advance.

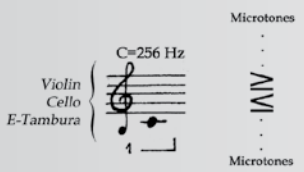
BD I think this is maybe the key to what we are talking about. Figuring out what happened in the 1970s…. Why people like Maryanne Amacher and yourself now seem to be the last generation of people, at least in the US, who were still somehow continuing this trajectory of thinking. From the 1980s on, I don't know…

CCH I felt it had disappeared and I think Maryanne thought so too. We had a very interesting composer in Sweden, Jan W. Morthenson, who introduced the idea of non-figurative music in his 1966 book *Nonfigurative Musik*, which has an introduction by Heinz-Klaus Metzger.[4] It was in the same vein, you might say, as the 'Drift Studies' by La Monte Young – presenting sound as a static gestalt with continuous internal movements. Morthenson developed this independently at about the same time. I like to apply it to some of my own works as well, although I was never directly inspired by Morthenson. Non-figurative music is a very catchy label…. Everybody wants to interpret sounds as figures, and I think that ruins the whole experience. The idea that sound has a narrative outside of itself, is to me difficult to conceive. I mean, the narrative we did with Cage[5] – that was over the top, it was a narrative in a dialectic with itself – totally unresolved and totally ambiguous. But a narrative of some kind that is linear in some way is, I think, outside the possibilities for music. I think it is a hallucination if you think that music is telling a specific story. Sound must work as more than just a signifier. The concept of non-figurative music shows that music can work without attempting to signify anything. If a sound comes without a reference, then it becomes its own referent, which signifies an extension of the concept of reference: signification without lexical referent.

BD But then I think it's important here to differentiate from what we touched on earlier when we were trying to say something about the contemporary reduction of music to this kind of combinatory play of elements within a very contained field, with no horizon, and no outside. In that context we were talking about an overarching narrative, a different concept of narrative in terms of the trajectory of the avant-garde and all that. It seems important to clarify that although obviously the internal structure of sonic and musical experience is fundamentally different from a linear narrative structure, that that does not necessarily contradict understanding sound within this other, larger narrative framework.

3. '…composing usually amounts to procedures of simply rearranging and modifying existent musical figures, that is other men's tunes, and giving them a personalized framework in time ('notes without ears'). Silicon composers are now achieving this faster and often better', Maryanne Amacher, 'Thinking of Karlheinz Stockhausen', in *Artforum*, March 2008.

4. Jan W. Morthenson: *Nonfigurative Musik* (Copenhagen, London, Oslo, & Frankfurt: Hansen, Chester, Norsk Musikforlag, & Wilhelmiana-Musikverlag, 1966).
5. See illustration next page.



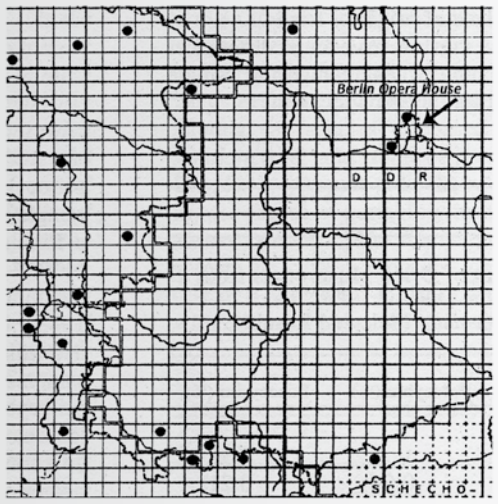
Sā-Ṣaḍja (Forefather of the Six)						
⊙ C	1/2*	ॐ	ether	HAṂ HĪṂ	multi-colour	peacock
Puruṣa (Ideator Principle)						

* ***According to Alain Daniélou:***
1 = 2 = 4 = 8 = 16 = 32 = 64 = 128 = 256 = 512 = 1024 = 2048 = 4096 = 8192 = 16384 = 32768 = 65536 = 131072 = 262144 = 524288 = 1048576 = etc. = 1/2 . f_0 = 1.

Der Raga erschöpft sich nur <u>zwischen</u> den Tönen (von allen Frequenzen).
[La Monte Young]

Contemplating Buddha's last meal:
What really happened
(Echoes of a revelation)

Sightings (•) of Interest →
(after Dr. Gartz, before Dr. Kagel)



Flyer for *RAAG IGNORANTI, Alap for Raag Tinitus via Soliton(e) Star*, an interpretation of *Solo 58* from John Cage's *Songbooks* (1970) conducted by Catherine Christer Hennix. Premiered by Ensemble Zwischentöne under the direction of Bill Dietz at the Berlin Grimmuseum on 19 July 2011.

ENSEMBLE ZWISCHENTÖNE *präsentiert*

unter die Leitung von
Bill **DIETZ**

RAAG IGNORANTI

Alap für **Raag Tinitus** *via* **Soliton(e) Star**

Zweiter Teil der Konzertreihe "Das Dort im Hier"

Catherine Christer **HENNIX**
conducts

eine Interpretation von "Solo 58" aus John Cages **Songbooks** *für Geige, Cello, E-Tambura, Computer und Live-Elektronik -*

(IRRELEVANT)
Eighteen full range microtonal 'ragas'
They are double;
The solos may be sung with or without other indeterminate music,

Is **Indeterminacy** *indeterminate music? If so, what determines its indeterminacy? (Are loaded dice musical instruments? - Mozart [K. Ahn. C 30.01], anyone?)*

im Sinne Karlheinz Stockhausens Ragabegriff -

(Interpretations of ragas differ distinctly and critically by which <u>school of raga</u> authorizes the interpretation)

Auf die Frage, ob eines meiner Werke eine unmittelbar nachvollziehbare Verbindung mit indischer Musik habe, antwortete ich spontan: ja, die *›Indianerlieder‹*; denn dieser Zyklus entfaltet sich ganz ähnlich wie eine Improvisation indischer Musiker über einen Râga, wenn der Râga im ålâpa (dem unbegleiteten Vorspiel) allmählich in allen Einzelheiten bewußt gemacht wird – Ton für Ton –, und wenn am Schluß dann der vollentfaltete Râga steht.

Allerdings gibt es in den *›Indianerliedern‹* eine wesentliche Erweiterung: der Râga ist eine 12-Ton-Melodie mit allen Eigenschaften, die erst die serielle Musik des 20. Jahrhunderts entwickelt hat.

abhängig von der offenen Bedingung dass 0 = 1 und dass - möglicherweise - von dem nullten Raga die Rede ist, und dabei auch von dem nullten "Indianerlied" die Sachverhalte angekommen sind (vergleich mit Daniélou, Kartenvorderseite).

***Uraufführung** (der ersten Fassung)*

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Fichte Straße 2, 10969 Berlin

Dienstag, 19. Juli 2011
19.00 & 20.30 Uhr

5-€

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mit
Johnny CHANG, *Geige, Stimme*
Agnieszka DZIUBAK, *Cello, Stimme*
Werner DURAND, *DJ*
Catherine Christer HENNIX & Bill DIETZ,
Rainpoles, Computers, Live-Elektronik, Stimmen
Catherine Christer HENNIX, *E-Tambura*

Texte von **Maria SABÍNA** *&* **John CAGE**
einer Software von **Simon HARRIS**
& Ausschnitte aus John Newlands Film,
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'Sound must work as more than just a signifier' TRAVELLING TIME 16700000

CCH Sure. But this also a very prevalent problem, say in the work of Marvin Minsky. His theory of music is based on the concept that there is a narrative. And that when you hear a piece of music, a movie goes off in your mind, and you see all kinds of pictures. You have the same idea in film music. Again, here you have hallucination in the parsing of the two, when you put them together. That is completely hallucinatory. Yet this is what Marvin Minsky thinks artificial intelligence should do when it synthesises music. So you'd have personal design music, which evokes the images in your mind that you prefer. As if you could do that! It would be as though there were a unique pill for a certain type of inner experience. So far no one has invented such a pill and it's hard for me to imagine that such a pill exists.

BD And yet that is still the assumption. This is even the assumption of so much contemporary music – that somehow one is referring to a certain stable given identity within which one can then just move around different given variables and that this somehow constitutes music making – or living.

CCH It certainly is confusing because music appears to me to be used more and more as a type of accessory – like you have you clothes on, you have your jewellery on, and then you also have your music on. It reminds me of a variable painting by Fahlström. He took a phrase out of Nathalie Sarraute's novel *The Planetarium*, which is about the total isolation of each individual, and distributed its individual words over pieces of clothing. Her characters just walk around in a vacuum talking to each other. In other words, nobody is talking to anyone. He illustrated that by setting up all these people with interchangeable clothes on magnetic hooks, each with a different word from this phrase, which the viewer could manipulate. So when you changed their clothes, you'd permute the words – when you change clothes you change your words, your mental contact plates. Fantastic. Here it's the same in some sense. You dial another iPod-tune and you've changed your accessory. They say, 'Listen to this', and when it's over after five minutes, they push another button and say, 'Listen to this'. It's like with comic figures: Superman changes his costume and changes his identity. That is basically the paradigm.

BD Not only that, but, also as with *Superman*, music projects a kind of fullness, or sense of completion and stability. Contemporary music, or improvised music, or noise music, all these things (instead of being radical ways of apprehending reality or reflections on being) are just more of this – but for special tastes, for specific target groups. Exotic forms of the same.... But, getting back to this issue of co-composing and the gap in understanding what composing is, what a composer is now, one thing that interests me – I don't know if it interests you – is the kind of the ethics of the compositional relationship. That to compose implies a certain relationship between people. And that often in the popularised discourse around improvisation this is reduced to one person being dominant and active and another person being passive and powerless. I think this comes from an odd reading of some of Cornelius Cardew's texts. But for me the compositional relation, that is, offering someone else something to do, implies a wonderful potential for a whole horizon of other possible ethical relationships beyond a sort of optimised combinatorial play within a given normative field – that goes for composition, sexuality, or whatever.

CCH The origin, the root of this lies in the notation in which compositions are formalised. Even in regular staff notation two people will play the same note slightly differently, sometimes radically different. That is why you have many interpretations of the same staff notation. But then, this proves that this is a shaky notation. Ironically, when this notation was invented a millennium ago, its purpose was to canonise liturgical music into a disambiguated form. When you go from this old tradition to graphical notation it becomes even more ambiguous. And it's clear that everybody is doing totally different things when they interpret a graphical score. And at this point people start to realise that each composition should have multiple interpretations because no notation is exact. That was the basic idea of a modern music piece. Each time you play it, it will sound different – not because of a deficiency of notation, but as a consequence of its basic internal form. That was the concept of newness knocking on the door.... So, if you draw the consequences completely from staff notation's ambiguity to the ambiguity of the graphical score you might even say that the interpreter becomes the composer in a given part of the composition – or maybe even the whole composition. But that remains a part offered to the player. In other words, it's just another way of playing your instrument: you are now playing it as a composer, but you are doing it because you are instructed in doing it by another composer in order to realise that particular piece by that other composer. So it's not that you are coming up with your own composition, what you are doing is composing according to the instructions given by another composer. That makes it very clear that the interpreter of such a work is not a co-composer. In the beginning, in the early days of such music, there was no ambiguity about this. Nobody claimed to be a co-composer just because they improvised a part of the score.

BD It was clear that composition was not at the level of arranging noises, but instead at the level of creating a kind of conceptual framework or some kind of structural basis in order for people to relate, for someone else to create something.

CCH The way I see it, is that it creates space for the mind to invent something, to perceive something that is new. That's always a refreshing experience. What is new is interesting. So that's why I find it so confusing today that nobody complains about notation. Nobody complains about the ambiguity of interpretation of musical compositions. And nobody seems to know anymore what a composer is. No complaints about that either. I just don't believe that people have thought this through very well.

BD Well, there is a whole history of thinking about these issues, but at a certain point it just seems to have snapped off. Or rather, if these things are addressed now, it's in rather superficial ways: reducing the role of the composer to something like a dictatorial entity.

CCH But that was Cardew's complaint. Cardew said that Stockhausen and all these people, including Cage, were fascists because they told people what to do. But he did not look at what it was that these composers were telling people to do. Here, we come back to the earlier story about poetry being written by everyone... but not by anyone.

BD But I mean, maybe the difference between that sentiment now and when it was being said in the 1960s is that at that moment it was also a kind of composition of someone else, for example, Cardew... or Beuys – something being offered to people to do. And that now, this moment of mediation, of someone giving, someone proposing, is totally lost. Instead, such things are just taken as the state of things. Not that saying everyone can be a poet was the most interesting statement to begin with, but that the structure of saying it at that moment was maybe different.

CCH In Sweden it coincided with a political ideology, which is labelled 'equality'. They say everybody is equal. And of course everybody is equal, but not everybody can drive the bus. It doesn't work that way; there's only one steering wheel. If everybody drove the bus, you'd have to put a steering wheel at every seat and try to make sure that everyone steers in the same direction. Which is basically impossible. So, I don't understand their point. They want to be active in the concert hall, the bourgeois cube, which has a certain ceremony to it... which has also basically vanished by now. I don't understand that people want to be seen at a concert hall. It's like being seen at a porno club or something. It's really humiliating in my opinion.

BD Yeah... I mean, even from a totally different perspective, Heinz-Klaus Metzger, who is also very critical of the development of European music and the rest over the past 20 years,

described things nowadays as, 'aufgehobene Unterhaltungsmusik' – basically, snobby pop music.

CCH That is what it looks to be: pretentious... and what else? Pretentious nothings. I think the test of a composer's composition is whether the composer wants to hear the piece more than once. Or more than twice. Or wants to hear it all the time. If the composer wants to hear the composition all the time, that's a *bona fide* composition in my opinion. I only know one composer who plays his own music all the time: La Monte Young. That shows that he is not casually interested in his own music or sounds in general. I am not sure that John Cage listened to his compositions very often. He made so many in the end that it must have been difficult to listen to all of them. I can imagine Feldman having listened to his own stuff from time to time.

BD But when you say, 'listen to his music', don't you mean something more specific? Aren't you talking about a kind of music that has this kind of listening as its subject matter? For example, I brought along a quotation from you in which you're writing in a very basic way about the drone we are hearing in the background: 'As a raga or chant unfolds it opens up an inner space, which progressively affects the perception of the *outer space*, one space aligning itself with the other along the intersection between sound and consciousness. [...] Remarkably, this mode of perception bears the signature of a unitary ground state transformation of an excitable medium processing topological quantum computations. Under this aspect, especially applicable to a musician in performance or practice, Vedic space becomes an *emergent phenomenon* by which each sound defines a unique state of space perceived in terms of a certain 'quality' or 'ambiance' specific to it as *mediated by a unitary ground state change originating in the minds of those present*. [...] Following this lead new areas of sound can emerge which, if not facilitating this correspondence, at least can enhance its prominence.'[6]

This is what I understand as the kind of intensive listening you are talking about. And maybe listening is almost the wrong word, rather...some kind of engagement with a specific sound and how it relates to consciousness. I think that is a fundamentally different understanding of listening and relation to sound compared to that which Cage maybe had to his own work.

CCH Cage was responding to a very different tradition. I responded to the tradition of Cage and Stockhausen. And of La Monte Young and Xenakis, maybe. They had already taken care of the previous generations in music, basically declaring them inadequate for our times. So these composers gave the premises for going one step further. And we are still struggling with this one step further. We haven't got around to it.

BD In the same way that people nowadays throw around clichés of the dictator-composer, you'll hear the same people saying that it's kind of backwards to have such a linear idea of the development of music history, such a simple projection from one step to another. This isn't what I think you are suggesting. You're suggesting a more sophisticated way of responding to music history – a serious way, which demands the rigorous consideration of history. So much of the little work today which responds to Cage and these traditions fails to do this and instead very obediently repeats certain Cageian gestures – maybe in a slightly expanded form. They stretch the time scale or something like that, or they use noises instead of pitches. But basically it's still operating in exactly the same framework as Cage. Not only is this framework not seen as something to... answer, I'm not sure it's seen at all.

6. From the appendix to Hennix' 'SOLITON(E) STAR, RESONANCE REGION 1A [ZERO-TIME SONIC MIRROR]', Text Version 2, as published for Arika's *Instal Festival* in November 2010.

An other music

CCH What is interesting, at least to me, about the break that modern music introduced in the 1950s, is that it emphasises Lacan's concept of the lost object – in the sense that the object that is lost is the lost sound. In other words, there is a deficit of sound, and this is what prompts these people to make another sound. And then in 1968 comes *Aus den sieben Tagen*,[7] which is also a search for a lost sound on still another level. Here Stockhausen comes to the end of a very fruitful period of compositions and for some reason or other he feels he has lost the sound, it's his lost object... besides his wife. And he finds the lost object by playing two notes on a piano. He listens to these two notes... and he abandons staff notation, he abandons graphical notation, and he starts what is basically a word piece, a series of word pieces. Now, the way I interpreted the earlier word pieces, those by La Monte Young and others from the early 1960s, is that this was a gesture to get back to basics. In other words, something had been lost and had to be found again. The word pieces were a way of directing the mind towards what was lost.

BD In a different way from Stockhausen.

CCH Yes. In other words, what was lost was found, for a while, and then it was considered lost again. The only one who did not lose it was La Monte Young. And Henry Flynt, of course. La Monte Young really stayed with his basic principles up until today. And you cannot say that of many composers. Xenakis changed, Stockhausen changed, Cage changed, Morthenson changed. Another significant difference between *Aus den sieben Tage*n and the American word pieces was that the original word pieces did not involve advanced instrumental techniques and there were thus no criteria for a failed performance. Whereas *Aus den sieben Tagen* by contrast involved many new instrumental techniques. Performances of the American word pieces were experimental and sometimes didn't pan out at all. This gave them an edge that I found challenging.

BD How then do you then describe, in the psychoanalytic terms you brought up in regards to Stockhausen, this 'finding' of La Monte Young – or, his 'staying with it'?

CCH He recovered the lost object, or he is in the course of doing so by listening to his own compositions.

BD But with this going back that you describe, to something that was lost, don't you find something different, something else? Where in Western music would we be returning to? To which basics?

CCH Well, up to a point, let's say, this type of listening was actually very prevalent for several hundred years – at least starting with the Notre Dame School in the twelfth century. I mean, you don't develop just intonation without listening. My idea of a composer was actually somebody who made his own scale, which was different from any other composer's scale. And that was what you worked with as your basic material. Painters have always developed colour scales, which were unique to them.

BD The other side of these scales, how they are heard, their processing in the listener, is what you're speaking about in the passage I quoted – when you have one space lining up with another, so to speak, the alignment of sound and consciousness you describe there.

CCH There's actually a popular notion of this now in psychology. They call it 'flow'. [laughter] That is supposedly the most desirable state of consciousness that people are looking for today. For me, it simply

7. In 1975, Catherine Christer Hennix recorded a version of *Aus den sieben Tagen*, which is currently being prepared for release.

means that it is an intransitive experience in which thinking becomes basically effortless, the sense of gravity disappears, mass disappears, and you have a frictionless journey to a space you haven't seen or experienced before. When I speak about unitary transformations there, it is actually the idea that states of consciousness are mediated by quantum operations. And unitary transformation is an operation where you go in one step from one stage to another, without any intermediary steps. And that is sort of how it feels if you walk into a sound that is striking. It changes you as though in one step, from one state to another. If you assume that life is supported by a sea of interconnected quantum systems, each one with its unique ground state, then, given a certain ground state, there is space for further migrations to yet other ground states mediated by attention. But the idea is to use this quantum theory concept to make what appears to be an infinite step in one step, and you have no idea how you got from point A to point B. It just switches you over from A to B.

BD What is then interesting for you about just intonation is not necessarily its rational organisation or anything to do with a particular quality or 'purity' of the sound, but rather how this mediates such ground state transformation.

CCH Yes. but I think the quality of the sound also determines this possibility – this is one reason why this unitary transformation suddenly takes place. When you listen to contemporary postmodern music, the quality of the sound is not sufficiently sharp. It does not affect you in this way. So you can listen to the music and think about a thousand other stories at the same time, or just wait for it to end, so you can applaud and have a drink at the bar. I think the sound quality is a very important aspect here. That is also why not every sound works.

BD Another limitation of certain music involved with just intonation is that they remain within the conceptual paradigms of classical mathematics and science (even literally so, referring to Pythagorean ideas, etc.), which is today, obviously, of a very questionable efficacy. This is especially apparent, for example, when you conceptualise the boundedness of oscillation on a universal scale – from between the Hubble frequency, at the low end, and the... quantum high end of the Planck frequency.

CCH Yes, so, in other words, this is all sort of borrowed from quantum formalism. Quantum theory is usually formulated in terms of Hilbert space. You can think of each oscillator as living in a particular Hilbert space. So the universe consists of this entire battery of Hilbert spaces, each one having its own frequency. If you now go from the Hubble frequency to the Planck frequency, what is between them is what I call the Cosmic Shruti Box – the Hilbert Space Shruti Box. In quantum mechanical formalism, you can actually write down how all the frequencies in the universe come about. You locate them through an oscillator; each frequency has its own oscillator that produces it. This is of course very abstract, but what you actually get is that the whole cosmos is breathing shrutis, although we don't hear any of them.... But that's our own fault. It's not just that we have limited perception, but also that we are not searching for these things. I mean, perhaps they cannot offer us anything – that possibility is not excluded – but of course they could just as well have very much to give, and we should discover that, and make something of it.

BD We've spoken already quite often about La Monte Young. Maybe we should be a bit more specific about your relation with him. For example, we have here this document,[8] 'The

8. 'The Two Systems of Eleven Categories 1:07:40 AM 3 X 67 – '(first revision of "2-3 PM 12 XI 66 – 3:43 AM 28 XII 66 for John Cage" from "Vertical Hearing Or Hearing In The Present Tense"', a privately circulated document by La Monte Young including appendices by Young, Henry Flynt, Catherine Christer Hennix, Dennis Johnson, and Daniel James Wolf. Quoted as it appears in the '85 XII 23 NYC Draft' (published by the MELA Foundation).

Sound is definitely a medium for consciousness formation and development. But depending on which sounds you hear your consciousness will develop in a particular direction.

Two Systems of Eleven Categories'. Is this from the time you first encountered La Monte?

CCH Yes.

BD But then you actually contributed to its development.

CCH Yeah, well, the thing is, he gave it to me when we first met. And then I came back a week later and I had written out the theory for his theory, which is my paper in there. I did this on the spot, you might say...

BD And the aspect of composing a kind of algorithm for leaving out specific sounds, rather than one that determines sounds – is that something that was already present when you first met La Monte?

CCH That was the carrying concept. In other words, everything he decides is based on which frequencies are not heard. He chose 60 cycles as a fundamental because that's the frequency of the electric grid in New York, and the whole United States. In the sixties in New York they had really bad wiring, so everywhere you went you heard this 60 Hertz buzz. After being immersed in La Monte Young's sound for three or four days, you'd walk out into the subway or somewhere, and you'd hear all these ambient sounds – but now you'd hear them with the extra overtones of La Monte's tuning. And you'd realise you were just walking out into a lower grade of that drone. It was all around you, 'tone and place'.

BD That's beautiful.

CCH Actually, La Monte did not play his drone very loud, but when I played *The Second Dream of the High-Tension Line Stepdown Transformer* in Stockholm,[9] it was an incredible drone. We were doing it at 100 dB or something. We were in the museum for a week with two days of concerts, on Saturday and Sunday. When we left the museum in the morning, at 5 or 6 o'clock, we could hear the drone from the La Monte Young composition in the city drone of streetcars. They made the only noise at that time of day. It was in the summer, there was almost no car traffic; everybody was on vacation. The streetcars were made of cast iron or something like that, very heavy material, and they sounded terrible, but when we came out, we just heard the drone in the streetcar noise. In other words, the entire ear became a filter in such a way that only those parts of the harmonics of the noise of the streetcars registered in a dominant way. For months I heard it that way, and then it started to decay.

BD This is something that Maryanne Amacher worked with a lot as well, what she called the 'after sound'. Very often in her performances, towards the end (though not always), she would do something like a 20-minute fade out of the sound. In this period, your ear is constantly adapting to the decreasing amplitude. I had a vivid experience of this the first time I heard her perform live, which was just fantastic, and without knowing much about her work and her thinking – this was before meeting her. At the end I couldn't tell whether the sound I heard was continuing to come from the loudspeaker or from my ears, it was so present. I remember literally pressing my ear up against the speaker, trying to figure out where the sound was...

CCH Sound is definitely a medium for consciousness formation and development. But depending on which sounds you hear your consciousness will develop in a particular direction.

BD This is also how I understand your interest in Indian and other non-Western music – insofar as these traditions have very specific ways of addressing states of consciousness. And that this aspect of music is much more central in those musical traditions.

CCH Indeed, that's the very issue. That's why you actually perform these kinds of music. Gregorian chant is a typical example in the West of an attempt to form consciousness with music for a spiritual path. And in India you have the ragas and other forms. In Japan you have Gagaku music, of course.

BD What is interesting to me in these traditions – or rather, what seems closest to being accessible or comprehensible to me (not having studied them extensively) – is that they stand as direct evidence for the possibility of modulating consciousness, or the possibility of difference, of shifting things and offering different relational positions.

CCH Yes. Music was originally used for magical purposes. Instead of using magic I try to have a more rational approach. What I do is tested, not so much subjectively, but more objectively (though that is not so easy with sound, since it is intrinsically subjective). Sound is intrinsically psychotropic in the sense that it drives consciousness in a certain direction, it modulates whatever you happen to think in the moment and it takes you away from it in another direction. Which, I guess, is what attracts people to it, because they are not attracted to where they are now. They go to the concert hall to get a break. And they feel elevated when they walk out, because reality has been shut out for a couple of hours...

BD This is the same as people listening to their iPods. There has to be this basis for it being such a popular experience... a certain pleasure in it, a certain suspension of reality – even if it is in this miniscule, contained form.

CCH Well, as I was just telling Marcus Boon, in this particular part of Berlin where I live, I have never seen so many pharmacies anywhere else.... Every block here has a pharmacy and an Internet place. It's as if the people oscillate between needing a dose of Internet and then a dose of headache pills.... They go back and forth between these two extremes. And the iPod is somewhere in between. It's just a way of alleviating the pressure of reality, which seem to overwhelm most people. Many feel totally deformed by it and this is a way to come back to life.

BD But how in a fundamental way does that differ from the experience of a La Monte Young drone? Is it a difference of dosage?

CCH Yes, but also you might say a difference of social ethics. Our present social ethics do not provide for any space for La Monte's indefinitely progressing compositions. There is not one single space in Berlin that you could dream of being dedicated to a La Monte Young piece for a year or even a month. The ethics of this society requires that you spend fifteen minutes on the Internet, then you go to the pharmacy to get your headache pills, then another fifteen minutes on your iPod or an hour on the Internet. And then back to the pharmacy. That isn't the social structure that's intended for classical Indian music, for La Monte Young's music, or my music. The necessary idea would be to have a society that is sufficiently generous to provide a space for such music instead of for a bank. It has to do with social ethics.

BD What does it mean then when a place like the *Dream House* in New York claims to be such a site? Or rather, to what degree is it also important to make clear in the broader sense that there is no permanent space for such a configuration at the present time? To acknowledge that the *Dream House* will likely also be transient? To what degree is it important to recognise within an artistic work the impossibility of its own situation... not paradise now, but paradise deferred?

CCH That was the meaning of the name of the band I had before the present one; it was called the Deontic Miracle. The miracle was simply that we were able to perform at all in public. And of course we were never allowed to perform again. The health czar of the Swedish government decided to come by, I don't know why, but he heard my sound and he was totally upset, and he told his colleagues in the cafeteria, 'You know, this sound is like drugs'. And of course, he was very anti-drugs. He felt it was the equivalent of a hallucinatory drug and that it should be forbidden, and he succeeded in doing so.

9. In June 1970 at the Moderna Museet.

BD In the traditional music we mentioned, the consciousness-transforming experience of music is always embedded in very specific cultural or religious traditions. It implies a certain relation to a community, a certain relationship between people. It's interesting then to see something like this emerge in the mid-twentieth century... through a kind apotheosis of Western music...

CCH Early Christian music, Chinese music, and classical Indian music – all these types of music presupposed an environment that was static. There was no sense of social development. You had one society for all time, and it never changed. During the 1950s and 1960s it was clear that society was not going to remain static. And so the idea was to invent a form of music that would accompany the dynamic development of Western societies, one that would keep pace with all the social leaps and jumps taken in these years.

BD Precisely with someone like La Monte Young, there is the emergence of something that closely resembles a kind of static tradition. (Which, I suppose, is also made literal in his relationship with Pandit Pran Nath.) But then I wonder why this has not had a stronger, more generalised effect. Maybe we are trying to reach a static point again, but obviously the real conditions of the world are not in harmony with this. What seems more fitting than the fantasy of another static state, even at a future stage, is a perpetually... statically transitive state – static but also mobile, that can move and be still at the same time...

CCH Yeah... it's a pretty much impossible quest, but that on it's own makes it all the more interesting to reveal. We're living in extremely unfortunate times, of course. You may wonder why you would spend any time composing music when things are falling apart at the rate they are now. But then again there might be islands or oases where you can go to chill out, to help you to conserve your mental energy, or even to generate additional mental energy. I mean, we do have to recognise that we are under attack – not just by the 1 per cent but also by the 99 per cent. There is basically open warfare between high, learned culture and the rest of society. There is a war on science going on, basically.... I mean, when you do this kind of work, you think of it as being for all time – you cannot conceive of it ending when you are involved with it. And then the disappointment comes when somebody pulls the plug on the whole thing. They say, 'You know, we have to have a new show in here, get out!' And stuff like that. We think we can postpone that moment indefinitely, but of course we can't. But at least there are times where you are able to push the envelope and have a two-week performance or something like that. But the basic idea that you have to trick everybody in order to get so far, shows that the ethics of society are deficient.

BD A mystified approach like this seems particularly detrimental at a time when it's so unclear what most people are doing when they claim to be making so-called experimental music. Somehow to be able to not only produce such work, but also to think about it very clearly, to be able to articulate its relations to the ethical conditions surrounding it, seems as though it should be a kind of prerequisite...

CCH I think so too. I said something like this already in 1976 – that the length of a performance is proportional to the ethical standards of the social order.[10] But I did not imagine that this would be a long-lasting conflict. I thought that these people would just walk away and not be interested in this. Instead they flooded the place and threw everybody who was a professional off the stage. We didn't know that there was a conspiracy against this type of thinking. So, I'm very inadvertently involved with this fight. In other words, this was not a fight I planned, or wished for.

BD But I have the sense that there is a real desire or need at the moment from many different places to start thinking about music in ways that you are suggesting.

CCH Recall that already in the 1960s and 1970s the idea was that those who turned their back on society were the audience for this kind of endeavour. I think this is the same today, but it seems that nobody is capable of turning their back on this society – they want to hang onto it. And as long as they do, it will be a continuous disaster. We must recognise that people did something wrong, otherwise it wouldn't look like this. But nobody wants to say: 'We did it wrong'.

BD Yeah, but I wonder if it's not just bankers and other people who did it wrong, but that there was also something implicit in a certain moment in 1960s thinking that also contributed to this.

CCH There must have been, yes.

BD I think what this was, was exactly this moment of mystification – assuming that it was so easy to just say, 'Hey, here it is'. To not simultaneously insist on the discrepancy between the work and the situation of the work.

CCH Perhaps we can put it like this: there is a peculiar notion of professionalism in the United States that you have to 'be somebody' that we don't have here in Europe... a particular mystique about the American subject that has a unique referent: in other words, the pathos of 'we are Americans, we can do anything...'. We don't have that here, except maybe in England. And the pinnacle of the mystique of this divided subject is the disappearance of the subject. In other words, what is most visible is now supposedly disappearing, although it is still present. When mystified the subject disappears because it's a form of transgression of traditional social norms that require that the 'mystified subject' not be seen as such. Or, equally, it is identified with the *objet petit a* – this is the Lacanian mechanism of something so abject that you cannot see it even though it's in front of your eyes. Its force makes what is most visible disappear. Its very presence causes its disappearance on pain of unravelling the entire social fabric – an abjection so extreme that it creates a blind spot in the mind. So in the 1960s, though all of a sudden the subject has appeared – not just through psychoanalysis, but in the wake of Heidegger, in Continental philosophy – no sooner does it start to emerge and divide than it's declared disappeared. This could be the definition of that 'mystification' of which you speak. A mystification that has become omnipresent in our contemporary society... a society that seemingly has no answers to its most pressing questions.... So, again, because mystification is by definition a form of transgression, we are now living in the era of the emergent normalisation of transgression, of 'perversion'. 'Anything goes' (Feyerabend). Multi-cultural becomes 'multi-transgressional'. Global capital itself is defined by the hysterical choice between transgressions relating to financial fiduciary conduct. Transgressions define our ultimate accessories in that they reflect what is taken to be our collective identity – who we think we are. And there we return to so-called noise music, field recording music, and other such 'new music' – music bearing the footprint of one mystified 'transgression' or another – music that now stands as evidence of the shakiness of this 'transgressive' foundation to begin with. Music that now leaves us struggling against the wake of mystification, and, in particular, for any need of accessories as signifiers.

10. '[I]t should be noted that length is restricted by the standards of ethics in our society – a cardinal example of a conventionalistic restriction of a useful modality. Length has to do with space in society, how much space can be taken up by musical performance? […] Our long performance styles are very good pedagogic examples of *overcoming* the obstacles existing for Freedom and Freedom in our society. This is how musical performance connects with ethics. There are obstructions for these long-style performances and our music documents the overcoming of those obstructions…'. Catherine Christer Hennix, from an interview with Rita Knox in the catalogue to *Brouwer's Lattice*, Moderna Museet, 1976.

Pitches Treated as Noise

Interview with Robin Hayward

Arie Altena

Tuba player and composer Robin Hayward has redefined the tuba's potential in the areas of noise and microtonality, and has developed a fully microtonal tuba in co-operation with the firm B&S. His compositions for other instruments reflect an experimental, medium-specific approach as that taken towards the tuba. Composers such as Alvin Lucier and Christian Wolff have written compositions for him and his approach to the tuba has been documented on the solo CDs *Valve Division* (2006) and *States of Rushing* (2009), along with various collaborative releases. He is active in many contemporary music ensembles including Phosphor and Kammerensemble Neue Musik Berlin. In 2005 he founded Zinc & Copper Works for continued research into brass instruments. This interview focused specifically on his tuba playing and tuba research, and was conducted by e-mail in early January 2012.

Arie Altena What initially inspired you to play (and develop) a microtonal tuba?

Robin Hayward In the years preceding the development of the microtonal tuba, I had been focusing almost exclusively on noise production when playing the tuba. Pitches were not banned but when they occurred I treated them in the same way as I did noise: the focus was on the intrinsic quality of the sound itself and not on relationships between sounds. By 2002 my focus had shifted to include relationships between sounds and it therefore made sense to concentrate on pitch, because of the precision with which relationships between pitches may be classified. Apart from this, my work with noise was beginning to feel less fresh than it had in the late 1990s and it felt like it was time for something else. By concentrating on pitch it seemed it might be possible to return to noise from a fresh perspective, just as focusing on noise had made it possible to decontextualise the traditional tuba sound and approach it from a different perspective through working with microtonality.

AA You have spent a lot time researching the tuba as an instrument in all its aspects, yet I was wondering first of all how you became a tuba player, and what are the characteristics of this instrument that most fascinate you.

RH I originally wanted to play the trumpet. The local school was forming a brass band, and as I was one of the larger children I was initially put on baritone horn and moved to tuba a year later. I liked the deep sounds and soft quality of the tone. I remember thinking that as the instrument was relatively unexplored, it would be open for exploration later, after I'd learnt to play it conventionally. Actually, I think conventional music education rather dulled this early desire for exploration, and it wasn't until my second year at music college, nine years later, that it re-emerged. It was at this point that it was becoming clear that I could play the tuba and go down the normal classical route, but I realised that it wasn't at all clear what I wanted to do with it artistically. It took quite a long time – nearly a decade in fact – before I discovered the technique of the rotating piston valve, which would open up the world of noise that preceded the development of the microtonal tuba. I'd actually had small glimpses of the rotating valve technique and the microtonal tuba when I was still at music college, but perhaps the environment was not conducive to me being able to appreciate their significance or develop them.

AA In your most recent pieces you combine the tuba with live electronics and a seven-channel sound system. What are you trying to achieve sound-wise in compositions like *Plateau Square* and *Tetrahedron*?

RH Both pieces use the sound systems to project harmonic space onto physical space. A common way of visually representing harmonic relationships is by means of a three-dimensional diagram in which intervals based on the prime number 3 are aligned horizontally, those based on the prime number 5 are aligned vertically, and those based on the prime number 7 are aligned diagonally. The space between prime numbers 3 and 7, lying between the horizontal and diagonal axes, is therefore depicted as an ascending series of plateaus, and it is the harmonic space implicit in one of these plateaus that is explored in *Plateau Square*, with each of the four speakers of the quadraphonic sound system representing a corner of the plateau. The tuba pitches are routed to the corresponding speaker(s) by means of sensors attached to the valves, which enable the signal to be routed differently according to which valve combination is being depressed.

In the piece *Tetrahedron*, written for the tetrahedron-shaped space at the Logos Foundation in Ghent, prime numbers 3, 5 and 7 are used to represent the three-dimensional tetrahedron within the diagram of harmonic space. This in turn is projected back onto the physical performance space by placing a speaker at each of the three ascending surfaces and four corners of the tetrahedron. Having established the essentially static relationship between harmony and space for each piece, the compositions then focuses on moving through this space over time (20 minutes in the case of *Plateau Square*, 40 minutes in the case of *Tetrahedron*).

AA Your composition *Nouveau Saxhorn Nouveau Basse* from 2010 also relates to the history of instrument design, as it refers to Adolphe Sax's invention of the saxhorn. What fascinates you about this history? What happens in the piece?

RH Adolphe Sax introduced the Saxhorn Nouveau Basse in 1852 after having developed his 'family' of saxhorns in the mid- to late 1830s. The instrument arose from an attempt to solve tuning problems caused by valve combinations on his earlier saxhorns, which were very similar in conception to the tuba. On instruments using valve combinations, each valve lowers the pitch by less when used in combination with other valves than it does when used in isolation, meaning that the more valves that are combined with each other the sharper the tuning becomes. The solution offered by the Saxhorn Nouveau Basse was a system of ascending valves in which each valve cut off an increasing amount of the overall length of tubing. As they could only be used in isolation, each individual valve could be tuned precisely to tempered tuning and the sharpness caused by valve combinations would no longer be an issue. The instruments were a failure, partly because the tubing had to be fed through each of the six valves twice before reaching the bell, which led to a dull tone, and partly because of the additional effort it required of the players who had to learn a radically new system.

In the composition *Nouveau Saxhorn Nouveau Basse* the concept of using only individual valves is applied to the recently developed fully microtonal tuba. Because of the microtonal tuning this now leads to an undertone row of fundamental tones based on the prime numbers 3, 5, 11, 13 and 17. The structure of Sax's instrument is then projected onto the performance space, in that the six loudspeakers distributed around the audience assume the role of the valves of the Saxhorn Nouveau Basse, and a seventh speaker placed backstage acts as a metaphor for its bell. The tones played using each of the individual valves of the microtonal tuba are first passed from speaker to speaker to speaker and then sent to the seventh speaker, following the same route as they would within the air column of the Saxhorn Nouveau Basse. As the tones move between speakers a small amount of the signal is recorded live and mixed back into the electronic signal, a reference to the sound being altered in Sax's instrument as a result of passing through so many valves that makes a feature out of one of the aspects that had led to the failure of the original instrument. So the piece arises from a sort of dialogue between the two instruments, both invented to solve tuning problems, in which the microtonal tuba could be seen as singing an elegy to the earlier invention.

The undertone row of fundamental tones in *Nouveau Saxhorn Nouveau Basse* omits the prime number 7, which is the reason that *Plateau Square* focuses on septimal intervals. As *Plateau Square* was originally conceived as a prelude to *Nouveau Saxhorn Nouveau Basse*, it seemed appropriate that it should focus on harmonic relationships omitted from the longer piece.

AA You work a lot with the space of sound, and with the space where you perform. I have the impression that the way you are dealing with space is very close to Luigi Nono's ideas about spatialisation, and is much less concerned with the spatialisation of

sound as it is used in commercial cinema, or the acousmatic music that comes out of the GRM tradition.

RH Having played Nono's *Post-Prae-Ludium per Donau* fairly frequently I have more first-hand experience of his use of space than that of the other traditions you mention. I love playing this piece but I wouldn't say that the pieces I've composed until now for tuba and live electronics are directly inspired by it, not consciously at any rate. The three compositions you asked about all have to do with spatial projection – of harmony in the case of *Plateau Square* and *Tetrahedron*, and of instrumental structure in the case of *Nouveau Saxhorn Nouveau Basse* – onto the physical performance area. The direction of the sound moves according to which aspect of the projection is being brought into focus at any given moment. This strikes me as being quite different from Nono's use of space, in which sound is moved through the performance space within certain passages of the compositions and acoustic spaces are evoked, for example, through the use of reverb. It may well be that his influence will be more pronounced in my future work with the microtonal tuba and live electronics. And one thing I have strived for in the pieces I have composed so far is the close integration between the acoustic instrument and the live electronics, which is a feature of the late Nono compositions that I have enormous admiration for.

AA Can you explain why issues of consonance and just intonation are so important? Is your research into this also taking music in a new direction – compared to more traditional Western classical music?

RH Arnold Schönberg's 12-tone method tacitly assumes equal temperament – it is after all the equally tempered chromatic scale that supplies the 12 tones upon which the system is based. This was due in part to the dominance of the piano at the time Schönberg was composing, and also to the fact that performance practice at the time regarded most other Western instruments as being limited to playing the 12 chromatic pitches without much concern for what lies between them. I'm not ideological about just intonation – I think different tuning systems are suited to different tasks – but it's important to remember that equal temperament became dominant because of the pre-eminence of the piano. It is a compromise brought about by the fact that there are only 12 notes available per octave on a standard keyboard instrument. One of the advantages of being a composer and performer is that I am less dependent on current standard practice. Limiting tuba tuning to the 12 pitches of the piano is actually profoundly unidiomatic to the instrument, as valve combinations work directly against it. What valve combinations do is add successive lengths of tubing to the instrument, leading to the formation of undertone rows, and therefore to microtonal tuning in just intonation. It is precisely this phenomenon of increasing sharpness with reference to tempered tuning that Adolphe Sax aimed to correct' in his Saxhorn Nouveau Basse, but it is only a problem to be corrected if tempered tuning is taken as the reference. If, instead, tuba tuning is taken on its own terms, it leads automatically to microtonal tuning, although as the instrument I developed in 2009 is fully microtonal, it can also play equal tempered notes if this is what is required.

It was actually the beauty of the concept of both the undertone and overtone tuning being latent within the instrument that inspired me to explore microtonality on the tuba in depth, as much as the resulting possibility of playing truly consonant intervals. Almost all of my microtonal compositions to date have been based on the simultaneous exploration of undertone and overtone structures.

As to whether this is taking music in a different direction – music is going in all sorts of different directions at once in the current era, and the hardest thing in all of this is to carve some sort of path through the chaos. The revival of interest in microtonality and just intonation may be relatively recent in Europe, but it has quite a long tradition in America, largely due to the influence of Harry Partch. I don't see simply working in just intonation as being anything particularly new. In terms of the history of brass music the micotonal tuba might well have some long-term impact, but this will really depend on how many players latch onto the idea. I don't think there's going to be any shortage of composers who

The rotating valve technique and the microtonal tuba provide alternative answers to the question of what a tuba is.

Roberto Fabbriciani & **Robin Hayward**.

Robin Hayward.

Robin Hayward playing English ‘noise’ tuba.

Robin Hayward playing the microtonal tuba, Berlin, 2011.

rather like I was fitting into an established way of playing. It may have been partly because I was considerably younger than most of the other players. When I listened to recordings of first-generation improvisers from the early 1970s I couldn’t help thinking that much of what I was hearing live was still being produced within a similar paradigm. Whilst there is nothing necessarily wrong with this, it wasn’t a paradigm that I felt very at home in, quite apart from the question of how well the tuba fits in to the instantaneous interactive playing that lies at the heart of so much of John Stevens’s school of ‘Search and Reflect’ – the title of his music workshop handbook. In fact, John Stevens, the drummer in the Spontaneous Music Ensemble, was one of the reasons why I moved to London, but he died within weeks of my arriving. I never got to meet him, which is something I’ve always regretted. Over the course of my three-and-a-half years there I found myself playing less and less when I improvised and when I finally played with trombonist Radu Malfatti in 1997 it confirmed much of what I had been feeling. I moved to Berlin the following year, where I found a small group of people open to pursuing similar interests, and it was the style of music that arose from this that came to be labelled as Berlin Reductionism. I’ve never been comfortable being described as a Reductionist though, and found this whole approach to improvisation much more exciting before it became tagged with this label.

AA At what stage do you think this scene is at now? It seems that both you and others are exploring other areas now – for instance drone-like microtonal approaches, going into contemporary composed music, performing Wandelweiser compositions. Is this as an outcome of the Reductionist scene, or not?

RH What happened in the late 1990s opened up a space that is now being filled in a variety of different ways, so in this sense this could be seen as an outcome, as the space may not have been there to be filled without the previous phase. There are so many people doing so many different things now that I’m not really sure if it still deserves to be described as a scene.

AA How do you regard the use of long silences in the compositions of Wandelweiser composers like Antoine Beuger as a way to sharpen the ears for ‘all the sounds’, or rather as a way to intensify a certain feeling for the passing of time? Or is it about what happens at the borders of perception?

RH I’m afraid I’m not that up to date with the latest developments in the Wandelweiser group, and anyway I have the impression that there’s considerable diversity among the Wandelweiser composers. But based on my earlier contact with the music, which mainly came about through the concert series at the Zionskirche in Berlin that Carlo Inderhees organised from 1997 to 2000, it seemed that silence was used partly as a way to structure time, and partly as an invitation to meditation, taking very literally Cage’s aesthetic of music’s purpose being to sober and quiet the mind. As far as the role of silence in structuring time is concerned, I came to the conclusion that the aesthetic might work rather better in visual art than in music, as the eye is capable of perceiving large empty spaces, even a series of empty spaces, at a glance, whereas the ear is necessarily dependent on the passage of time, which implies spending a lot of time waiting. Perhaps this was the point – defeating feelings of impatience and concentrating only on the present – but this then seemed to be closer to meditation than to music. But I was very impressed the last time I heard Radu Malfatti play, in the summer of 2011, and it was clear he was moving in fresh direction, so the impressions I have of Wandelweiser may be rather out of date.

AA What happens in *Coda Variations* by Alvin Lucier, which you recorded?

RH The piece is based on the last eight tuba tones of Morton Feldman’s *Durations 3*, which was composed in 1961 for violin, piano and tuba. In 2005 I showed Alvin Lucier a tuning chart for the standard German F tuba, which, though it had not yet been modified for microtonal tuning, still had considerable microtonal possibilities. Alvin then asked me to send him all the possible microtonal tunings of the last eight tuba pitches in

will be interested in writing for it once the players are around. But such considerations can actually be distracting – I'm far more interested in concentrating on what I'm doing now than considering how it may be seen at some point in the future.

AA Much of the playing techniques that you develop 'traditionally' fall in the realm of extended technique – which was quite fruitful in the second half of the twentieth century. In the beginning it was about pushing the boundaries of music, whereas now all these sounds have become part of the realm of music and can be treated as elements to be used. The sounds of extended techniques do not sound 'weird' or out of place any more – in the sense that multiphonics on a saxophone in the 1960s were perceived as strange. Do you have the feeling you are pushing boundaries, or rather working with available musical elements when you work with the noise sounds on the tuba and the rotating valve technique.

RH I actually dislike the term 'extended technique' as it implies a 'central' technique to which things are then added, though I can see how it may have made arisen within the context of classical music in the 1960s. My explorations of the tuba have much more to do with finding out what's implicit within the medium. The rotating valve technique and the microtonal tuba provide alternative answers to the question of what a tuba is, and once those answers have presented themselves, it's almost just a question of getting out of the way and letting the instrument speak for itself. Different conceptions lead to different materials and therefore different music. Some might even require different instruments, which is why I use the English tuba for the rotating valve technique and have adapted a German tuba for microtonality. Attempting to imitate the noises of the English tuba on the German tuba or trying to force the English tuba to become microtonal would be pushing each medium to be something it isn't. Though noise production is possible on the microtonal tuba, it is a very different kind of noise than that which is latent within the English tuba. So, maybe 'intrinsic' rather than 'extended' technique would be a better description. As for pushing boundaries, well yes, in the sense that neither technique was around before, I am pushing boundaries. But I'm not into pushing boundaries merely for the sake of it. I was profoundly dissatisfied with playing the tuba in a conventional fashion, and at the time it was a question of either finding approaches I was happy with or giving it up. If I had been comfortable in the role of classical tuba player I probably wouldn't have noticed any boundaries that needed pushing.

AA You founded Zinc & Copper Works and conduct research into brass instruments. How is this connected with your artistic and musical approaches?

RH Zinc & Copper Works is a brass ensemble of flexible instrumentation that includes a microtonal horn and tuba, and consists of players who are actively researching the resources of their instruments. The main research of Zinc & Copper Works is finding out what is possible within the medium of brass chamber music in the twenty-first century. It is research by doing – perhaps exploration would better apply to the ensemble than research in the strict sense of the word. The doctoral research I am currently doing into the acoustics of the microtonal tuba might well later extend to acoustic research into other brass instruments too, but for the next few years at least I've got my work cut out researching the tuba acoustics.

AA You were closely involved with the Reductionist type of improvisation when it started evolving in the 1990s. Where did the 'desire' to use long silences and extremely low volume come from?

RH I remember that when I started improvising in the early 1990s I questioned why it should to be a virtue for an improvisation to contain lots of energy. Containing lots of energy need not necessarily be a bad thing, but I did not see why it should be a criterion for assessing the quality of the improvisation. When I moved to London in 1994 I found a very active and open improvised music scene, but it felt

Durations 3, and he then permutated the tones with microtonal variations to make a piece that lasts over 40 minutes.

AA In the press release to your 2009 CD *States of Rushing,* Arnold Dreyblatt states that the sounds you make 'force us to sense the air pressure in contact with the physical world without framing the sounds in the conventions of contemporary or traditional music. In this sense, Hayward's approach is refreshing and revolutionary.' That's a pretty far-reaching statement. How important is the physical effect of the sounds you make?

RH The pieces arose from my physical interaction with the instrument, and because they are acoustic there is direct contact with the outside space without the intermediary of electronics. It's an interesting question whether the listener's focus is directed towards the sounds themselves, or towards the physical processes that produced them (air pressure, for example). When I composed the pieces I tended to concentrate on the phenomenal nature of the sounds, but then of course I'm inextricably connected to how they are produced in a more directly embodied way than if I were using field recordings or electronically synthesised sounds, for instance. So, to attempt a direct answer – yes, the physical impact of the sounds is important, but it maybe arises from the way in which they are produced and therefore it's not something I consciously think about when I'm making them.

Actually your question about my use of space finally made me look up the word 'acousmatic' and it occurred to me that Schaeffer's definition of 'referring to a sound that one hears without seeing the causes behind it' could to a certain extent apply to my approach to the English tuba, as the horizontally positioned bell prevents the audience from being able to see how I'm making the sounds. I was quite amused to discover that the word has its origins in Pythagoras lecturing behind a screen, as this would connect much better to the microtonal than the noise tuba, although it was supposedly the noise of blacksmiths hammering that led Pythagoras to investigate tuning systems.

AA A second question that arises from Arnold Dreyblatt's remark: does your music fall outside the 'frame of reference' of contemporary music?

RH My background was originally in classical and contemporary music, but it's not that important for me that the music on *States of Rushing* is regarded as continuing this tradition. In terms of performance practice it's quite far removed from the model that is still fairly dominant within contemporary music, of the head (composer) telling the body (players) what to do. In that sense it does fall outside the main frame of reference of contemporary music. It's not that easy to frame it within the context of improvised music either, as some of the pieces – for example, *Release* – are fully composed.

Opening up New Spaces, Exploring Time
Interview with Hilary Jeffery

Arie Altena

Hilary Jeffery was interviewed the day after the premi re of his electronic composition *Mesmeric Forest* in Krems, Austria. As a trombonist Jeffery plays in many different ensembles, ranging from Catherine Christer Hennix' Chora(s)san Time-Court Mirage and Zeitkratzer to the Kilimanjaro Darkjazz Ensemble. He works in and in-between the fields of improvised, electronic and contemporary composed music.

Arie Altena What is *Mesmeric Forest*?

Hilary Jeffery *Mesmeric Forest* is a soundscape of an imaginary electronic forest. The version performed last night is a multichannel piece that uses the space and possibilities for spatialisation with a multi-speaker set up, in this case the GRM (Groupe des Recherches Musicales) Acousmonium installed into the Minoriten church in Krems. I call it a forest because the material suggests possible sounds and atmospheres of a forest. The piece uses synthetic sounds, which makes it an imaginary electrical forest. I call it 'mesmeric' because my intention is to induce something like a light form of hypnosis.

The idea for making this type of soundscape originates from my research and work into making scores. I'm trying to find alternatives to approaching, perceiving and reading music in a linear way. When music is read through notation in the Western tradition, it is typically done so in a linear fashion. I've been trying to get around this in my work. I came up with the idea of making scores which function in a similar way as maps. One can explore a territory with a map in an intuitive, interactive and non-linear way, and I have been trying to apply this to explorations of specific musical territories.

I have tried this idea on several occasions with different musicians. I made a map of an imaginary city for instance, as well as a forest, and I used these scores for ensemble playing. I see *Mesmeric Forest* as part of a larger project that includes using maps as scores. The next stage in this work will have the same soundscape plus a new map describing possible representations of this abstract forest. The map could then be used by listeners to find their way in the composition and orient themselves in the space created by the sounds, as well as functioning as a score for musicians who perform live with the soundscape.

AA You used maps as scores in a concert with Rozemarie Heggen, Pamela Kurstin and Patrick Puslinger, which was recently released on Col Legno under the title *Besides Feldman*. Can you explain how that worked?

HJ It was a concert in Vienna in 2010, which drew on the ideas of Morton Feldman as a form of inspiration for a group improvisation. During my research for this concert, I studied some of Feldman's work and identified what I considered to be key aspects of his ideas, eventually coming up with five sentences that summarised these aspects. I wrote these sentences on paper and illustrated them with graphics that could suggest ways of playing them. I made a few versions of this and we each chose a different one to refer to while playing. The diagrams, signs and words functioned both as a map of potential music, and as a way of focusing the playing and directing the mind. Some of the words on the map can be clearly related to music ('*patterns not loops*', '*repeat same chord in different ways*'); others ('*timeless, floating music*', '*being in-between*') are more vague and require a personal interpretation. We did not really play anything by Feldman, especially because he did not hold improvisation in very high regard. However, we did manage to find our own way to enter into, and inhabit parts of Feldman's universe, with the Score Map as a reference.

Every composer dealing with notation obviously has to think about the question of notation, and find his or her own individual solutions. Of course there are infinite possibilities and my Score Maps are just one such attempt to delve into this question, and not a particularly original one at that.

AA What source material did you use for *Mesmeric Forest*?

HJ The source material comes from my imagination. I'm very inspired by the specifically electrical qualities of natural sounds, and sounds in forests, for instance, the sounds made by crickets, birds and frogs. Firstly, I just imagined extensions of these sounds. I tried to actively listen while in such environments, while simultaneously trying to figure out how such sounds could be technically realised in a studio. With this in mind I created some initial sounds using simple synthesis techniques using Max/MSP. Most of the material used in the piece was eventually generated at the GRM studios in Paris using a combination of analogue and digital techniques. The actual methods I used for this version are only a few of very many possible ways to create such sounds. The most important thing for me is to convey the idea I originally imagined. For this version I did it in the best way I knew, and with the resources at my disposal. Another time I will use other techniques.

AA How did you structure the composition?

HJ I wanted the beginning of the piece to be quite low level, almost subliminal, so that you don't even really notice that the piece has started, and you also hear the natural sounds of the space, and your own sounds, which include thoughts. Especially the beginning should be like being in an environment that is also an internal environment. Many of the sounds could be similar to tinnitus or to the sounds you hear in your own ears when you are in a very quiet room. I try to invite people into that world.

I like to leave space in my music where the listener can imagine things for him or herself. *Mesmeric Forest* is an attempt at creating a twilight world where you are not sure where you are. It's called a forest, but listeners can also find their own associations and imaginations with the sounds. The music does not say everything; it only makes suggestions and leads the way into open structures, which each listener can actively engage with. The idea was partly to create something close to hypnosis. The piece has loops that repeat, and the listener's mind will naturally try to latch onto these loops, making their own patterns, which could create alternate or a trance-like states of consciousness. In terms of structuring the composition my working method is inevitably very informed by my background as an improvising musician. I am guided more by intuition than by prepared structures. In my music, a structure is gradually revealed through the playing. I put *Mesmeric Forest* together in the studio, intuitively combining the various loops in different ways. The structure and the form appeared from that process. It was created with the live performance on the Acousmonium in mind; a CD version would be very different. I will continue to work on this piece and eventually would like to have all the basic loops appearing and disappearing during a live performance, controlled by random, generative or natural algorithms, preferably something which has a relation to an actual living forest. My intention is to realise this next step in a version for the Game of Life wavefield synthesis system in The Hague.

AA How important is instrumental technique for you?

HJ It's absolutely essential. I'm not a natural instrumentalist. Some people have a knack of picking up many instruments and being able to play them. I'm not like that and only really play the trombone. I have to work consistently to master the instrument. It is somehow not surprising that I have chosen the trombone, as it is a very difficult instrument to master; it takes a certain kind of single-mindedness. On a more general level my feeling is that no matter what style of music you play, you need to have a good technique on the instrument – whether it is a trombone, harp, sitar, voice, washboard or laptop. I am what is called 'classically trained', although there isn't really any other way to learn how to play a trombone, and most other instruments too. In terms of music practice I was never particularly attracted to playing classical music, except as a good exercise. I was more attracted to the jazz tradition. To a certain extent I am interested in what might be called 'contemporary music' for trombone, particularly the solo repertoire. As a young student I was very inspired by Stuart Dempster's book *The Modern Trombone: a Definition of Its Idioms* (1994), from which I learnt a lot of techniques and gained a deeper understanding of the instrument and its potential. I was also very inspired by James Fulkerson's solo music for trombone and live electronics. It has

been a great privilege for me to meet, study and work with him since I first came to the Netherlands in 1998.

As an interpreter of written music I'm only really interested in doing this when playing in an ensemble, such as Zeitkratzer, or when I can work directly with a composer. The highlight of this way of working with composed music for trombone has been the work I did with James Fulkerson and the American composer Philip Corner. This resulted in a complete CD of his trombone music for New World Records (*Extreme Positions*), released in 2007. In the end I cannot subscribe to any particular tradition and I always feel uncomfortable when someone asks me if I am a 'classical' or a 'jazz' player. This is a question that often comes up and I think it is due to the arbitrary and small-minded classifications of music created by the combination of many music schools, performing rights organisations and market forces. A lot of the music I make is in-between worlds and in fact my definition of a musician is someone who is inevitably '*between worlds*' in all kinds of ways. I cannot really say that I am a jazz musician or a classical musician, or even an improvising musician. I am a musician and composer and I'm trying to find my own way.

AA Were you attracted specifically to the trombone?

HJ No, not consciously anyway. It was an arbitrary choice that I made when I changed schools and the only instruments they taught were wind instruments. I had been studying the violin before this and I never intended to become a trombonist, at least not exclusively, and it isn't the only thing I'm busy with. At the same time I really appreciate the trombone as a central part of my life in music and I'm very grateful to have had the chance to learn how to play it and for all the experiences that have come with playing it. I like it because it's just a piece of metal and is a very simple instrument in some ways. However, to produce a good sound on a simple piece of metal like this is not easy, so playing it means that I have to have some kind of discipline. It helps me to stay at least partly connected to this planet.

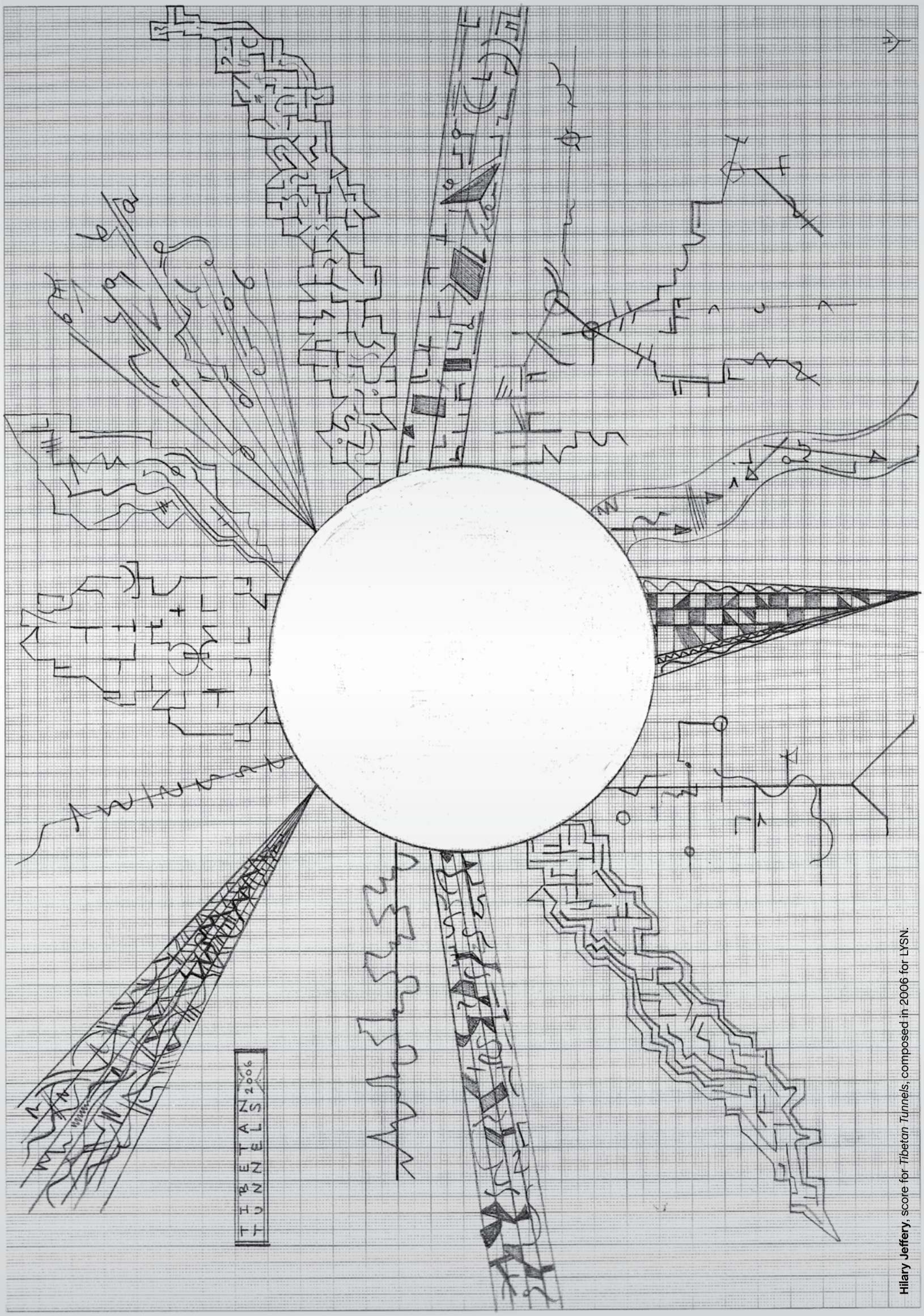
AA The German artist Jan-Peter Sonntag – who also plays the trombone – once explained to me that he finds the instrument so attractive because playing the trombone forces you to listen to the physics of the sound. It's just a tube and it has a direct connection to the physics of sound.

HJ That is absolutely the case. It informs my playing too. The harmonic series is so clearly there. Playing the trombone is a good way to focus on music. In fact the trombone is also always more than just a piece of metal – it is also the person playing it and the space(s) in which it is played, including the 'virtual' spaces offered by amplification and digital or analogue electronics. A trombone in a cathedral will sound completely different from the same trombone played in cupboard. The space is part of the instrument, and a certain space can almost change it into a different instrument. With digital sound processing these spaces can shift all the time, one moment you play virtually in a cave and the next moment it sounds as if you're playing in the open air. I find this a very fascinating idea, because it means that when I play in this way with electronics, all of these spaces become part of the instrument too and I can move between them at different speeds, or occupy several simultaneously. I am therefore very interested in working with sound artists who can help me to explore expanded and changing virtual spaces. One such artist is Joel Ryan, with whom I am very much interested in working with in the future.

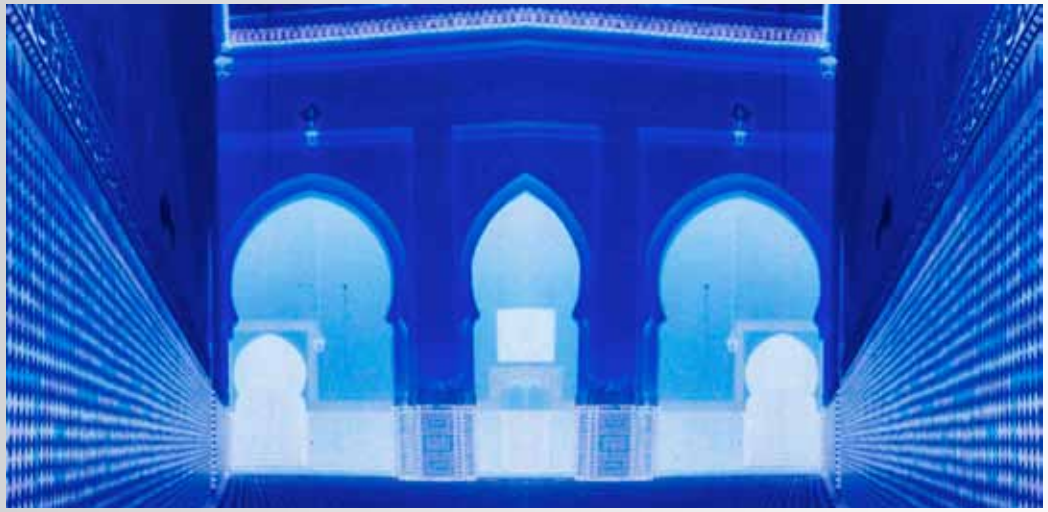
AA You use high-pitched, almost tinnitus-like sounds in *Mesmeric Forest*, which worked for me because the sounds you use are very close to the sound I hear in my ears when it is very quiet.

HJ Yes, although I don't know if that worked for everybody. In theory it could give you the feeling that you're also hearing something inside your own head at the same time as the music is playing. This is something Maryanne Amacher was working with in a much more consistent way, although I do not really know her work that well, and never had the chance to hear her perform. I discovered some aspects of these types of high-pitched sounds through meditation. I try to

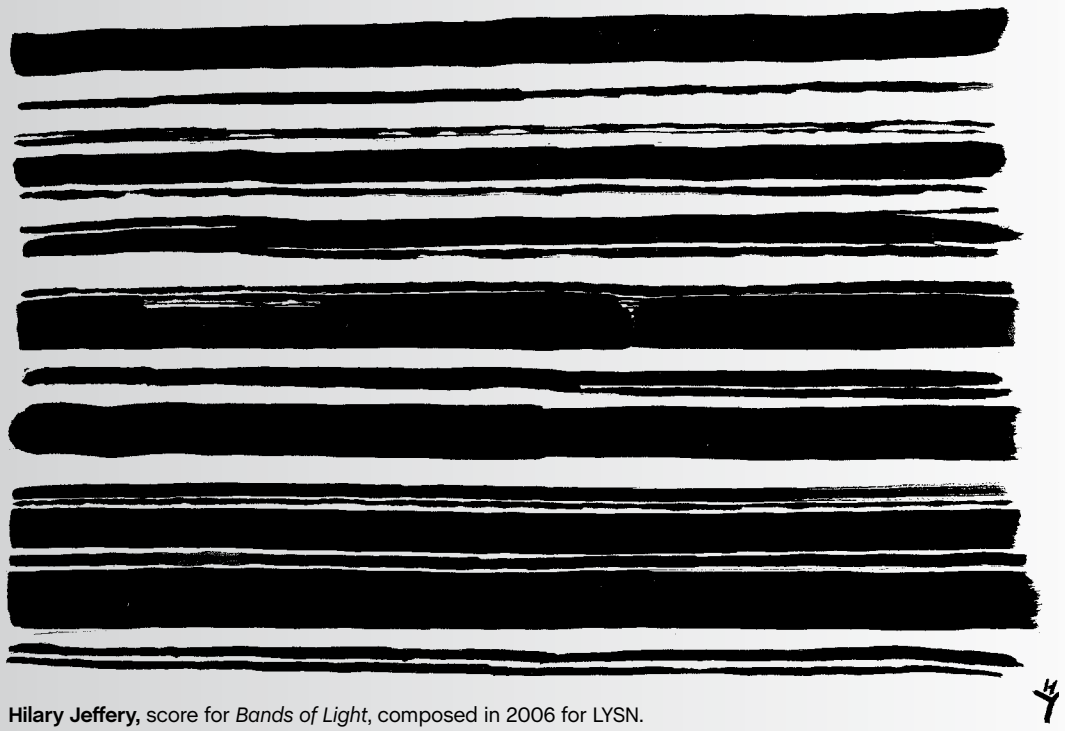
Time is not always linear.
Time can also be vertical, or
move as a spiral.



Hilary Jeffery, score for *Tibetan Tunnels*, composed in 2006 for LYSN.



Hilary Jeffery, *Third Entry*, 2009.



Hilary Jeffery, score for *Bands of Light*, composed in 2006 for LYSN.

use them as a way to focus my attention while meditating. Rather than attempting to get rid of them or block them out, I try to go into them. Then one starts to notice there is actually more to them than just a ringing – several pitches start to appear in a form of beautiful and very personal additive synthesis and one can travel internally using these pitches as vehicles. Such a form of listening becomes a real-time musical composition, which in fact everybody has access to. Everybody has his or her own sounds inside them. I don't exactly know how this works for deaf people, but I would suggest that somehow it does. John Cage writes about it in *Silence* (1961), when he relates his experience in an anechoic chamber. This subject also connects directly to the work of La Monte Young and Catherine Christer Hennix and their work with tuning and inner sounds. Hennix talks about these sounds as a way to focus the mind. Last night I hopefully created an environment in which listeners, those who are ready and open to it, can interact with these sounds in their own minds. The music only provides some information; the rest is up to the listeners. You can make the connections and if you enter the right state, it probably feels like an internal space is opening up.

AA To some people that might sound rather vague...

HJ It's true that sometimes people speak about these things as if they really are vague and unclear – 'tuning into your inner sounds' – but I think that they can actually be approached in a clear and scientific way. My approach is still inevitably that of an improvising musician's – I play with the ideas and eventually arrive at a point where I hit on the right thing. At some point I find material, space and an approach that works and then I can explore that further. I learned a lot in this area through working with Catherine Christer Hennix. She lives with a drone; it plays all the time in her house. She uses it as a way to stay focused and centred. Sometimes she listens to it while going to sleep and hears her own inner sounds interacting with the drone. We also play with this drone in Chora(s)san Time-Court Mirage.

AA How is it to play in Chora(s)san Time-Court Mirage?

HJ It's a fantastic experience. If you give it enough time, whole worlds open up and it can become very engaging and uplifting. It is a specific approach to ensemble improvisation within a very defined area. We play with the electronic drone, which is in fact a composition in itself entitled *Soliton(e) Star*, created from many repetitions of a tiny sample, placed forwards and backwards so that it is a mirror image of itself and repeated infinitely. When I first heard it, it didn't sound like much. But as I started to play with it, particularly with Christer's notes and guidance, I started to hear a lot more and felt like I was moving into a new space.

My experience is that first you just play, and nothing seems to happen and then suddenly it is as if a window opens inside the sound. If this interaction between the mind, the sound of the instruments, and the drone happens, you do feel as if you are entering a different space. Specific notes suddenly have a very clear effect. If you play these specific tones and you keep playing them, your ears open up. When we play acoustically it is hard to tell if other people can really hear this too, as it seems to be a private inner experience. A lot of what is happening sound-wise takes place in your own head. That's one of the reasons why we amplify our instruments, because the effect is much more pronounced. We use amplification and a delay system and there is often continuous controlled feedback through the use of long delays. Gradually different harmonics appear and as you play you reinforce these harmonics through feedback. We constantly play the same tones, adjusting them slightly all the time. Sometimes it's as if we are surfing, riding the sound waves.

Christer likes to have brass instruments in the ensemble because the harmonics are very rich and clear. The tuba, trombone, French horn and trumpet are ideal instruments for this music, and voice, of course. A trombone is very useful as you can adjust the pitch with the slide, though actually the slide only does half the work, I do a lot of adjusting with the embouchure and breath. It's the same with the tuba and trumpet; Robin Hayward plays his microtonal tuba and Franz Hautzinger has a microtonal

trumpet. As far as I can say so far, this music is about the interaction between the mind, body and the group sound, which in the end are all connected. I also tried to achieve this type of interaction in a different way with *Mesmeric Forest*, and it connects to my idea of using Score Maps as well.

AA How does it connect to using Score Maps?

HJ The combination between the map and the soundtrack creates an interaction within your own mind. If the map is not totally descriptive or directive, and if the sounds of the world the map represents are open enough, there is a real chance of discovering and entering a new environment. This is a truly interactive way of working, not in the sense of computer interaction with a '3D' virtual world or sensor-based interaction with computers. Rather it is based upon the idea that what we usually call reality is virtual anyway (which would make VR into Virtual VR). My feeling is that reality is not real, because so much is happening in our own minds. Ideally the music I make will not be linear, it will have different dimensions, informed by improvisation and also interacting with internal sounds and states.

AA Drone music, like that created by Catherine Christer Hennix, seems to efface time. Or at least one could say that it replaces time with space as the most pronounced factor in the music. *Mesmeric Forest* in a sense starts with an ending – and then it goes on and on. It changes one's experience of time. Is that important for you, getting into a different sense or experience of time?

HJ Sure. What I consider to be 'Music', is always in-between, it isn't just sound; rather it uses sound in the same way as painting uses paint or cooking uses ingredients. A good example of this way of thinking is to say that a melody is actually the space created between the notes. So we have sound, all kinds of music, all kinds of sound art and so many compositions, but actual Music – as far as I am concerned – exists in an in-between world or abstract space. This obviously has consequences for how time might operate in this world. My ideas and experience in this area are not so deeply developed and are still quite superficial, but what I can say so far is that it means that time is not always linear. Time can also be vertical, or move as a spiral. That certainly becomes apparent when the drone music I'm working with makes me feel as if I'm travelling upwards in time.

It's also a reason why I'm trying to get away from the idea of linear time in music and reading scores in a linear way. Reading a map and travelling through it is very much an individual choice and a multi-dimensional experience. This means at the very least that one can go forward and backwards in time, and shift around in time as space. There is no start or end to it. Of course, at some point and on some superficial levels, the music begins and ends, but within it you can try to create the feeling that when a piece begins it had actually already started and that it does not really end at the end. What you hear is a fragment of a world that is still going on after the concert has ended. An older classic example of this, at least to my ears, is the music of Johann Sebastian Bach. To me it sometimes sounds as if he was tapping into a stream of music that just keeps going on even when the actual piece ends. Of course there are countless other examples of this in most music – gamelan and classical Indian music are another two obvious examples. I find it very interesting to think that our idea of linear time might not be the right one, that reality isn't linear, that it doesn't start and end, and that there are all these different aspects to time.

AA Linear time is clock time. Much Western music – at least since Bach – has been clock-based, using the rhythm of a metronome. Do you think people are beginning to be interested again in music, which time-wise is structured in a radically different way? Not linear, not as a progression through different variations leading to a well-defined end?

HJ Classical instrumental training with a metronome is a very clock-based thing. It's almost too restrictive, but a good musician will utilise and transcend such restrictions in a creative way. I think you need a reference point in music. It can be a key, a drone or a rhythm; sometimes it's a metronome or a beat. But the actual music shifts in relation to that reference point, and creates something more complex. The first time I experienced good jazz music was in a workshop led by Keith Tippett. Keith's composition and direction got the band, particularly the rhythm section consisting of Ben Clark (drums) and John Richards (bass), to create a feeling of several rhythms and time-modes happening simultaneoulsy, which I feel is an essential part of the feeling for time in jazz music. This way of playing music literally gives one the direct experience of several different times happening simultaneously. It can be truly liberating – liberating in a way that has life-changing consequences, beyond the practice of a particular 'musical style'. The Voodoo music I've heard has this element very strongly too, and obviously it's in jazz through the influence of African music. This could in fact all be studied scientifically but probably not so much with a Western musicological method. I have thought about notating Voodoo music and am working on a new percussion piece where I explore these ideas and experiences with non-linear time. It's not easy to find out how to do this in a clear way, which preserves the feeling of the music and also translates the ideas into a notation that a classically trained percussionist can read and interpret. I like to imagine that if one applied recent discoveries and models of physics to Voodoo music, for example, you might arrive at very interesting insights into how it actually deals with time and how time relates to space, but my knowledge of physics and Voodoo are too miniscule for me to conduct this type of research by myself.

AA What you try to get at is an understanding of time and place that is closer to quantum science?

HJ I'm not qualified to speak in any serious way about quantum science. I'm an improvising trombonist who through music has had the good fortune to have a taste of many other worlds of experience, beyond what is sold to us as 'reality'. I consciously try to go further into these experiences in the compositions I make for groups, such as my flexible ensemble Lysn. Two colleagues – one of whom I'm working with now – Catherine Christer Hennix, and another who I hope to work with – Joel Ryan, are much more qualified to speak about such issues. Christer says that now the real avant-garde is happening in science, not art. According to her the arts are seriously lagging behind. She has been working from the time when the art world was open to new possibilities that were often informed by science, and she actively promotes a return to those conditions. I'm inspired by this attempt and in my own intuitive way I'm joining in the effort.

‘You can make extremely loose music with computers’

Interview with Keith Fullerton Whitman

Arie Altena

Keith Fullerton Whitman was interviewed in his hotel room the afternoon before his electronic composition *Natural Rhythms* premiered at the Kontraste Festival in Krems, Austria, October 2011. The main objective was to ask him about his way of dealing with time in music through the use of software, his compositional methods, and his love for early electronic music. By way of introduction I explained the theme of Sonic Acts XIV and our ideas about music as a way of transforming or manipulating the experience of time. It wasn't really necessary to formulate questions. Keith Fullerton Whitman enthusiastically embarked on what was mostly a monologue, providing answers to questions that could have been asked. This text is based on the recording of his hour-long talk, and has inserted questions for structural reasons and to enhance reading pleasure.

Arie Altena At the Sonic Acts Festival 2012 we would like to focus on the experience of time. We are, for instance, interested in how music and film can manipulate an audience's sense of time...

Keith Fullerton Whitman My favourite example of how music can manipulate the sense of time is a concert by the Swedish composer CM von Hausswolff, which I heard in Chicago – I think it was 2001. He started at 7 pm with just a slowly rising sound, which after a while transformed into a field of unique tones that fluctuated slightly in pitch. The whole room was humming. It was dark, it was a cold winter's day, it was warm in the space and there were still projections of weather maps. The whole setting made you concentrate on the climate. Immediately after entering the concert space I felt as if I was falling asleep. I suppose I went into an alpha state. I was aware I was at a concert, I was aware of the actions, but I wasn't thinking of anything else directly besides the effect of the sound, how it affected the environment, and how comfortable I felt. When the drone finally receded and the volume faded to to zero, I sort of woke up with the impression that 20 minutes had passed. It was quite shocking to realise it was 9.30 pm. I thought, wow, that really worked! This is what Von Hausswolff was trying to do: stop the experience of time, and it was successful. I think everyone in the audience was lifted out of a trance after the two-and-a-half hours.

AA How did he achieve it?

KFW: I still wonder about how he pulled off this time-wizardry, even ten years later. He didn't use any specific timings or time markers; he did it by creating a beautiful blur of sounds. There are of course a lot of magic tricks that you can do with audio, like slowing down and speeding up sounds, Brownian motion (noise created by random intervals), and Shepard tones (sound which creates the impression of continual rising). Maryanne Amacher was very good at this – she had a really scientific approach in this respect. How Von Hausswolff changed the experience of time and duration also had a lot to do with the combination of all the sensory elements, like the warmth in the space and the still images. He streamlined the experience of music to create a static place and time, freezing the experience of time.

AA Is it something that you have attempted in your own music?

KFW Many times. From 1998 to 2006 I did concerts with guitar, laptop and a mixer through which I fed the guitar. The concept was about feeding the guitar notes into a self-evolving system that would eventually sustain itself. A concert of an hour or even two hours often involved only ten minutes of actual guitar playing before arriving at a composition that consisted of the cycling of many different multiple sound 'engines'. Sometimes there would be up to a hundred different clocking engines that were doing various delays and filterings. The effect was like a moiré: you heard the overall sound., you could focus on all the rhythms within the sound if you really wanted to, but even then after a while it wouldn't really matter anymore. A few of these performances were quite long. One was in a school building in a rural town in southern Ireland. That time I just put the guitar down – normally I'm too obsessed with being in the moment and being in front of the audience to do that – sat down on the carpet, closed my eyes, and zoned out for a while.

AA Something similar happens in drone music and in the work of La Monte Young, for example.

KFW I've been reading about Terry Riley playing twelve-hour concerts, about Charlemagne Palestine's two hours of slowly rising music. All of that is extremely relevant in this respect. Lamonte Young's and Marian Zazeela's *Dream House* is of course 'eternal', once turned on it goes on for ever – at least in theory. You can go into the *Dream House* and be lost for quite a long time. The experience of being in there is significant; the experience of time passing is not. It's so powerful because it makes you shut down. When your life is about accomplishing things on a daily basis, business, work, music, doing favours for other people, then having an experience of not being aware, not being conscious of time is meaningful and pleasant. Not many artists and musicians have been able to make such an experience happen. Catherine Christer Hennix can certainly pull this off in a setting where she just has a drone and acoustic instruments playing microtonal stuff around it. Riley, Hennix, Charlemagne Palestine and Lamonte Young abandon many conventions of concert music: the tuning system, the dynamic of going to a concert, the audience–performer relation. If all those things are abandoned, then, when the context is right, it is probably just a small leap to also abandon the sense of time.

Morton Feldman's music is another example. You don't listen to Feldman for the notes only. It is also about all the other elements, the pacing, the timbre. You need commitment as a listener. His *String Quartet No. 2* is six hours long; if you go to see it, you prepare yourself mentally. I have had different experiences with it, actually being in agony halfway through and thinking I couldn't bear it any longer. But when you stay you come to terms with it. You start asking yourself: what is causing this agony, is it my own mind, is it because I'm hungry, or because I'm dying to check my e-mail? It is all of these things, but then you realise all these things are not that important. The most important thing is the present, it is where you are now, and then you get to a place of rest. If that happens, the point of the piece is accomplished. There is an eternal peace in the last hour of this string quartet. If it doesn't happen to you, you're too much part of the twenty-first century...

AA With La Monte Young, Riley, and Hennix, there is a connection between music and ritual, their music is a vessel for something beyond music. Music, for them, is a means to achieve transcendence, to attain a different state of mind.

KFW As a listener I've come out of some concerts – like La Monte Young playing just intonation piano, for instance – hearing things in a completely new way. Listening to just intonation piano for hours straightens out all the little hairs in your ears. The rest of the world sounds so much weirder afterwards, and you assimilate that into what you knew before. Such experiences change you. Last week I saw Jason Lescalleet playing a concert in Paris. He started with a screeching, roving sine wave of 12 or 13 kilohertz, deafeningly loud. Deafeningly loud at such a frequency is really loud, it's a lot of energy. He only played for about fifteen minutes but with the high tones that he was playing, it seemed an eternity before he receded into quieter, more musical sounds. The high tones he played don't only affect your physiology – you recoil – they completely reframe how you hear everything else too. Somebody coughing or whispering became extremely loud. I became hyper-aware of the non-musical sounds in front of the stage. I could hear a guy washing a glass 100 metres away at the bar; I could clearly hear every turn with the rag. I thought my hearing would be fried after being exposed to such deafening sounds, but it was the other way around. It was a genius thing. He re-tuned the audience. Through the painful ritual act of the performance he made the audience temporarily aware of the architecture and the actions that go on in there.

AA What is you opinion of the music of the Wandelweiser composers?

KFW I quite like the work of Jürg Frey, Antoine Beuger, Michael Pisaro and Radu Malfatti. Their compositions really tune you into the sonority of the space, to the instrument and the dedication of the performer. It is often insanely restrictive for a performer. There is

no room for personality, ego or individuality. It also shows that music cannot exist in an anechoic chamber; all the ambient sounds are part to the performance. I lived in Boston when a lot of the Reductionist music happened, which is very close to the music of the Wandelweiser composers. There was a very heavy power electronics scene, quite viscous and masculine. In the span of six months that scene developed into playing unamplified in punk basements, musicians making the smallest possible gestures and barely audible sounds, just breathing though a metal tube, using all the aspects of sound that you normally take for granted. It was brave and vanguard, and in a sense more painful than the power electronics, and more cathartic.

AA How do you work with the notion of time on the computer? A computer can react faster that a human being when working with sound...

KFW One way of approaching the way a computer deals with time is indeed to build systems that react faster than a human being can, where you are no longer in control, although you might think you are dangling the strings. When I'm performing live with a laptop my own timing is almost arbitrary because the music is all about the timing and the clockings of the system I have built. In that sense I'm not really composing music, as much as designing systems to create music. I'm definitely into building sound in a completely hands-off way. I was involved with an analogue version of algorithmic composition for a while. I used a synthesiser and had the internal clocks running slightly out of time. Because I used divergent timings for the engine generating the melody and for the patch generating the rhythm, it generated slightly different music each time I ran that system. In general the computer allows me to do many elastic things with sound. What is the conception of time of a computer? That's a fascinating subject that relates to the question of the soul of the machine. In the 1960s Gordon Mumma and David Tudor were building circuits that were designed to fail. They were power starving circuits and letting them die a slow death. I think the conception of time of an electronics circuit can be really different from ours. Think of the slowly dying pulse of a battery, how such a non-organic thing creates it own time and space.

AA Can you give an example of a system you built over which you do not have total control?

KFW I built a lot little pieces of software, which listen for attacks in audio. Let's say I play an improvised set with a drummer, then I might have the drum set miked, and for instance, a hit on the snare drum would for be a trigger for an audio engine in my laptop. But exactly how the computer decides which sound is an attack and what is not, lies deep within the algorithms. Being less of a computer programmer these days, I generally work with objects that others have built, so this is not something I can touch directly. How the attacks are processed within the greater system is my end of the composition. I can control it, but ultimately it is also arbitrary. Maybe there's a noise because a cable is badly connected and that gives off a signal that is also interpreted as an attack by the software. The pitch-tracking system that I built in Max/MSP messes up when my travel guitar picks up interference from a light bulb. The bulb sends a pulse wave to the guitar pick-up, and then all the pitch-tracking system registers is 60Hz in the US or 50Hz in Europe. Either my playing is then destroyed or the computer can't recognise it. If I turn away from the light bulb, everything is fine again. There are always ghostly things that are beyond control. No matter how much control you program into the software, it can change as soon as you do real-time stuff. Such uncontrollable external elements are in fact part of the system. And actually, the external elements are quite interesting and attractive, because they cannot be fully replicated each time. These factors are different from night to night. No one has complete control, except maybe if you do pure number synthesis in the computer. I used to perform with these controllers and when a potentiometer broke it sent an awesome analogue channel noise to the computer. It can be very exciting when such an arbitrary breakdown happens, the sound might be great, and you work with it when it happens.

When I'm performing live with a laptop my own timing is almost arbitrary because the music is all about the timing and the clockings of the system.

AA Can you tell something about your new piece *Natural Rhythms*, which you composed at GRM in Paris?

KFW The piece is entirely based on natural rhythms. The source recordings are mostly natural occurring rhythms, like rain falling off the side of the house, rain in the gutter, dripping. A lot is sounds of water, which creates parallel rhythms that are completely irreproducible otherwise. I gave these recordings to musicians, amongst others the drummer and sound sculptor Eli Keszler. He listened to the recordings and then added individual fragments on hi-hats and snares, playing loosely in the mould of the source recordings. There are also recordings of pinball machines, which make fine pointillistic sounds. The sounds are about gravity, energy and entropy. I ran all these recordings through gates in the synthesiser, listening for attacks. The piece is really a collage of sounds and attacks. When I perform the piece a lot of sharp sounds fly around the concert room. In the composition the sounds are very accurately distributed in time and space to create key events when all the sounds are perfectly synchronised. A lot of energy is then lined up across every channel. There is one such event that makes a big impact every minute or so. This morning during the rehearsal I was making notes, at which moments in the performance I should really open all the faders of the mixing desk to have a short big effect when the sounds are synchronised, to have a peak, before it returns to chaos again. It sounds like free jazz in an electronic arcade.

AA There are so many rhythms in the piece that it becomes quite chaotic and intense...

KFW The piece is a tight textural thing. The effect I create is one of amassing all the rhythms of the sounds, all these sharp sounds flying around. Then you get the moiré effect that I'm after. That's all I aim to do in this piece. There is a moment in the first five minutes when you stop hearing rhythm and start hearing texture, because your brain can't process all the sounds. For your brain there is a gradual transition from hearing just a sound, to hearing lots of sounds, then you get into hearing polyrhythm, but, if you add even more sounds to this, you arrive at a point when your brain cannot fully process all the sounds and rhythms anymore, and you just start hearing a smear or a spread of sound. After a while you start hearing textures. I'm working on such transitions now. Perhaps it's comparable in a way to how Stockhausen spread out rhythm into notes and melody using his formula composition technique, only I spread rhythm into texture.

AA In what way is your music informed by your interest in early electronic music? For me the interest in early electronic music is more than nostalgia. One of the things I find fascinating is the utopian aspect of early electronic music, the idea that these composers were working to make a new world of sounds.

KFW The significance of early electronic music is not just in the technology, which was new, or in the new working methods that were invented as they went along – which in itself was also an important thing. The key element is that these methods were so cumbersome and time consuming that editing at the composition state had to be very careful. That still comes across. Tape cost money and editing had to be done in such a way that the section you were working on had to be finished before you turned the machine on again. We live in the days of endless undo, Command Z, Command Z. In the 1960s they couldn't afford even one undo – everything in the working process had to be exactly right at every stage. Whenever I listen to a really early piece I think about the process of making it more than anything else.

AA What about the sounds they were using?

KFW Of course the sounds fascinate me as well, because they were not avoiding certain classes of sounds, everything was new. Now there are whole classes of sounds that you can't use, because they are immediately associated with cheesy SF or commercial dance music. These connotations have ruined whole classes of sounds, at least for academic electronic music. I have become very fascinated with Central and South American tape music. French composers like Jacques Lejeune, François Bayle and Bernard Parmegiani were, each in their own way, quite refined in working with electronics. The Venezuelan and Chilean composers from the 1960s, like Jose Vincente Azuar, were relative outsiders. Their music is cathartic – they used all these slowly descending sounds, and barbershop stuff too, it's as if they didn't know that some of those sounds were already 'forbidden' in serious contexts. It is the punk rock version of electronic music. Early electronic music was also more free, and looser. That's also true for the composers associated with the GRM, the Groupe de Recherches Musicales, in Paris. Luc Ferrari's *Heterozygote* from 1963 is really quite aggressive. He was radically screwing around with different ideas, and *Heterozygote* is completely different from his later pieces, which are based on field recordings. Iannis Xenakis' *Bohor* from 1962 is 20 minutes of grinding BEAD noise; it's crude and nice, and based on just one class of sounds. It. A lot of the early tape music is about the *jouissance* of being able, for example, to speed up and slow down sounds. Nobody knew how to handle that. The blank slate is what draws me to it: suddenly you have tools to do things with sounds that you didn't have before. Everybody in the 1960s had an attitude like: this is brand new; let's see what we can do with it. It still sounds amazing. Now we can play 128 channels of 24-bit audio on our laptops, there is no limitation. Does it make us more blasé that the processes are more automated, and more streamlined?

AA Could we have a similar enthusiasm in contemporary electronic or process-based music?

KFW If you record a sound and play it back on tape and speed it up you get a great sound. Some composers in the 1960s based complete compositions on just such an effect. You can wonder what the value of that is now. We have Max/MSP, and our computers are so incredibly powerful that you can be overwhelmed by the possibilities. It makes it harder in a different way. What I find really interesting is that you can make extremely loose music with computers. Nowadays I gravitate towards music that is really free in time, like Mark Fell's work. It's so liberating to hear those great electronic dance music sounds turn into something that has no function at all as dance music, and is not minimalism either. It is totally a-synchronous and I want to play it really loud every day in my office to get me into a good mood. Mark Fell reclaimed the sounds of acid techno and has turned them into something else, something that is not about shaking your ass – it's about just appreciating the language of that music. That is super valuable.

The Amplification of the Soul through Technology

Interview with Gilles Aubry

Arie Altena

This interview with Gilles Aubry took place at Kontraste Krems, the afternoon before the premi re of his new composition *L'amplification des âmes* which was commissioned by Kontraste / Sonic Acts. For this piece he worked with various recordings of religious services and urban environments in Kinshasa, Congo, which he combined, overlaid and spatialised for playback on a multichannel sound installation, in this case the Acousmonium of the Groupe de Recherches Musicales (GRM). For the past few years Gilles Aubry has mainly worked on sound installations and live performances, often using field recordings. His work is informed by a cultural, critical and ethnographic interest, but also by formal experiment. Before starting the interview we discussed the connections between semiotics, Lévi-Strauss and the writings of Pierre Schaeffer, founder of the GRM and 'inventor' of *musique concrète* with Pierre Henry.

Arie Altena What are the sound sources you have used for *L'amplification des âmes?*

Gilles Aubry There are basically five categories of sound. First the general soundscape of the city, with acoustic signs of religious presences, like preachers in the market. These sounds are always present in the background of the composition. The second source is the documentation of actual religious services, which contain ritualistic elements. The Libambu Ministry in Kinshasa, where I spent most of my time, is a neo-Pentecostal church specialising in soul deliverance. The third source is recordings from Prophet Libambu's office space in downtown Kinshasa. This is where he stores and edits his personal audiovisual archive of hundreds of VHS tapes of services, campaigns and journeys. There are moments in the composition where you hear the distinctive VHS sound of the videos playing, plus his voice commenting on it. The sounds recorded from the television allow a critical distancing: it's clear you hear a document of a document, not a document of reality. Also, it helps to avoid the impression that you are listening to just some kind of crazy exotic thing.

The fourth source consists of sounds recorded inside or outside the informal cinemas that are often located in traditional markets. These small makeshift cinemas are dark, extremely loud, and are mostly visited by young men. They project a lot of Western erotic, horror and action movies. You hear the sounds of the movies and of the surroundings. Such situations are examples of Western cultural influence in contemporary Kinshasa. They also emphasise the presence of fictional images in everyday life situations, which is so pervasive that, according to anthropologist Filip de Boeck, the boundary between reality and the phantasmatic collective imaginary sometimes seems to have collapsed.

I was in one of those cinemas when they screened a violent cannibal film about a group of researchers from America who end up being eaten by cannibals. Cannibalism is extremely relevant in this respect, because one of the major activities the church engages in is identifying kids who have been accused of being witches or sorcerers, or of having eaten people. Most times the community bans these kids. For example, your neighbour could say, 'I dreamt that your kid is a sorcerer, and you'll have to kick him out, otherwise we're going to set him on fire'. These kids end up on the streets. The church tries to do something about it, but in a very ambiguous way. At the same time they confirm the witchcraft and proclaim, 'Now they're saved'. What exactly happens with these kids afterwards is not clear. Sometimes they remain rejected by their families and live on the street. So the idea of eating people is connected to some very concrete problems.

A fifth sound category comprises recordings of the daily life of people who go to the Libambu church, and the preparations for an evangelical campaign, including meetings, rehearsals, voices announcing the upcoming service on the street, building up the stage and dealing with the authorities. By mixing all the sources together in the piece, my intention was to portray a reality such as this as a highly fictional construction relying on an economy of signs and images.

AA How did you use the Acousmonium, the 'orchestra' of eighty speakers, designed by François Bayle at the GRM in the 1970s?

GA The Acousmonium is all about immersion in sound, which has now been adopted by commercial cinema. I thought it would be interesting to use space and the spatialisation of sound as a way to conceptually organise the different sound sources in *L'amplification des âmes.* With the Acousmonium I can create an immersive décor, which conveys the feeling of being in the city. This illusion is shattered when you hear the video recordings made in front of a television. The spatialisation of the sound works well and is quite efficient, because you can present one idea in one place and another one somewhere else in the space. Sometimes in the piece you hear a sound on one side, and something that contradicts it on the other. This creates tensions. But of course, it's sound; it doesn't stay in one place as images do. The sounds merge into each other. I tried to structure the piece not only according to musical aspects but also in terms of discursive ideas. The piece consists of five parts. In the beginning I introduce elements of the city soundscape, including the amplified voices of street preachers. Then it moves into the church, where you hear several extracts from a soul deliverance service. From here it goes into the cinema, and then back into the church. In the fourth part you hear recordings from the prophet's archive, and the most intense moments of the ceremony. You don't hear any religious sounds in the last part; instead you hear sounds from daily life. I recorded the working environments of the women who attend the Libambu church. You hear hairdressers, women selling stuff on the market. You hear them talking and, as *you p*robably don't know their language, it will sound exotic. But it's really down to earth at the beginning and at the end. Very characteristic moments in the piece are, for instance, the sound check in the church. You hear 'one, one, *check*, Jesus, Jesus'. At the end, the singer has a bit of spare time, and lets go. He sings like a baby and about a woman, and there is a weird, Hawaiian guitar player. That's where these stereotypes start to change.

AA Can you explain the title, *L'amplification des âmes*, the *Amplification of Souls*?

GA The title is an indication of what was going on, but it should be taken as a bit of a joke too. If you take it literally, there is amplification through technology, and it relates to the spiritual aspect of amplifying the soul. The title is French, referring to French acousmatic music, especially that created by the generation of François Bayle, who, as a director of the GRM in Paris, came up with the idea of the Acousmonium. His generation had some really weird ideas, often tending towards esoterism and cosmic music, but mixed with modern rationalism. Take Bayles' idea of the Erosphère, this very sensual and very scientific 'sphere', which is evoked in his music. It is completely cut off from reality, in the tradition of the elite avant-garde. There is no reference to a world of praxis, everything is up there in space. It's very psychedelic, but also monumental, thus reproducing the power structure of Western modernity. I jokingly wanted to allude to this grandiosity.

AA Bayle regarded the Ascousmonium as a utopia of pure listening, and perhaps he thought that through pure listening you gain access to a different perspective.

GA The concept of transcendence is a key element here. Bayle frequently uses the word transcendence in interviews, specifically with regard to the Acousmonium. He sees it as a performance tool, but he also says this tool needs to be transcended by the acousmatic composer – music has to transcend materiality. For Bayle the composer is 'god' who is able to make that transcendence happen. Of course transcendence is also a key concept in religious practises in Kinshasa. I asked Pastor Libambu several times how he views the role of technology. Of course he said that it's important to have this power to spread the gospel. But, he said, it is not divine in itself; God and the revelation are divine. So he makes quite a clear distinction between the apparatus and the revelation of God, a distinction that is much less clear for the avant-garde composers of acousmatic music, who adored the technology and the music.

AA Wasn't the possibility of transcendence through technology on of Bayle's main preoccupations?

GA Perhaps. Going towards pure listening, pure experience, pure sensuality, pure music. Composers like Bayle believed that sounds have an intrinsic meaning inscribed in their morphology, therefore they empty the sounds of human and cultural connotations. That is what *musique concrète* is about, and it goes back to Pierre Schaeffer's writings on sound. But then they talk about the human and cultural aspects all the time, much like the traditional–modern ideologies of African churches, which while rejecting traditional religion, spirits and witchcraft, talk about it continuously.

AA Your piece is also a reflection on the media and technologies used in the ceremonies, and on how meaning is produced. Instead of trying to arrive at pure sound you focus on the socio-political aspects of the use of sounds. Is your piece an investigation into how this works?

GA It is research, yes. In fact I experimented with what you could regard as a new form of sound ethnography, because I'm using sound recordings made with a portable microphone, and sounds sourced straight from the mixing desk that they use in the church. I really wanted to get the sounds from the individual inputs on the mixing desk because they have a specific quality and provide a separation of the voices. I call it the mixing-desk perspective of the ritual. No one in the actual ceremony hears it that way, so it's not exactly realistic. It's interesting to hear the differences between the sound recordings; it facilitates a finer analysis of the structure of the ritual.

Through it I am also trying to position myself in relation to the robust tradition of pure music. The idea of pure music is still resilient in institutional avant-garde music, not only in France. I think it is important to reflect on the various aspects of music production, to deconstruct them a bit. I don't like the myth of the divinely inspired composer who produces music without supposedly really knowing how he did it. The audience comes to hear what he has made, but the process of generating the composition remains hidden. In my musical practice I use a reflection on the aspects of music production as a way to invent new forms that allow the audience to get a feeling for such a reflection. If you emphasise that you're using different types of sound sources, it becomes clear the piece of music is a construction, and does not come – divinely inspired – out of the blue. I try to make that construction process audible. It's very common practice in the visual arts, but less so in the sound arts. I want it to be playful though, and I strive to arrive at something that is, in the first place, aesthetically interesting. I use the research to create a new artistic format. I'm an artist, not a scientist. My work is not the presentation of a study; it is a work of art, with all the freedom of interpretation a work of art allows for.

AA The use of sound recording technology was a major shift for ethnography. What does multi-track recording add to ethnography? Does it mainly provide poetic material for a composition?

GA In this respect I think a multi-track recording is important because it allows a 'view' behind the scenes of the religious spectacle. These ceremonies are highly structured and ritualised in time, and the roles in the ceremony are precisely assigned. You cannot crack that ritualised structure by just being there with a camera and microphone, with which you merely reproduce the staging of things. One strategy I used to get a deeper understanding was to also record other moments associated with the service: before, after, and the beginning and the end, when people go home, the sound check for their next session. Another strategy was to record the entire ceremony through the mixing desk. It was a very basic set-up. But with this I could hear how the ceremony progressed; I could hear the distorted sound from the mixer and captured the artificiality of the situation and the presence of technology. Technology does play an important role in the ceremony. The sound in the church has a bad, distorted quality, but is it because they're using cheap equipment or is meant to be that way? This kind of documentation makes it obvious that they

I use a reflection on the aspects of music production as a way to invent new forms.

are using the noisy aesthetic. I think some people would even say that the noisy way of expression is a way to establish continuity with a traditional musical aesthetic of African noise. When they do use the noisiness in these ceremonies, it is to their taste and relevant to the practice.

AA In your composition you use the idea of simultaneity or contemporaneity, the same moment in time is represented with different recordings of it, positioned at different places in the spatial set-up of the sound system. How did you deal with time in this piece?

GA There are moments when the multi-track mixing-desk recordings and my microphone recording are synchronised, creating a kind of co-presence. I had to limit myself to a composition of 30 minutes, whereas I had hours and hours of recordings to consider. In the composition time is kept in the moment. A sense of time is created through the sequence of fragments. There are key events in the compositions, each of which I allow just enough time to play to establish the idea for the listener, then I cut it, and go to the next one. Some of these might deserve a longer duration, so the listener can go beyond the moment of surprise and exoticism, and be immersed in the temporality of the recordings. The logic of the time construction is derived from the actual ceremony. The piece opens with a sound check, followed by the preaching and the soul deliverance, and then there is a kind of climax, and finally there's the time after.

AA Is the piece informed by your experience as an improvising musician?

GA The influence from improvisation is certainly present in my taste for noise and abstract music, and in how I combine sounds. But my compositions are more reflective and controlled than my improvising. I really felt something special and powerful in Kinshasa. The only thing that seems truly relevant to me is the concept of the piece and the idea of sharing these documents and this experience. It would feel wrong to use all these sounds as just pure sound material in an acousmatic way and then not acknowledge their original content in the composition. Therefore, I decided I didn't want to improvise with this sound material. Why should I improvise like crazy, twist knobs, manipulate the sounds, when in fact the basic recordings provide an amazing listening experience. As a composer I create conditions for listening experiences, which is also an ethnographic tradition, but I do add some twists on top. The piece is a reflection on the sounds and the technologies. I'm not a sound ethnographer, I'm not into the idea of purity of sound, and I'm definitely not a proponent of the idea that a recording can reproduce reality. The only possible position I can take is that of an external observer who is also participating. It needs to be made clear that a distortion, a selection, and an interpretation have occurred: the original context and the reception are not the same. What is being documented is not only the situation but also my own position. That's why I'm always documenting the production of documentary work too; that's why there are all the reflective moments, the sounds of technology, the noise, my own voice, manipulations on the microphones. These things focus the attention on the material and on the cultural aspect of producing such a work.

AA How does this new piece relate to your earlier work?

GA The method and approach is quite characteristic of all my work since *Berlin Backyards* (Crónica, 2008). That piece was much more poetically naïve, and I think I've developed since then. It started with an interest in the pleasant acoustical qualities of the gardens. I thought it would be a good idea to record them and do something musical with them. During the process I became more aware of the social aspects; in a sense *Berlin Backyards* revealed these social aspects by avoiding them. There is hardly a human sound in the recording. After *Berlin Backyards* it became important for me to not aestheticise spaces and real-life situations, but rather to try and construct an artistic discourse that includes the social aspects.

AA One of the themes underlying the concept for the 2012 Sonic Acts Festival is that a work of art is a container of time...

GA I made a transparent sound screen on the border between Switzerland and France, *Reversible Sound Wall* (2011). Amongst others it reflects on the idea of sound pollution. I would like to exhibit this screen later, not as a sound screen but as a dust collector. The screen would remain in the forest for one year, and afterwards it would bear traces of nature, rain, insects and pollen. In its form it refers to Marcel Duchamps' *Large Glass of The Bride Stripped Bare by Her Bachelors, Even* (1915–23), which in addition to many other interpretations is sometimes seen as a container of dust, time, or frequencies. My *Reversible Sound Wall* also stores time in a way. I find it interesting to display parts of this noise screen as traces of time. It's a physical trace of time and, in a way, makes time tangible.

A shorter Dutch version of this interview was published in *Gonzo Circus*, #107, January–February 2012.

Sound Out of Time, & the Buzz

Hillel Schwartz

Ordinarily, noise is defined as sound out of place: the roar of a snowmobile in a pristine winter wilderness, the shrill of a steam calliope just outside a Baroque harpsichord concert, whispering and chatting behind you in the cinema, orgasmic lovemaking in a surgical waiting room. Equally often, though, noise is sound out of time: a horn player squealing from his flat in an apartment building at three in the morning, a boy whistling brightly at a funeral, a novice coughing during Zen meditation, mobile phones ringing during a bar exam, a candidate laughing hysterically during an interview for an executive position.

Since noise punctuates the beginnings of things as insistently as silence punctuates their ends, we might hear noise as sound that not only disrupts acoustic expectations of place and time but as sound that has, one way or another, run out of time.

In English, 'running out' has several different, and differently evocative, meanings.

1) to deplete a store or stockpile…
   'we are running out of gas';
2) more abstractly, to reach the end…
   'we are running out of options';
3) to flee…
   'people are running out of a burning building';
4) to make a quick, temporary exit…
   'I am running next door to borrow some sugar';
5) to abandon…
   'a husband runs out on a wife';
6) vice versa, to expel, violently, as a villainous gang is
   'run out of town by the sheriff.'

I will enlist each of these connotations of 'running out' while tracking noise as sound (running) out of time.

I have been moved toward these 'auriculations' by my scholarly work as an historian of millenarian movements and by my professional work as a case manager for people who are gravely ill or dying. In both instances, the sonic arc runs from the orderly through the inchoate toward a quiet, silent, begrudging, or jubilant finality.

With millenarian movements whose partisans expect the imminent end of the world, a mounting accumulation of individual and societal noises of conflict, decay, anxiety

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and panic is but a foretoken of the acceleration of a general cacophony, at once the sign and vibrational agent of apocalypse. So millenarians listen for customary sounds to become inevitably louder, more disturbing, more earthshaking, and more unintelligible, the unintelligibility itself a strangely oxymoronic prelude to a chaos that must precede the End and, eventually, a New World here or elsewhere. As this old world returns to its Babel, like the talk of the senile that disintegrates into childish babble, the soundscape is one of the chief telltales of a world running out of options and appeal. Traffic snarls, the wheels of industry screech and wheeze and threaten to come to a grinding halt. Husbands shout at wives and wives screech at husbands; parents scream at children and children sass their elders; babies bawl, unattended and unhappy, or hungry, sick, abandoned. Volcanoes erupt, glaciers heave and crack, hurricanes thunder through jungles, tornadoes howl across plains, and tsunamis boom and wash over coastlines. Buildings and bridges, roofs and tunnels crack and collapse. These are the sounds of time running out, and they are inevitably noisy: noise might even be heard as sound itself running out of time, that is, losing touch with the saving graces of rhythm or unison. And in this context humans become inarticulate, screaming and weeping or struck speechless.

Among those who are dying, whether of declining old age, serious illness or accident, or from the complications of surgery, radiation, or chemotherapy, the dozens of alarm sounds of an environing medical technology are compounded by amplified sounds from diagnostic devices and monitors, and by new noises from their own bodies, some of which only they can hear, as with the tinnitus that frequently accompanies high-intensity dosages of antibiotics.

Unlike millenarians who are avid gatherers and trumpeters of the loud evangel of apocalyptic sounds, those who are dying are, as Jeffrey Kittay, author of the paper *The Sound Surround*, would say, a captive audience, especially alert to the aggravations of small sounds, half-intelligible, and to larger sounds far too automatic. In institutional settings, they are surrounded by sounds biomedical, clinical or pastoral, sounds as thoroughly ambient as bad perfume, sounds of others' bodily

functions. At home, they may be surrounded by a congeries of voices, music, ratchetings and rumblings issuing from domestic technologies, media, doorjambs and plumbing. In their profusion, arrhythmic repetitiousness, and tonal insipidity or unwarranted complexity, these sounds become noise. If they are the sounds of themselves as mortal beings running out of time, they are also sounds inept in time, awkwardly or impersonally broadcast, and the dying, if only they could, would like to run these sounds out of town.

Since hearing is usually the last of the senses to go, the dying are particularly captive audiences to annoyingly out-of-range whispers, the unprovoked rustling of tubes and hugger-mugger of machines, the shuffling of newspapers, the buzz of fluorescent lights. What they miss, sometimes, is full-on conversation; at many other times, they seek a quiet that can be counted on. And many more than we know suffer from noises in their ears.

I come to the question of 'sound out of time' from yet a third perspective, that of sacred time. Asked to compose an entry on the subject for the second edition of the *Encyclopedia of Religion*, I have thought at length about the ways in which time is parsed for purposes numinous or holy. In this context, I suggest that there can be something numinous to sound at the end of time, whether that time is universal or personal. While millenarians, attending to the profane cacophony of the end time, anticipate the completion of a divine timetable, the dying struggle – often intently – to listen only for what is worth their while, and this, as I have observed, is a more exhausting struggle even than the struggle near the end to speak only what is most essential.

Their appreciation of what is significant at once heightened and narrowed, the dying find most sounds of quotidian life resolving into noise: sound running out of a place in time. What remains worth their audition has superlative, perhaps supernal, authority, whether the mew or bark of a pet or the concerted words of a lover. But the sounds that for each person remain 'in time' at the end of time are inveterately idiosyncratic and individually unpredictable; I cannot tell you now what sounds or words I shall still welcome when I am on my deathbed, nor the sounds that will most resonate for me with the numinous. Surely they will not be the old Western clichés of church

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bells tolling, even when electronically revisited by Krzysztof Penderecki, or harp strings being plucked, even by Harpo Marx. Sounds there will be, however, that will be closest to my heart so long as my heart keeps to its own beat.

Eschatologically, one could argue that noise bears an asymptotic relationship to sound: a tailing in several dimensions. In terms of volume, when sound dwindles to almost nothing, it can be as indeterminately vibrational as sound so loud that it can be experienced only as vibration. We have, then, the noise-of-almost-nothing as well as the noise-of-everything-all-at-once, opposite ends of the spectrum of apocalypse as either utter silence or utter cacophony.

In terms of tonality, sound at the highest and lowest frequencies, just before they become inaudible to human ears, are indistinct and ordinarily unintelligible, no matter how loud or soft, and may be experienced rather as sense-vibration than as acoustic waves. We have, then, ultra-noise and infra-noise, sounds that we may appreciate without cognizing, feel without hearing, or hear apocalyptically as inner prophetic voices.

In terms of rhythm, sound beats too complexly compressed or too distant one from the other are again indifferentiable, lacking tempo; just before they lose their tempi, they may be felt (understood, experienced, fantasised) as panic or as a last gasp. We have, then, the noise of the frantically vanishing and the noise of the frustratingly slow, or of the fleeting and the catatonic, the two extremes of apocalyptic catastrophe, the literal end of time in summary onrush or full-on entropy. Does the world end with a bang or a whimper or just the missing of a beat?

Let me recapitulate (as recapitulation itself keeps apocalypse at bay). Sound becomes noise when, for one reason or another, we cannot make out its frequency, tempo, or patterns, but this is not to say that noise is meaningless sound. Rather, we tend to associate noise with analogical situations, conditions that in themselves are phenomenologically intense and temporally problematic: chaos, riot, mob action, insanity, drunkenness (before stupor), sudden disaster, blooming confusion, obsessive repetition, explosive fury, implosive frustration, spectacular pain, outrageous celebration, orgasm. All of these conditions are experienced as suspensions, interruptions,

or even overturnings of the customary ongoingness of time, wherefore we confess ourselves at a loss to capture them in words: they become 'unbelievable', 'incredible', 'indescribable'. The soundfulness of these conditions entails a sputtering or speechlessness in their aftermath. Our flustered straining toward a sensible articulation of these out-of-time experiences becomes, *per se*, strong evidence of their essential noisiness.

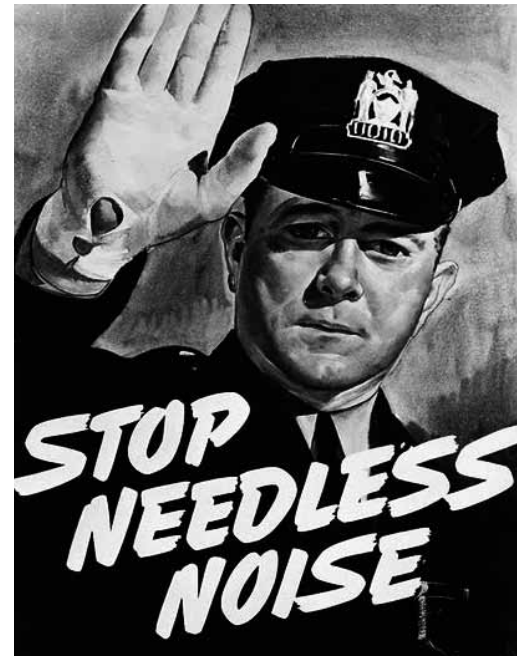
What we now call 'white noise' is noisy precisely because it has no tonal centre and no rhythmic definition; it is sound out of place *and* time. Yet its acoustic randomness does not leave us at a loss for meaning. By personal predilection or social consensus, we may associate it with the pounding of ocean waves, the falling of water in cascades, the distant murmurings of a prayerful congregation, the crackling of dry leaves and gravel underfoot, or something else reputed or remembered to be comforting. This seems, and of course is, oxymoronic: noise as restful, noise as calming, noise as a mask for sleeping easily through the night or hearing ourselves think in a loud subway car. But the success of white noise as an opiate or soporific or sound conditioner stems from the power of noise, as noise, to remove us almost bodily from our immediate, eventful time.

As sound out of time, then, noise is not necessarily or implicitly senseless, or terrifying. It may be as anti-apocalyptic as a snoring sloth. Indeed, the absence of noise in a world typically noisy may be far more nightmarish, a signal of loss, death, or impending horror.

In order to better appreciate the sound-system of noise and the consequences of sound out of time, hearken to the shifting historical and socio-acoustic contexts for one sound in particular, the electric buzzer. The sounds of electric buzzers are notoriously difficult to isolate or describe in words. Although they have echoes, to be sure, among bees, wasps and mosquitoes, the sounds of electric buzzers have historical resonances far beyond the insect world, most of them within the realm of noise, and many of them timely.

I mean that timeliness literally. The first uses of electric buzzers were in psychophysical laboratories and astronomical observatories. Psychologists used buzzers when testing the reaction times of human subjects,

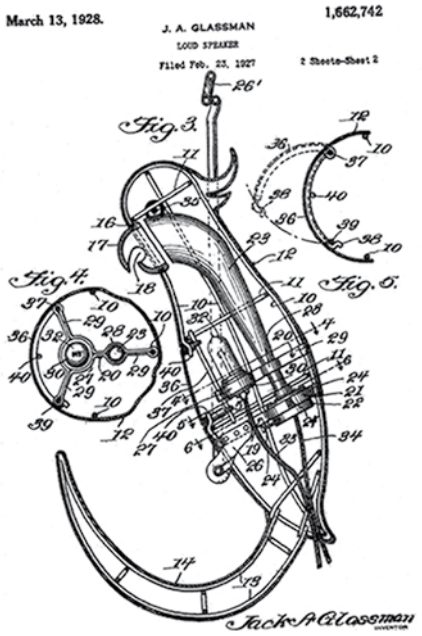
Noise is Our Enemy Too, poster for federal campaign, 1942.



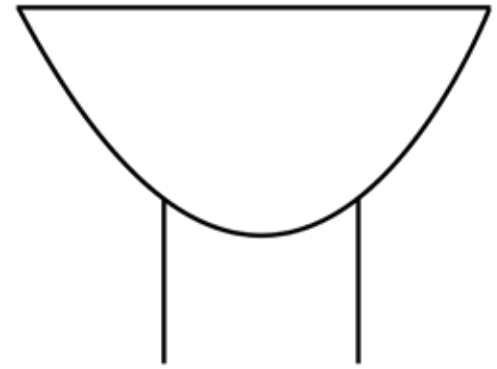
Stop Needless Noise, poster for federal campaign.

Air Raid Sirens, hand screen-printed poster by **Flood The Valley**.

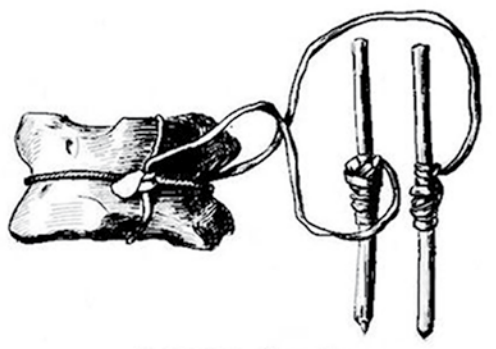
Federal Thunderbolt Air Raid Siren advertisement, 1950s.



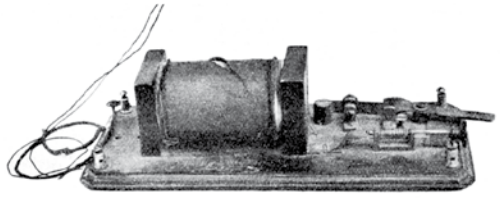
Design for a *Parrot Loudspeaker,* J.A. Glassman, 1927.



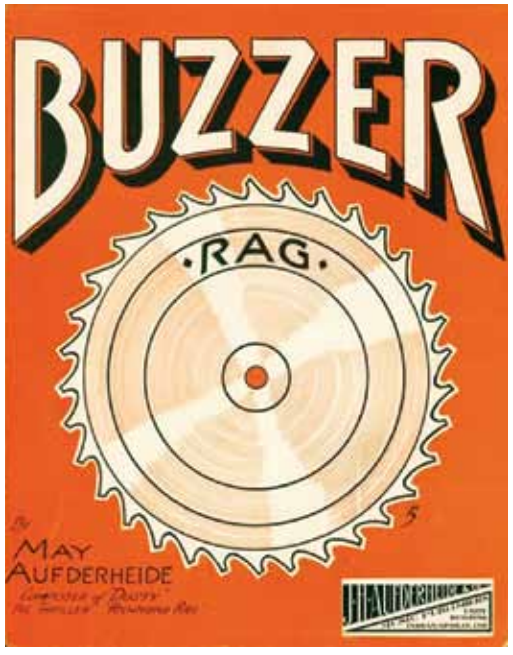
Circuit diagram symbol for a buzzer.



Eastern Cree bone buzzer, 1912. From Alanson Skinner, *Notes on the Eastern Cree and Northern Saulteaux Anthropological Papers of the American Museum of Natural History* pp. 1–178 (New York: The Trustee, 1912).



Induction coil with manually operated buzzer, from *Popular Science Monthly*, vol. 70, 1907.



Cover of May Aufderheide's ragtime composition *Buzzer Rag*, 1909.

Noises for all pockets, advertisement, unknown date.

the many
forms of time-
transcendence,
timelessness,
counter-time,
escapes and
emancipations
from Time 454;

What we now call 'white noise' is noisy precisely because it has no tonal centre and no rhythmic definition; it is sound out of place and time.

which were critical to figuring out the dynamism of the brain-body connection; for tracking nerve impulses through healthy and injured tissue; for comprehending sensorimotor disorders and cognitive deficits; and for quantifying what was called individual sensitivity or constitutional sensibility. Reaction times were of especial moment in astronomical observatories, where the 'personal equations' (or reaction-time patterns) of professional and amateur observers had been shown to affect the timing and registration of astronomical transits. Electric buzzers respond more instantly to touch than do bells or other hand-sounded instruments, so they can be used as signals and markers (or confirmations of a key tap) while the eyes are otherwise engaged. Not coincidentally, they also appear visually to be counterparts or extensions of the neural system itself, with a simple input (stimulus), often-hidden wiring (nerves), and straightforward output (response). It's almost as if buzzer systems have been extruded by, or lifted from, a neuroskeletal frame, so they are finely metonymic partners to our investigations of our neurophysiological selves.

By sometimes-explicit extension from mid-nineteenth-century neurology, buzzers were then introduced to the central offices of electric alarm companies, where timeliness in warning of property crime was increasingly apt to a commercial world of speeding locomotives, cross-continental telegraphy, hourly news dispatches, transatlantic underwater cables, cheap mantelpiece clocks and international time zones.

Once consumers began to flock to department stores, the timeliness of modern customer service was itself often represented by the counter buzzer, which never entirely replaced the older counter bell but did make noises toward an insurgent democracy of urgency. In the past, hand bells, gongs, and metal triangles had been the acoustic whip wielded by masters or mistresses to summon servants or slaves. In more egalitarian societies, where time was equilibrated with capitalist expediency, the buzzer could be as demanding among equals in neighbouring business offices as it was across social classes, especially since buzzers could be far more sonically insistent than typical bells, admitting no intervals of silence when continuously pressed. Unlike bells with clappers, buzzers had a rhythm

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only if one toyed with them; on their plain-faced own, they were gracelessly immediate, practically atonal, sonically invariable, imperious, and rather impervious to manhandling.

We can hear the acoustic changes rung in a shift in the street play of young apprentices, who on holiday or off work on Saturday nights were known to run down streets randomly slamming the knockers on the front doors of houses of the more privileged. When manual or electric door chimes were installed, the raucous tradition continued as apprentices raced up and down porches competing for the noisiest passage down sedate avenues. Where buzzers were installed in place of knockers, however, these high jinks dwindled, for small buzzers were nowhere as handy or as public a target as large brass knockers or the pull chains of chimes. Moreover, the brief depression of a buzzer while on the run from porch to porch raised little sonic havoc within substantial households and, worse, did not echo down the boulevards like brass resounding on hardwood.

With the late nineteenth-century spread of the telephone, the elevator, and electrical utilities, electric buzzers advanced to the heart of things: newsgathering headquarters (whence the 'buzz' of rumour and headlines), corporate offices, central switchboards, railroad command centres, nurses' stations in hospitals, and bank vaults. Heard as a more penetrative, directive sound than bells or whistles whose tones commingled confusingly with street cries, trolley screeches, train switching yards, and the clanking of wagons laden with girders or paving stones, buzzers could be audibly distinct and insistent indoors and out.

These qualities of distinctness and insistence made buzzers a perfect tool for Ivan Pavlov (1849–1936). His 30 years of experiments with Russian dogs, which established the model for classical or reflexive conditioning, often relied on keying sounds to hunger or hurt, food or shock. He used many other sound makers for his experiments, but in retrospect it was his use of the buzzer as an 'audicon' of wrongness and presentiment of pain that would have the greatest impact on Euro–American sound systems, for the meaning of the sound of a buzzer would take on, first, a new and memorable sense of immediate peril, then a more

conclusive sense of having come to an end, having run out of time – whether failing to answer a question in a quiz show or flat-lining in a critical care bed. The buzz that had embodied the white noise of impassive presence and the pink noise of liveliness would now have a dark side, a stolid black noise of emptiness, loss, death.

True, business, apartment, prison, and hospital intercoms would continue working with buzzers as alerts to the immediate fact of visitors, messages, and appeals for decisions. True, those who said they were experiencing 'a buzz' were more likely to be enjoying an artificial high than suffering a fatal reaction to the sting of a wasp. And true, the buzzer was rarely an instrument of torture, though sometimes in the hands of pranksters it would produce a mischievous, hilarious shock in unwary handshakes. Still, a continuous buzzing (in headphones, inside elevators, on ICU floors or CPU monitors, or in one's head) would suggest mechanical malfunction, mental illness or, at the very least, low or dead batteries. More generically, and socio-symbolically, a continuous buzzing could suggest a serious, sometimes permanent, loss of responsiveness, of consciousness, timeliness, liveliness.

Such an ambiguity in the sound-aura of buzzing became surprisingly clear during the Cold War when the US Office of Civil and Defense Mobilization came up with a clever solution to problems posed by studies that showed that air-raid sirens, however powerful, would be sonically inadequate to warning citizens of a nuclear attack. Sirens in large cities were so ubiquitous and anonymous that local civil defence authorities themselves tended to ignore them; out in the suburbs, the cacophony of blenders, washing machines, dishwashers, televisions, lawn mowers, and barking dogs outdid the shriek of the typically distant siren, and on city streets as well as suburban roads, drivers in plush sedans could hear little even of police sirens when they had the windows rolled up, the air conditioning on and the radio blasting. Farther out, in the countryside, sirens more distant yet were no match for the stridency of huge combines, threshers, chainsaws, gristmills, motorcycles and hotrods. So civil defence experts conceived of NEAR, the National Emergency Alarm Repeater, tested in 1960 in 1067 homes and 400 offices in Charlotte, Michigan. The Repeater was essentially

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a black box that plugged into house current and used the second and fourth harmonic voltages of the 60-cycle power frequency to deliver a raucous buzz at 240 or 255 Hz, 'considerably louder than an electric alarm clock'. With their uncivil tone, NEAR units were supposedly disruptive enough to get people at home to stop what they were doing, and instructive enough to prompt them to turn on their radios for emergency advisories. Many experts were dubious, especially those who were intimate with the overwhelming wheeze of vacuum cleaners or the pounding of heavy industrial trucks on rutted pavements; for these and many other reasons, a NEAR system was never implemented, but it was surely considered and tested because buzzing had already assumed the contrary bearings of immediacy and apocalypse, timeliness and being (almost) out of time.

This contrariness lies at the cult(a)ural root of noisiness as both a perception and conception of sound. It also lies at the root of experiences and notions of being out of time, for one could – and many have, East and West, North and South – recast the 'running out of time' from catastrophic apocalypse into a welcome timelessness, a more or less permanent escape from the demands of the daily round, or superseding history itself.

In this state, white noise and black noise seem to converge upon the numinous, the holy, upon whatever one knows of things unconstrained by years, months, days, hours, minutes, seconds, sequence. When sounds run out of time, they end up as noise. When we run out of time, at the final buzzer, where do we end up?

Ulysses Becomes Electra: Electric Energy in Joyce's Novel

Enda Duffy

> Rethink body, subjectivity and social change in terms of movement, affect, force and violence – before code, text and signification. These latter reiterate arrest (the Law: where bodies cease, only to mean, and where meaning carries a sentence).
> —Brian Massumi, *Parables for the Virtual: Affect, Movement, Sensation*[1]

> The whirr of flapping leathern bands and hum of dynamos from the powerhouse urged Stephen to be on. Beingless beings. Stop! Throb always without you and the throb always within…
> —Stephen Dedalus passing by a Dublin electric power plant, 'Wandering rocks', *Ulysses* (10: 821-3)

Near the climax of the 'Circe' episode in James Joyce's *Ulysses* there appears the teasing character of the nymph. She reaches out of the centrefold reprint framed above the Blooms' bed ('A splendid masterpiece in art colours'[2]) to discourse on Bloom's fetishistic longings: she reminds Leopold Bloom that 'You kissed me in four places. And with loving pencil you shaded my eyes, my bosom and my shame' (*U* 15:3263). The work of high art that is *Ulysses* here showcases what is truly a work of art in the 'Age of Mechanical Reproduction', the very epitome of the art poster whose mass replication provides the basis for Walter Benjamin's famous essay. The nymph, as a mass reproduced image, has come to life here as only a kitsch commodity in capitalism can. Even more than the soap rising in the east in the same episode of the novel (*U* 15:334), more than the infamous 'Plumtree's Potted Meat' (*U* 5:145), which shadows Bloom all day, more than the throwaway (*U* 10:294) Bloom is handed, the nymph is the climactic star turn in this novel where modernism meets consumer carnival.[3] Not a real artwork, not a real Venus, not a real woman, the nymph is closer than the other animated commodities to the novel's cross-stitch of sexual and consumer desire. At this moment of her coming to life, she introduces into this magical nexus of consumerism, sexuality and modernity another striking component of the modern scene. She declares of her kind: 'We eat electric light' (*U* 15:3393).

'Time was vulnerable 457;

With this declaration, the world of new inventions, of technology, of science – and of science put to mass public use – is brought, comically but resolutely, into the novel. We have felt the force of this new matter of science and technology in the novel before, but only as a low murmur, an occasional mutter heard as background noise to other, more pressing and foregrounded matters – nation, city, people's cares. Now, at the novel's very climax, it gets to coyly show its hand, and to declare itself as that new thing in the lives of Dubliners in 1904: electricity. Moreover, this electricity is cited as the force that takes commodified sexual excitement – and brings its bearer to life. The inert object springs to life, the image lives. It gets enough sexual energy to come to life, and it gets it from electricity. The technology animates the object, replacing its dull inertness with an unpredictable capacity for observation, speech and action. Modern technology fuels this commodity with life.

This essay explores what the arrival of electricity via mass electrification – this immensely powerful, potentially pervasive and strangely invisible force, harnessed by science and technology from nature – may have meant for the representation of force, energy and movement in modernist writing, and specifically in Joyce's *Ulysses*. The nymph, a modernist Electra, deserves close attention because she perfectly exemplifies a dominant strand in the representation of fantasies about the newly available electricity in these years. This was the idea that human bodies could literally be electrified. Powered by this force, humans could, the fantasy went, have themselves, or rather, their bodies, 'enlivened' or 'revivified'. This dream-possibility was exemplified by another – and, this time, avowedly sub-literary – source for Joyce's electrified nymph: the advertisements, common at the turn of the century, for electric 'treatments'. Countless advertisements of the day promised 'electric power' and 'relief to the nervous system' of ailing or worn-out bodies. A standard example, from the Sears, Roebuck and Co. Catalogue of

1. See Brian Massumi, *Parables of the Virtual: Movement, Affect, Sensation* (Durham, N.C.: Duke University Press, 2002), p. 66.
2. James Joyce, *Ulysses* (New York: Vintage Books, 1986, ed. Hans Walter Gabler et al.), p. 445. Future references to this text will use this edition, citing episode and line number.
3. For a fine discussion of the role of apparently banal objects in *Ulysses* see Saikat Majumdar, 'A Pebblehard Soap: Objecthood, Banality and Refusal in Ulysses', in *James Joyce Quarterly*, vols. 42–3, nos. 1–4, pp. 219–38.

1901, is reproduced here (see illustration further on). This strand of advertising, and its fantasies, was also a feature of Dublin life circa 1900. The real 16 June 1904 edition of the Dublin *Evening Telegraph*, the paper which Bloom consults in the cabman's shelter in 'Eumaeus', features an advertisement for 'The American Doctors and their Good Work' in exactly this mode. 'In their offices at 15 Kildare St.', notes the advertisement, the doctors use 'electrical equipment of their own invention, patented in all civilised lands' that 'can make paralytics walk' and cure a long list of ailments with 'Electro-vibration [that] will make you strong and vigorous. This is certain'.[4] (Kildare St. is the address of the National Library, the setting of 'Scylla and Charybdis' in which Bloom and Stephen almost meet; it is also the site of the 'Lestrygonians' scene of the near-encounter of Bloom and Blazes Boylan). American hyper-modernity, in Dublin in 1904, is electric, it used electricity as medicine, that is, in the care of the enervated body, and it promised to bring vigour to every Irish body. As the advertisement said: 'This is certain'.

These advertisements are comic and outrageous now, not only because of the populist dreams of sexual potency they coyly (or not) put on offer, but because we see they represent the hope, since proven naïve, that a new technology would revive our bodies. (That electricity might revive our minds, however, is an idea that persists in the continued use of electric-shock treatments in psychiatry). In the electric-charged bulging muscles of the advertisement-superman – who looks suspiciously like Eugen Sandow,[5] one of the original hawkers of the cult of bodybuilding, whose exercises were known to Leopold Bloom – we see the pathos of the idea that a new technology could make one a superman. Nevertheless, the hope that the new technologies could indeed directly

4. See the *Evening Telegraph*, Dublin, 16 June 1904, New Series, 7131, p. 2. The same edition, p. 4, has an article on 'Rathmines Electric Light: Action Against the District Council', about a claim by the National Electric Construction Company regarding damaged electrical equipment; the claim was valued at 1d (i.e., one penny) per lamp.
5. Sandow was one of the first popularisers of self-help bodybuilding, and enjoyed an immense popularity in both Europe and America in this period. His popularity was symptomatic of a crisis of masculinity in the Boer War era. See Maurizia Boscagli, 'Wearing the Body: Sandow as Sandwichman', in T*he Eye On The Flesh: Fashions of Masculinity in the Early Twentieth Century* (Boulder: Harper Collins/ Westview, 1996), pp. 104–16. Bloom thinks that he must begin again on Sandow's exercises, and owns a copy of Eugen Sandow's *Physical Strength and how to Obtain It* (see U 17:1398).

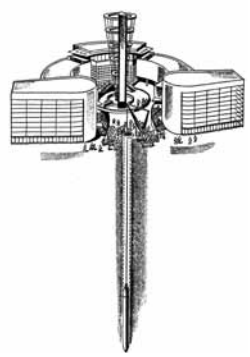
impervious to time 457;

affect the bodies of their users, and change them, was widespread: the advertisements merely fed off the assumption that new technologies unleashed powers that would have a direct effect on people's bodies and well-being. As the inventions of Edison and others became available, they were not sold to the masses of people as conventional commodities, not in the final instance as glamorous objects that would enhance their buyers' prestige, or enhance their sense of selfhood. They did not appeal to their future users, in other words, at the level of their identity or even of their subjectivity. Rather, they sold themselves as entities, which would improve bodies, improve 'well-being' and improve 'life'. They cast themselves, therefore, as the bearers of forces that existed below the waterline of culture, and as such appealed directly to their future user's physical well being, rather than to their cultural identity. This direct approach of the technology to the physical body of the user was decisive, I suggest, not only for the ways new technologies were taken up in the modern period, but for the ways in which high culture confronted them as well. High culture, intervening in the direct approach of the technology to the physical body, not only represented these technologies in texts and artworks, but also developed a new kind of interest at this moment in the corporeal, the physical, and the life, which animated the human body.

The question of this essay is this: how does the potential energising power of the burst of new technologies that appeared around the turn of the twentieth century, invoked overtly through the nymph and elsewhere in *Ulysses*, infiltrate the text and its representational protocols and stratagems? My working hypothesis is that the arrival of these new technologies and their spectacular energies and powers did nothing less than challenge writers such as Joyce into a full-scale re-inscription of the role of energy in modernity. In the first instance, I propose, this took the form of an intense new attention throughout modernist texts to the ways in which the lived experience of individual bodies involves the disbursement of energy. *Ulysses*, through narrative strategies, is a novel whose newness is in part – possibly in very large part – due simply to the new kinds and levels of attention it granted to human energy. In this sense, it is, literally, an electrified

text. It is as if all of its characters, not merely the nymph, have eaten the new electricity, and their expenditures of energy are being anatomised. Moreover, the vaunted modernist strangeness of the text often simply turns out to be the result of textual strategies developed to more accurately annotate these energies, their ebbs, flows and routes of circulation. The new technologies are not simply on occasion referred to in *Ulysses*; rather, their very presence precipitates a radical revision of what needs to be recorded to delineate the – now energised – subject. I'm suggesting, in other words, that the novel shares some of the assumptions about a well-lived existence as do the advertisements: like them, it focuses, in new ways, on human energy and it's tracking in the human body.

At the beginning of the twentieth century, this essay proposes, an unconscious, smouldering awareness of this new importance of energy in all aspects of existence, its continuous hum, as an extension of the technological logic of the time, helped to radically cast older modes of subject-representation into crisis and in the process energised texts. This energy in texts did not matter only to bodies, but it is most noticeable in the new ways in which energised embodiment is attended to in modernist texts. The shock of modernism, therefore, also relates to the shock of electric-shock therapy. The foldings of such energies into textualities involved a complex writerly rewiring which in the first instance reworked the representation of embodied subjectivity. The electric charge travels from the poster-girl brought to life because she has eaten electric light (she is a mythic Eve for the technological era) to the living characters, highlighting, for readers, their own less spectacular, but palpably intense, energies. We might see her as one of the minor signature characters in the text, one prototype for the rest. Certainly her ghost-robot embodiment is the model for how every quasi-embodied character in the phantasmagoric charade of 'Circe', the episode in which she appears, is constructed, and 'Circe' is the climactic experimental episode of the novel against which all the others must be read. *Ulysses*, throughout, richly develops this newly complex version of human, embodied energy it conjures here, in the nymph who clearly benefited from the electrical cure of the type offered by the American doctors on Kildare St.



through space-time 457;

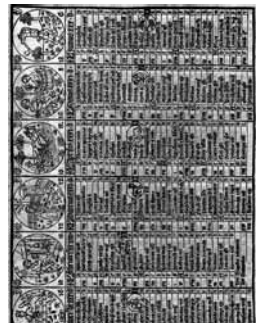
What the force of technology achieves in the nymph's case, albeit as a surreal joke, is to make a live body of what had been a commodity. It the gift to it of life. The advent of new technologies such as mass electrification, in other words, pushed the modernist text towards the re-evaluation of a category no less fundamental than that of life itself. Confronted with the issue of showing life itself in a new way (even if, as here, comically), the modernist texts turns both backwards and forwards: backwards to a traditional form, the ghost story, from which it takes the figure of the ghost, and forward, to a new popular genre, the science fiction thriller, from which it takes the figure of the automaton-robot. For this character at the heart of *Ulysses*, if only as a joke, electricity allows the two sides of her nymphly significance – her ghostliness and her robot-quality – to signify at once. Her eaten electricity might be what D.H. Lawrence, a novelist much more prone to introducing the language of electromagnetism into discourses of sexuality than was Joyce, in these same years would call her 'life force', or what Henri Bergson, who enjoyed an enormous vogue in these same years, theorised as the '*elan vital*'. The new technologies brought life itself to the fore as an issue in high modernism.

If this is life, then, it is a problematic, highly fraught version: to show this version of life as energy, for modernism, turned into a complex experimental enterprise. The surreal jokiness of the Bloom–electric nymph encounter suggests the apprehensive, strange and unnerved representations which had characterised both pre-and late-modernist literary responses to the new technologies. The electric nymph is either a spirit or an automaton. Charged up to step out of a cheap print, she emerges as a mirage: a ghost, or a robot. She tells Bloom that she has eaten electricity, first, to explain her ethereality, her ghostliness, which refers in turn to her morality: she is a pure and ethereal creature, who subsists on an invisible substance, so that she blushes before Bloom. On the other hand, the electricity refers to her robotic aspect: her dynamism. The nymph, comic star of the carnival of curiosities of a turn-of-the-century industrial exhibition, shadowy and doll-like at once, encapsulates an early, and anticipates a late, response

to the sudden arrival of a host of new widely available technological inventions and the new adaptations which they made necessary. As ethereal wraith, her literary ancestors are various late nineteenth-century ghosts; as electric-powered machine, her literary successors will be the robots of science fiction. The years before modernism witnessed a wave of credulity regarding table-knocking, ghosts and spiritualism: consider the case of Yeats, whose spiritualism led eventually to *A Vision*, or that of another proto-modernist *avant-la-lettre* with an Irish background, Arthur Conan Doyle.[6] At almost the same moment there arrived the crowd of technological inventions, the telephone, the phonograph, the radio, the automobile, the movie camera and the rest that have come to characterise twentieth-century technologically mediated mass culture,[7] which were answered in mass culture with the invention of the exotic cyborgs, automatons, and other metallic machine-people of modern science fiction. Sandwiched between 1890's spiritualism and 1930's science fiction, high literary modernism may be seen as responding to the new energies of technology by throwing up fantasy figures, like the nymph, who are both ghosts and automatons at once.

What we have with the electric nymph, then, is a congruence of older ways of imagining aliveness by seeing it as 'spirited', that is, as infused by some ghost or spirit, with the new ways informed by mechanics and technology, which led it being cast as a robot. Thus the nymph in 'Circe' is one of a series of such ghost-automatons who make star turns in many modernist texts. This double-helix of ghost-automaton may be said to begin with the decomposing, half-alive figure in the painting in Oscar Wilde's *The Picture of Dorian Gray*, still playing, at least, within the terms of a game of

6. Other Irish writings in the ghostly vein range from the works of the Ballyshannon poet Richard Allingham (1824–89) to the still-popular 'fantasy' novels of the Meath ascendancy landlord, Lord Dunsany. Just as there has been some attention in recent years to the ways in which Celtic Revival spiritualism both related to and in turn inspired aspects of a late-empire global realignment of notions of 'spirituality', so too it would be interesting to imagine how the 'spiritualist' tendency of the Gaelic revival, from existing simply as a reactionary force opposed to industrial and technological change, actually contributed not only to the Irish but to the British and even global accommodation to the new stage of technologised modernity represented in high culture by modernism. One way in which one might begin to revise the consideration of the cultural role of the 'spiritualists' would (as in Conan Doyle's case) be to examine the role of new kinds of camera in seeing the ghosts summoned at séances.
7. The by-now classic text here is Stephen Kern, *The Culture of Time and Space 1880–1918* (Cambridge, MA: Harvard University Press, 1983).

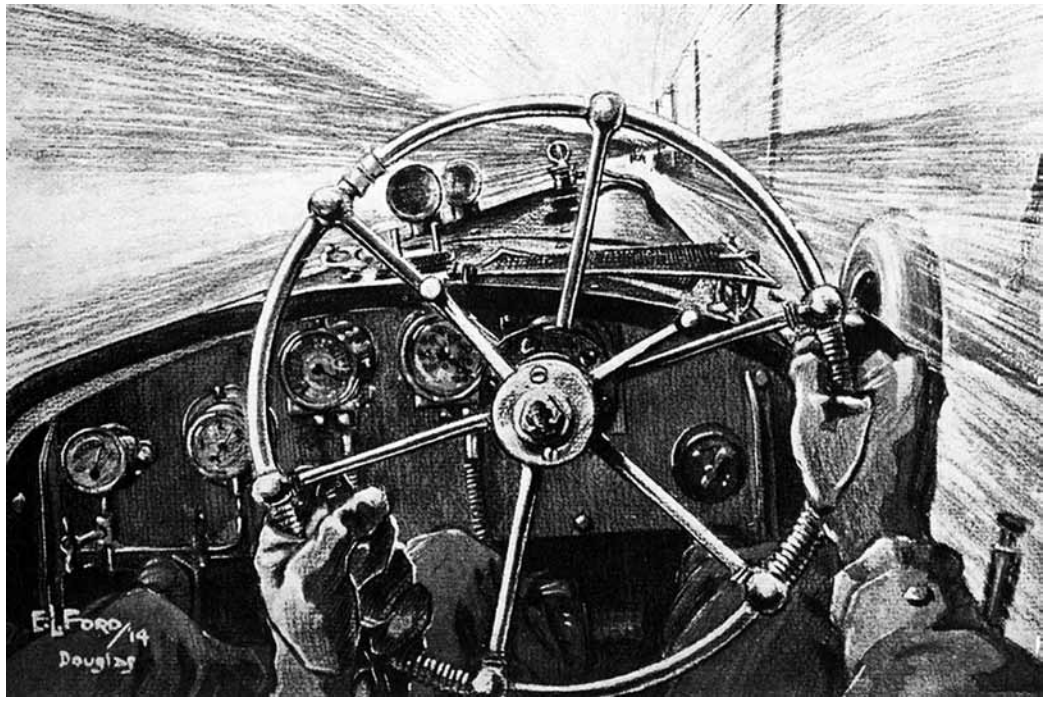


the one-way vector "time" 457;

Victorian morality; looking forward, it ends with the robotic Maria of Fritz Lang's *Metropolis*, coming to android life in a series of electrified smoke rings. None of these characters possesses life in the conventional, humanly embodied sense; rather, each offers a makeshift version of some of its components. Each, in the wake of new technological developments that offered themselves as prostheses or as enhancers of life, attempts to recreate versions of life from the ground up, using alternative versions of imitation-aliveness – ghost or automaton – in order to do so. While the ghost-robot figure appears repeatedly in modernist texts, the spirit-robot version of artificial life only overcomes its strangeness and lapses into a joke in *Ulysses*, which it never does in Dracula or Yeats's *Words upon the Windowpane*, the chillers of H.P. Lovecraft or the dystopias of H.G. Wells, because in *Ulysses* it is surrounded and superseded by extensive attention in the relatively realistic parts of the novel, and in the realistic characters, to what constitutes energetic actual life in the era of the new technologies.

How does the modernist novel, in portraying this new version of an energised version of living, delineate the existence of its character-subjects? Once life – and, implicitly, human life – becomes the object of representation, the text is no longer readable simply at the horizon of the ideological, although questions of life's worth are ideological ones; it is not simply to be accounted for at the level of a political reading, however totalising, although bio-power, and the care of the bodies of the living, is very much a political issue; neither is it simply the moment when the literary becomes a branch of the life sciences, although the text, in its new attention to evidence of life, does work as a symptomology, closely attending to the minutest signs of life. (We might even be reminded that the young James Joyce, recently graduated from University College Dublin, began studies in medicine in Paris, before returning to Ireland at the time of his mother's final illness). *Ulysses* as the Book of the Living (as opposed to *Finnegans Wake*, on which the most illuminating criticism explicating its obscurities reads it as a Book of the Dead[8]),

8. See John Bishop, *Joyce's Book of the Dark* (Madison: University of Wisconsin Press, 1986).

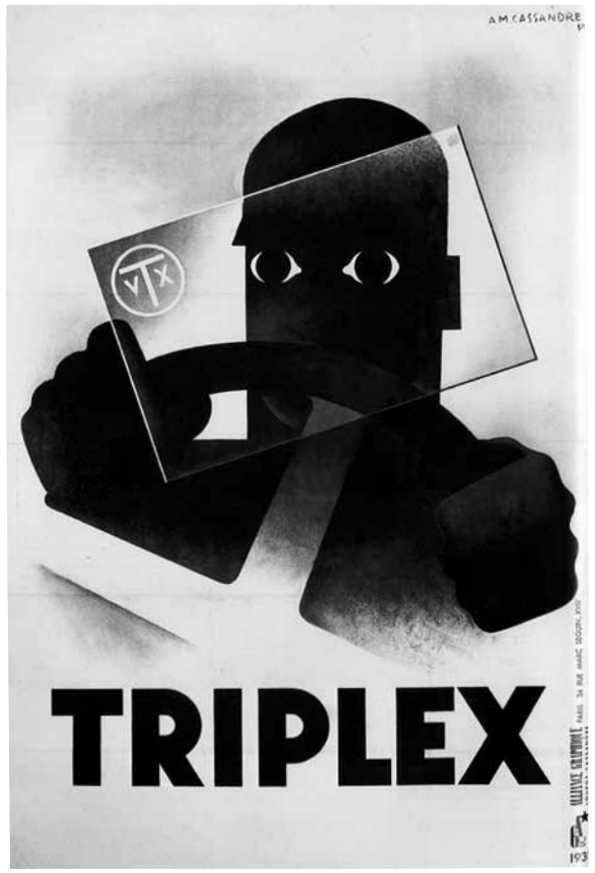


Ernest Ford, *Climbing Snaefell: A Driver's Outlook* (All he sees is a little strip of road 100 yards ahead), *Motor Magazine*, 1914.

Jacques Henri Lartigue, Delage Automobile, Grand Prix des A.C.F. Circuit de Dieppe, France, 26 June 1912.

Robert Demachy, *Vitesse (Speed)*, photograph, 1904.

Francis Picabia, *Portrait d'une jeune fille americaine dans l'état de nudité*, 1915, © courtesy of the artist's estate.



A. M. Cassandre, *Triplex*, Paris, 1931.

signals its preoccupation with life in part in the surreal phantasmagoria of banal commodities come alive in 'Circe', and carries ideology, politics, science and modernist textuality[9] along together to a zero-point where a new aesthetics is necessary to elucidate each of them in their new and surprising interdependencies.

A text such as *Ulysses* recast life as energised not only by representing human interactions with the new technologies, but by developing a style through which the ebbs and flows of human energy in particular could be very minutely tracked in the text. The shock tactics of much high modernism and the often soothing, smoothing effects of the new technologies do not provide simple or obvious parallels. High modernism in the arts staged its shocks and stunning effects within a logic of ostentation; the new technologies, on the other hand, insinuated themselves into everyday lives as if by stealth, advertising themselves via a rhetoric of convenience. Inevitably, modern machines appear from time to time in modernist texts: in *Ulysses*, there is the typewriter and the telephone in Boylan's office (*U* 10:388), the telephone in Thornton's Grafton St. shop (*U* 10:336), and even the flash of a car windscreen, in the year after the Gordon Bennett Cup race was staged in Ireland, which for a moment, in 'Wandering Rocks', blinds Bloom. By 1921, however, if not quite so fully by 1904, when the novel is set, the 'increased pace of life' had become a commonplace of the culture and of some texts: Bloom even contemplates 'the velocity of modern life' in answer to the 'Ithaca' question, 'What were habitually his final meditations?' (*U* 17:1774). The Taylorist emphasis of those years on schedules, time-clocks and the amount of bodily movement that could comfortably be engaged in a given period infiltrated modernism too: *Ulysses*' time allotment in the eighteen episodes is a Taylorist timeline transported to literature. And Joyce absorbed Futurist influence: see for a start the *Dubliners* short story about the famous Gordon Bennett Cup motor car race run in

9. There has been a persistent interest in Joyce's version of modernism and the scientific revolution of the period in which he wrote; one of the finest books in this area is *Joyce, Chaos and Complexity* (Urbana, IL: University of Illinois Press, 1997). Joyce and medicine has been a topic on which a great deal of fascinating research has been done, some of it by doctors. See, for example, the illuminating essays by J.B. Lyons in *Thrust Syphilis Down to Hell and Other Rejoyceana: Studies in the Borderlands of Literature and Medicine* (Dublin: The Glendale Press, 1988).

at unknown angles from the simple line of Time 533;

Ireland, 'After the Race', first published in *The Irish Homestead* on 17 December 1904. All these observations, however, imply a reactive model of the confrontation of literature and the newly technologised life. They suggest that the literary, as bearer of the values of an earlier age, rather resentfully incorporates the new machinery into its now archaic circuits. Instead, we need to begin the task of imagining how high modernism engaged dialectically with the new stage of the technical. As a contribution to such a project, I concentrate here on how human energy became a preoccupation of high modernist representation in the wake of such new technologies, and their attendant evocation of new energies in nature, as electricity.

The past 25 years have witnessed a new attention to the relationship between technology and high culture in the early twentieth century.[10] To the extent that this concerns energy, and specifically, the relation of technologised to human energy, it concerns the issue of movement, and thus the measurable rate of movement, i.e., speed. By speed I simply mean 'moving very fast'. To understand modernism's relation to technology we must grasp how the notion of 'the increased speed of everyday life', so much a commonplace of life in urban modernity that it is even invoked by Bloom himself, is to be thought of critically. Why should technology-saturated urban life be faster, and how might such speed manifest itself? In general, the narrative of a speeded up existence, when it is considered in any detail, is almost invariably cast in wholly negative, if not downright tragic terms. There have however been exceptions, both then and since. It was Aldous Huxley, for example, who, in a brilliant short essay,[11] observed that speed was the only truly new experience

10. Together with Kern's work, another source of inspiration for current efforts is Modris Ekstein, *Rites of Spring: The Great War and The Birth of the Modern Age* (Boston: Houghton Mifflin, 1989). Work on technology has been influencing criticism mostly of modernists other than Joyce. For example, see *Virginia Woolf in the Age of Mechanical Reproduction*, edited by Pamela Caughie (New York: Garland Publishing, 1999), and for a brilliant exploration of how the development of radio and the discovery of radium and radioactivity influenced the lyric and the modernist image, Daniel Tiffany, *Radio Corpse: Imagism and the Cryptaesthetic of Ezra Pound* (Cambridge, MA: Harvard University Press, 1999). Much of the best recent work in the field has been done in media studies, and is a result of the interest in digital studies. A key source text here is Friedrich Kittler, *Discourse Networks, 1800/1900* (Stanford: Stanford University Press, 1990).
11. Aldous Huxley, 'Wanted, A New Pleasure', in *Aldous Huxley: Complete Essays*, Vol. III, 1930-35, edited by R.S. Baker and James Sexton (Chicago: Ivan R. Dee, 2001), pp. 263–4.

invented by modernity. This is an audacious idea: that all the other pleasures proffered by new technologies were merely enhancements of experiences which had been enjoyed for much longer, but that here at last was an experience that was truly new.

Taking our lead from such groundbreaking works as Stephen Kern's *The Culture of Time and Space, 1880–1918*, we need a grammar of this new pleasure, the rhythm of its thrills, anxieties and excitements. The barrage of new speed inventions of the *fin-de-siecle* – the telephone, the airplane, the typewriter, the elevator, the pneumatic tire, the roller-coaster, the zipper, and mass electrification – fulfilled needs, awoke new sensations, incited actual, novel desires.[12] If life in the early twentieth century was indeed 'speeded up', one might assume that this new mode of living needed to be rendered pleasurable if people were to participate in it. To understand this pleasure, deterministic accounts of technology's impact will not suffice, just as describing how high art of the day reacted to the actual appearance of technologies in their texts will also only begin to explain the new technology's transformative power. At the moment when mass culture (as in the advertisement) decided that technological innovations could have a direct impact on human energy – to the extent that it could make one not just feel, but actually be, more alive – high culture too made a new investment in investigating the symptoms and rhythms of the body's energy. In other words, modernism subjected the human bodies of its characters to a much more invasive quasi-medical gaze. To understand the complexity of this quasi-medical examination, we will first explore how, in this period, a further narrative about the human body and its flows of its energy entered medical discourse, and soon, both high and popular culture: that surrounding the discovery of an exciting new apparent source of human energy, adrenaline. The new account of human energy in *Ulysses*, I want to claim, owes much to the old popular literature of ghosts and the new one of automatons, but even more to a new sub-medical one, of adrenaline.

12. For a work that attempts to tease out the philosophical and critical implications of these advances for modernism, see Sandford Kwinter, *Architectures of Time: Towards a Theory of the Event in Modernist Culture* (Cambridge, Mass.: MIT Press, 2001).

leaving Time to be the *real* term 534;

Adrenaline was discovered in 1900 by Jokichi Takamine, a Japanese scientist working in the US, who won final patents for his discovery in 1903.[13] The first structure determination of the enzyme molecule, and the first chemical synthesis of adrenaline came in 1904. At the time it was a popular medical sensation; the boxer gene Tunney was said to have it on hand at every fight. It is fascinating as a medical discovery, because, in the era of the new speed technologies and of electricity, it discerns within the human subject's body itself the source, as it were, of its energy: an in-body power surge. Adrenaline does exist, but one might posit that if it did not, it would nevertheless at that precise moment have needed to be invented; it's a centrepiece of the medical project – at the same time as the pop-cultural and high-cultural efforts – in these years to reconceptualise the human organism, and to rethink 'life' itself, as the capacity for energy, that is, for movement at speed.

To read the early accounts of adrenaline is to be struck, first, by the way in which this nebulous secretion is characterised as the bestowal on the organism of an instantaneous energy boost, an internal electric shock, and second, how this is instantly narrativised as the now-familiar story of 'fight or flight', that is, as a story of power contestation in a Darwinist, 'nature red in tooth and claw' frame. The first discursive strain–adrenaline as an in-body voltage (exhibited through a raising of the body's reaction speed-time) situates this secretion's effect at that borderland between the body's natural and inevitable functions and reflexes (for example, your heartbeat, your breath) and your conscious actions: the surge of adrenaline works as a kind of electric spark which crosses from the realm of the inevitable to the realm of the conscious, from embodiment as instinct to embodiment as consciousness and culture. How do you know that you have had a surge of adrenaline? Your heart pounds, your hands sweat, your senses become acutely aware and alert – and you instantly make a decision. This decision is then tabulated in the second discursive strain of the early accounts of adrenaline as the enforcer of a choice –

13. See K.K. Kawakami, *Jokichi Takamine: A Record of his American Achievements* (New York: William Edwin Rudge, 1928).

of fight or flight. This was very much a Baden Powell Boy Scout choice between courageous masculine bravado or cowardly running away. (R. Baden-Powell's *The Boy Scout Handbook* would be published in 1908[14]).

This brilliant, complex, but thoroughly culturally determined new account of the human subject's capacity for intense energy casts that energy as a correlative of exterior stress, and sees it not as the ability for sheer plod, as would have benefited the era when bodies mostly mattered for the energy of their physical labour alone, but as a heightened alertness, as the trigger of consciousness, and the necessity and the ability to make a decision. This implied a new theory of human energy for the clerk, the teacher, the typist – in short, for the new knowledge worker (even the advertisement canvasser): it told a tale of transmuting physical into mental energy. It saw energy as friction with the urban stressful world, a friction that had been described in such accounts as J. Beard's *American Nervousness*[15] of almost 20 years before, and which would receive its most complete treatment in Georg Simmel's classic essay 'Metropolis and Mental Life', of 1906.[16]

What does the medical accounting for the energetic powers of adrenaline have to do with the works of James Joyce? I suggest that this envisioning of life as the capacity for a certain dispersal of energy, coming at this historical moment, marks nothing less than a recasting of the very concept of the human, and that this recasting was further negotiated in the artistic complexities we have come to call 'modernism'. Joyce, I want to claim, was the first writer to discern and annotate, with scientific attentiveness (of the doctor he had thought of becoming but never became), the minutest calibrations of adrenaline-effects in his characters. In doing so he offers an extraordinarily supple and thorough analysis of the effects of the new era of technology, machines and speed on twentieth-century lives. And this analysis, note, is no mere celebration of the new definition of human energy as increased alertness; rather,

14. See R. Baden-Powell, *Scouting For Boys* (Oxford: Oxford University Press, 2004). Originally published 1908.
15. G.M. Beard, *American Nervousness, Its Causes and Consequences* (New York: G.P Putnam's Sons, 1881).
16. Georg Simmel, 'Metropolis and Mental Life', in *The Sociology of Georg Simmel* (New York: Free Press, 1950), pp. 409–24.

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it relishes speed's deployment as the uses of alertness, but it also formulates strategies of speed resistance. That is, countering the fast, the alert, it also celebrates the slow.

The figure of slowness in all Joyce's writing is *flanerie* – the compulsive walking of the character as pedestrian. I've just described how accounts of adrenaline transmuted the simpler notions of human energy as the capacity for labour – sheer plod – into a notion of such energy as an excited response to stress, demanding mindful decision. All Joyce's texts are lists of such latter kinds of moments of heightened adrenaline: *Ulysses* in particular, however, is a veritable *vade mecum* of intense moments of 'fight or flight'. Bloom, our hero, is awash in adrenaline, a barometer of the body's energy in its newest measurable form. But he is also extremely calm: and this is associated with the older kind of energy, the pedestrian's sheer plod. Pitting the old notion of energy as the use of one's muscles, as sheer plod, against the new adrenaline-age one of energy as stressed alertness, *Ulysses*, upon the grid of a timeline which, whatever its pretensions to echo the mythic time of the *Odyssey*, nevertheless hews carefully as well to the rushed scheduling necessities of modern Taylorist clock-time, can be read as a guide for human survival in a world of technologies which harness speed.

First, consider *flanerie* and slowness.[17] Begin with this simple observation: Bloom's day in *Ulysses* is uncharacteristic of a day nowadays as most of us experience it, in that there is seldom any hurry in it. Bloom, unlike many of us, is almost never rushed. There are exceptions: he rushes downstairs, for example, when Molly smells the kidney burning (*U* 4:380) – but even that was because he was dawdling over the unspoken presence of Boylan's letter, over *Ruby, Pride of the Ring*, Molly's underwear, and metempsychosis. Mostly, he is leisurely, and this leisureliness is measured in the rhythm of his footsteps, his *flanerie*. True, Bloom is impatient to get rid of McCoy because he wants to open Martha's letter, but even then he is soon diverted as he ogles the well-heeled woman climbing on to a cab on her way to Broadstone

17. It goes without saying that the seminal text here is Walter Benjamin, 'On Some Motifs in Baudelaire', in *Illuminations*, translated by Harry Zohn, edited by Hannah Arendt (New York: Schocken Books, 1969), pp. 155–200.

station (*U* 5:130). Earlier, in the same 'Calypso' episode, he had taken ample time to observe everything as he takes a shortcut (ostensibly to 'save time') through All Hallows Church. In 'Hades' we hear of the mourners, post-funeral, walking on the gravel path: 'They turned to the right, following their slow thoughts' (*U* 6:921). In 'Lestrygonians', Bloom lingers over a leisurely lunch. And so on through the novel.

Now, one can put this down to the possibility that Dublin in 1904 was a provincial or a colonial backwater; as such, Bloom's meandering *flanerie* becomes a kind of benign, sluggish counterpoint to the paralysis – the absolute lack of movement – that Joyce had professed to find in his native city and which he displayed profusely for all the world to see in *Dubliners*. Alternately, you might ascribe his slowness to Bloom's recalcitrant, measured, oblique and measured personality: here is a man, perhaps, who is clever enough to forego nervousness. Or you might explain it as the chief symptom of the waiting game that, after all, Bloom is playing all day: he is waiting out his own cuckolding, and Dublin becomes one great waiting room for him on 16 June. Or perhaps Bloom's unhurried progress simply matches the epic leisure of Odysseus's voyage. All of these ways of explaining the leisurely progress of Bloom have some possible truth; all no doubt contribute to the leisurely pace of the novel. Yet none proves *necessarily* true: that is, if the Bloom we encounter had turned out to be incessantly harried or nervous, one could as easily have advanced any of the above reasons to explain away that nervousness just as well. For example, a man waiting out his wife's escapade with another might be expected to let his anxiety express itself as heightened stress. Each of these explanations therefore can be turned back upon itself. Instead, all that can be said is that Bloom's *flanerie* is leisurely because *flanerie* is in itself leisurely; that is, it is an activity out of the era when the expenditure of human energy was thought of in pre-adrenaline terms.

Flanerie, that prototypical pedestrianism of almost every major character in every modernist text, is a pre-modernist, archaic remnant in the modernist novel: it marks the earlier era when the human body was thought of in terms of the body's capacity for repetitive labour. As such, for example, Bloom's *flanerie* is a tribute to

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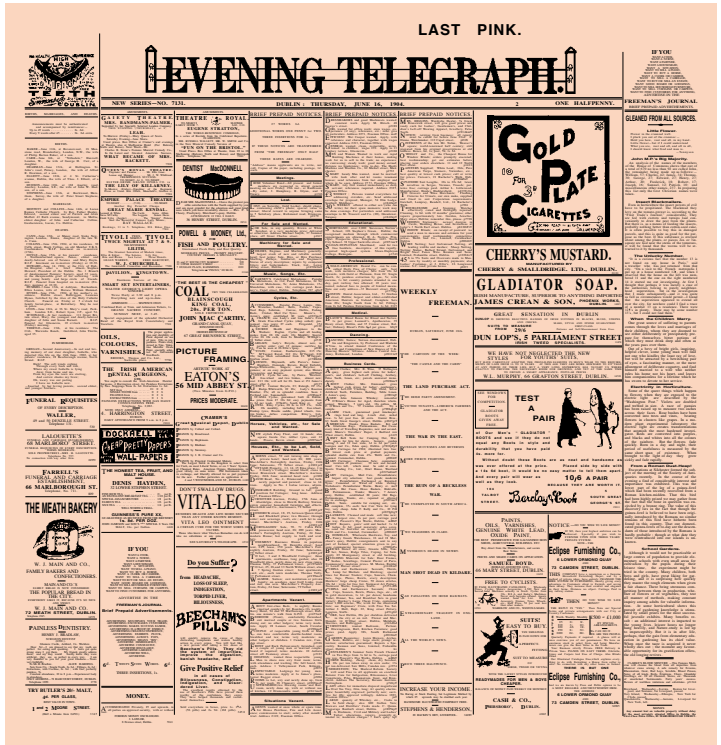
his father, who, selling door-to-door, had literally to walk for work. The H.E.L.Y.'S. sandwichmen suffer the same predicament. So does the worn-out prostitute of the 'Sirens' and 'Eumaeus' episodes. Note too that the novel's useful retrospection – written in 1914–21, set back in 1904 – may matter in this regard, for in 1904 Bloom still walks in order to work, whereas by 1917 or 1920 he might well have been able to sit in an office; only thrusting, up-to-the-minute businessmen like Boylan had an office telephone in 1904. (And, despite the telephone, the number of Boylan sightings in the novel suggests that he too walked quite a bit in the course of his work.)

But *flanerie* is necessarily leisurely in another important way too. For as walking for work disappeared, walking in cities, as Walter Benjamin makes clear, was turned into the leisure activity that would be the standard behaviour of the new activity of the consumption of commodities. Modern *flanerie*, Benjamin points out, was contemporaneous with the invention of the plate-glass window and its alluring display of commodities. Modernist *flanerie* is programmed for leisurely progress and contemplation in either of these guises. First, its rhythmic, repetitive expenditure comes from an earlier era, when the kind of energy that the labourer needed was stamina, a massive amount of which was implicitly displayed by Bloom in the novel, while second, its new role as designated 'leisure activity' – walking to shop, makes it an activity which must be enjoyed in order to ensure the survival of nothing less than capitalist consumption itself.

Is Bloom, then, walking for capitalism? While it is tempting to see Bloom's slowness and leisurely *flanerie* as a species of resistance, in literature, to the new speeded-up world of technologised velocities that were being put into effect as Joyce wrote his novel, such a reading might well be a romantic Luddism. For the fact is that slowness and speed are relative; they can be measured, and even sensed, only in relation to one another. Just as Bloom's progress seems leisurely to us because we are, relatively speaking, harried, and just as new speeds were only discernible as such when all else up to that point had been slower, so too, conversely, slowness itself was only discernible once everything else had been speeded up. Further, the social forces that created the culture of



LAST PINK.

EVENING TELEGRAPH.

NEW SERIES—NO. 7131. DUBLIN: THURSDAY, JUNE 16, 1904. 2 ONE HALFPENNY.

THE AMERICAN DOCTORS AND THEIR GOOD WORK.

VISIT THEM SOON IF YOU WANT A FREE TRIAL.

The American Doctors will soon have been in Dublin two years. No institution for the healing of the sick in Ireland can point to a record as great as theirs. There are literally hundreds of people in Dublin and elsewhere in Ireland who are to-day happy men and women, cured of chronic diseases that were believed to be incurable until they attended the institute, at 15 Kildare street. Electro-Vibration is certainly a blessing to humanity. Dublin Physicians, who have investigated, recognise that the American Doctors are accomplishing wonders, from the fact that their electric equipment is as near perfection as it is possible to attain, and everything new in Electrical Science that can better the physical condition of humanity is in constant use. The Methods and Electrical Equipment are their own inventions, and patented in all civilised lands.

WONDERS ARE DAILY PERFORMED.

The *Dublin Evening Telegraph* of 16 June 1904, electronic reprint, with the article about 'The American Doctors and their Good Work' in their offices at 15 Kildare St.

the
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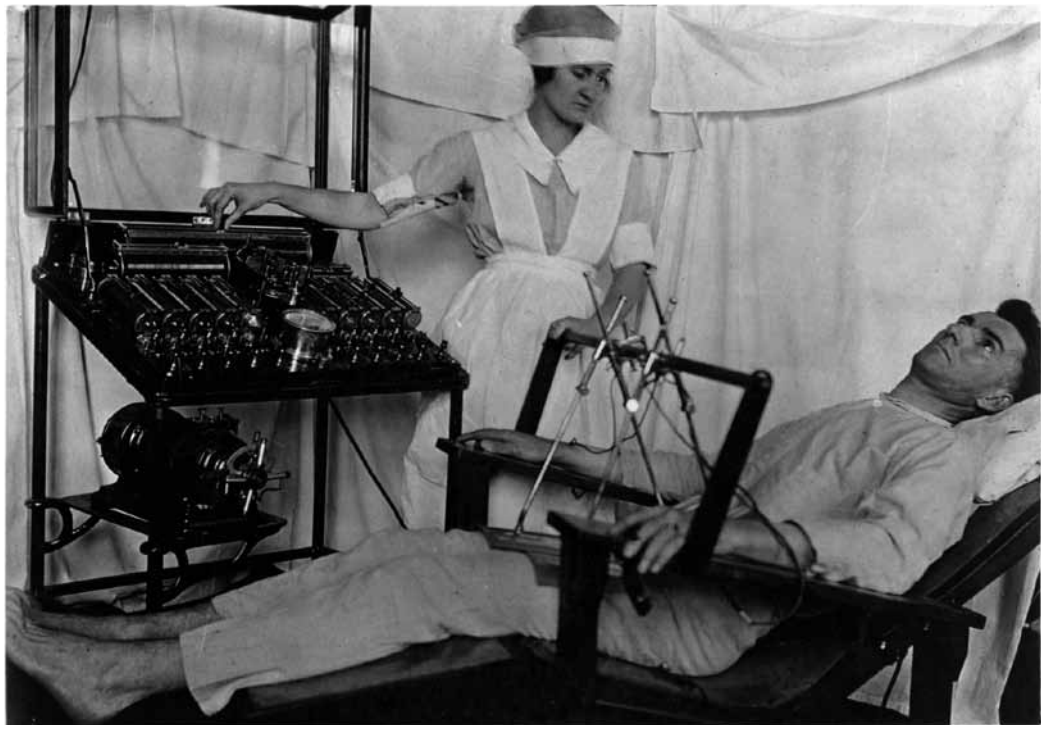
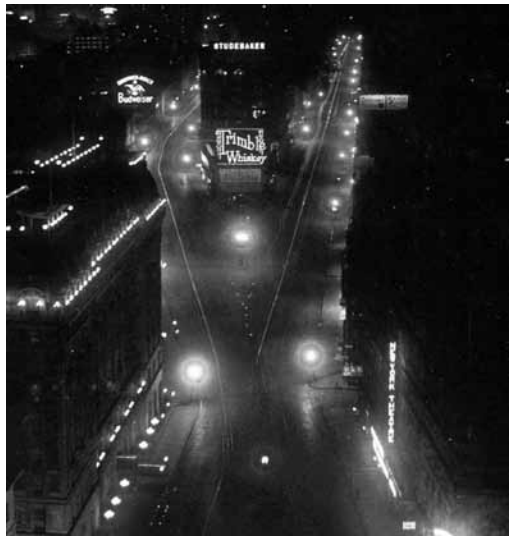
Joyce was the first writer to discern and annotate, with scientific attentiveness the minutest calibrations of adrenaline-effects in his characters.



Bergonic chair for giving general electric treatment for psychological effect, in psycho-neurotic cases. Around WWI.



View of the **electrification of Times Square**, New York in 1904. Unknown photographer.

Advertisement for Edwards No. 1 High Frequency and X-Ray Treatment Coil X-ray units, *You need this coil!*, 1911.

Heidelberg Alternating Current Electric Belt, as advertised in Sears, Roebuck & Co. mail-order catalogue, 1902.

schedules, new technologies and new speeds was fully capable of turning slowness, as well as speed enhanced in various ways, into a pleasure for its own ends, as it did in making walking and window-shopping the basis for leisured (not driven) consumerism.

Nevertheless it seems clear that *flanerie*, which is the dominant motif in almost every modernist masterpiece, from Eliot's *The Love Song of J. Alfred Prufrock*, to Woolf's *Mrs. Dalloway* to *Kafka's The Castle*, Musil's *The Man Without Qualities* and Mann's *Death in Venice*, is a deeply mysterious activity, however apparently mundane its appearance, whose performance in the modernist urban milieu of shocks, schedules, and abrupt breaks and speeds is ambivalent and worthy of much more critical scrutiny. Joyce's (and Bloom's) version of *flanerie* is a kind of resistance precisely because, unlike the vast majority of examples of *flanerie* in modernist texts, whose practitioners if not harried are at least anxiety-driven, that of *Ulysses* suggests a considerable contentment. Bloom takes a kind of unspoken pleasure in his walking that exists in stark contrast, for example, to the angst-ridden *flanerie* of Prufrock in Eliot's poem, or even to the sometimes pleasure-filled, but much more nervously ambivalent urban navigation of Mrs Dalloway. This ease in the Joycean text does not arise because Bloom is engaged in consumption. Bloom's purchases are all minor: the kidney, the lemon soap, the modest lunch and dinner, the pig's trotter, the cups of coffee. As he is a minor consumer, his *flanerie* seems to represent a faithfulness to an archaic order of energy deployment, and, as well, a refusal of the new behaviour in which human energy comes and goes as adrenaline.

In more conventional works where modernist anomie and angst strike the dominant notes, such as T.S. Eliot's *Prufrock*, the anomie represents itself as a grim awareness of the languor of the *flaneur* – in other words, it comes across to the reader as lassitude, which is experienced by the reader through the scrim of her own impatience. We are allowed to feel impatience at the slowness of the *flaneur*'s steps, in other words, as an index of the overall anomie felt by the character and transmitted by the poem. The perverse result of this is that the text, in its languorous anomie, acts as a perverse

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incitement to speed, as a way for the reader to escape the anomie exhibited in the poem. Bloom's unique acceptance of his rate of speed as *flaneur*, which is an index of the novel's equitable and comic spirit, is an exception to such depictions. *Ulysses* seems to offer a thoroughly unalienated sense of the joy of slowing and a delight in idleness thoroughly at odds with the modern demands of time management and the thrills of speed.

Which is not to say that Joyce does not make the new voltage of human energy known as adrenaline the central accounting of each character in *Ulysses*. On the contrary: if *flanerie* marks in its nonchalant steps the book's base rhythm, it is the somatic signifiers of shots of adrenaline that again and again mark the novel's cruxes and turns. What happens is that Bloom's leisurely wanderings are punctuated continuously by encounters, which as we now say, cause him acute stress. These encounters are annotated for us as readers – we who, through the stream-of-consciousness thread in the book, are privy to Bloom's viewpoint – in terms that mark the ebb and flow of his adrenaline and its effects. Here, I wish to make two more claims: whereas the slower flanerie is related almost wholly to the realm of work and the related sphere of public life, these adrenaline-releasing encounters have almost all to do with his private, personal and sexual life. They are, nevertheless, almost always staged in public spaces. And strikingly, whereas *flanerie* had to do with work or with consumerism, these encounters, cast within a newer, and more fluid order of energy expenditure, almost always involve a trivial object – usually a commodity or what might be called a near-commodity – which mediates the stressful encounter between Bloom and his interlocutors. This kind of stress, then, felt upon Bloom's body and annotated with an almost medical eye for the reading of very specific symptoms by the new kinds of narrative on display in the text, is the way in which adrenaline bursts as spells of heightened energy-expenditure are put show in the novel. Stress, not from the slowness of his *flanerie* but from the speed of his encounters with others, is what electrifies Bloom. It is at these encounter moments that he becomes like the electrified nymph: much more spirited, and also a kind of automaton – as we now say, 'on automatic pilot'.

Such encounters are the electrified transmitter points on the energy grid of the novel. Private life mostly in public places, sudden personal encounters, stress, and a trivial commodity mediating Bloom's adrenaline-driven response: the first of these moments in the novel might be the moment in the Blooms' bedroom when Bloom's nervous chatter with Molly is interrupted by her with news of the burning kidney – and he flees. Others often end set-piece scenes or close whole episodes: the clash of Bloom and Menton over the dinge in Menton's hat at the end of the 'Hades' episode, set in Glasnevin cemetery, the near-miss of Boylan by Bloom at the end of 'Lestrygonians', where Bloom frantically searches for his black potato fetish, the near-accident with the sand-spreader in 'Circe', when Bloom throws the pig's trotter to the dog. Adrenaline, never mentioned, flows: Bloom, deeply stressed, makes snap decisions – or flees to the safety of objects. In 'Lestrygonians', when Bloom sees Boylan approach, there is one of the prime examples:

> Mr. Bloom came into Kildare Street. First I must. Library.
>
> Straw hat in sunlight. Tan shoes. Turnedup trousers. It is. It is.
>
> His heart quopped softly. To the right. Museum.
>
> Goddesses. He swerved to the right.
>
> Is it? Almost certain. Won't look. Wine in my face. Why did I? Too heady. Yes, it is. The walk. Not see. Get on.
>
> Making for the museum gate with long windy steps he lifted his eyes. Handsome building. Sir Thomas Deane designed. Not following me.
>
> Didn't see me perhaps. Light in his eyes.
>
> The flutter of his breath came forth in short sighs. Quick. Cold statues: quiet there. Safe in a minute.
>
> No. Didn't see me. After two. Just at the gate.
>
> My heart! (*U* 8:1167–79)

Reaching the Museum gate, he searches frantically in his pocket, in time with his beating eyes and quopping heart:

as if it were time 602;

> I am looking for that. Yes, that. Try all pockets. Handker. Freeman. Where did I? Ah, yes. Trousers. Potato. Purse. Where?
>
> Hurry. Walk quietly. Moment more. My heart.
>
> His hand looking for the where did I put found in his hip pocket soap lotion have to call tepid paper stuck. Ah soap there I yes. Gate.
>
> Safe! (*U* 8:1188–93)

The language here is not 'stream-of-consciousness', rather, it may be described as jabs of consciousness issued at the rhythm of short, breathless, breaths. Neither is the language merely 'telegraphic', even if to cite its analogical relation to new forms of technologically enabled communication over long distances is to begin to trace the relation between these new technologies of speech empowerment and speech condensation during this exact period. Specifically, the language here reiteratively attends to the relation between somatic evidence of Blooms' adrenaline flow – 'His heart quopped softly', 'with long windy strides', 'moment more, my heart' – with the fresh-out-of-the-gate-of-consciousness notions that pop, adrenaline propelled, into Bloom's head: at one point he gets out the following, presumably a memory of a guide-book fact: 'Sir Thomas Deane was the Greek architecture'.[18]

The novel's language at this point, if it were reflective – if, that is, it matched the more stately rhythms of pedestrian *flanerie* – might (in a more conventional novel, or even one as unconventional as Woolf's *Mrs. Dalloway*) have addressed the key problem at that moment for Bloom's personal life, the fact that Boylan and Molly are to meet that afternoon. As Franco Moretti pointed out bluntly, the novel's central mystery may be why Bloom did not do something on this day about his rival.[19] At this moment of confrontation, however,

18. The incredibly nuanced quality of this report of Bloom's reaction to the sight of his nemesis strongly suggests the influence of Bergson on Joyce. See Henri Bergson, *Matter and Memory*, translated by N.M. Paul and W.S. Palmer (New York: Zone Books, 1988), originally published in French in 1896 and translated into English in 1908. Most important to this discussion is Chapter 1, 'On the Selection of Images for Conscious Presentation: What the Body Means and Does'.
19. See France Moretti, 'The Long Goodbye: Ulysses and the End of Liberal Capitalism', in *Signs Taken For Wonders* (London: Verso, rev. ed., 1988), pp. 182–208.

such resoluteness, which might have been induced by all the adrenaline pumping through Blooms' bloodstream, is instead replaced by a jumble of tourist-guidese. This is anti-inspiration by adrenaline. And it progresses from tourist-guide to the search for the potato fetish. The 'Where did I?' of the second quote refers to a shrivelled black potato, which Bloom associates with his mother and which he carries as a charm. In this mad search, the flailing of Bloom's arms from pocket to pocket is a physical dance propelled by adrenaline that is literally pre-conscious, and which rather belongs to a realm of instinctual bodily knowledge, operating beneath consciousness. It is jig-like: 'His hasty hand went quick into pocket, took out, read unfolded Agendath Nataim. Where did I? Busy looking. He thrust back quick Agendath…. I am looking' (*U* 8:1183–4).

Thus here, then, we have, first, a refusal to propel the plot forward in conventional terms – that is, Bloom does not confront, or in any sense enter into a confrontation with, Boylan. Second, we have an exploration of how the adrenaline-driven reaction makes the consciousness, to the extent that it is activated, cling merely to clichéd discourses stored on shreds of memory. Third, the account of the moment examines how the adrenaline-aroused subject rushes, more or less impulsively, to objects – fetish objects, in fact – as signs of safety. Here the potato is the fetish object, clutched by the hand sweaty from the adrenaline rush.

In rushing towards the statues of the plaster goddesses at this moment, and even by entering the museum, which is a store of objects, Bloom enacts the same object fascination as a cure for stress, which consumer culture still teaches each of us to do. In searching for the safety of all these objects, whether potato, statues or the museum's object hoard, Bloom, highly stressed, is fully obeying the imperatives of capitalist consumerism, in which, as Marx pointed out in his analysis of the commodity form and its powers of reification, the real relations between people will henceforth be mediated by relations to commodities, to things. This adrenaline textuality, therefore, hews to the logic of consumerism. Bloom, however, does not buy here; instead, he turns instinctively to the material world in search of fetishes more aura-laden and with a power to comfort greater

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than mere purchasable commodities. Still, the text, when it places the protocols of adrenaline-induced stress and the search for the comfort of objects in such near relation, implies that, for the would-be middle-class subject in this period, even in such impoverished colonial outposts or marginal first-world places as Dublin and Ireland, nothing less than an instinctual consumerism had been put in place as the sole antidote to stress.

In a short article the Italian philosopher Giorgio Agamben makes the following startling claim: 'By the end of the nineteenth century, the Western bourgeoisie had definitely lost their gestures'.[20] He goes on to describe the fascination with the spasmodic movement in their patients displayed by the French *fin-de-siecle* physicians Tourette and Charcot, explaining in detail Tourette's invention of a paper-roll measuring device to record the exact level of jerkiness in his patient's footsteps. *Ulysses*, as a precise measuring device of the vagaries and intensities of Bloom's *flanerie*, is an almost exact literary analogy of this footstep-measuring device of Gilles de la Tourette. Agamben goes on to characterise early, particularly silent, cinema as the pre-eminent artform where culture tried at once to reclaim its lost repertoire of gestures and to record this loss. Again, the suggestiveness of this for *Ulysses*, a vast record of human movement beginning with the relentless step after step of *flanerie*, is extraordinary. Yet the only rationale Agamben offers for his claim is his observation of all of the attentiveness shown to human movement at this precise moment, whether under the gaze of medicine, as with Tourette, or under the mechanical eyes of the new prostheses of seeing: Muybridge's motion studies, silent film.

Agamben suggests that what these turn-of-the-century acute observers saw was nothing less than the human gait in peril. Another way to view this, I propose, is to become aware that, at this moment in the history of modern culture, physical movement began to be discerned, with new kinds of attentiveness, as a profound index

20. See the essay by Giorgio Agamben, 'Notes on Gesture', in *Means Without Ends: Notes on Politics* (Minneapolis: University of Minnesota Press, 2000). It opens: 'By the end of the nineteenth century the Western bourgeoisie had definitely lost its gestures', and goes on to a discussion that ranges from the research of Gilles de la Tourette to the jerky, exaggerated movements of silent film. See especially pp. 51–2.

of human stress. What Agamben leaves unanswered is why this occurred, he does not discuss any but the most general sense of the social or cultural forces in whose context it developed or which may have given rise to it. This is the question to which a reading of *Ulysses* as movement text, as a book in which a huge repertoire of movements is delineated with almost scientific care, might offer an answer. Further, were the jerkiness and ataxia, the tics and dystonia, which fascinated Tourette, and which are replicated in the first silent films – 'this ballet of a humankind that has lost its gestures' – a symptom of a changed subjectivity, a change in the subject's relation to his or her body, and a change in the subject's relation to others? Was this a change simply in how bodies moved together or apart, whether in making love, in dance, in the traffic of the urban street? The discourse of newly invented adrenaline, and the observation of impassioned human movement under stress that went with it, attempted to narrativise some of the possibilities available at this crisis moment. What remains to be theorised is how changes in affect, response, and the possibilities of consciousness were generated, whence they came in fact, and the changes in culture, and in the socius, to which they gave rise. In this new bio-political archaeology, *Ulysses* is a starred exhibit: its adrenaline aesthetics beg to be inferred.

What Joyce achieves at the end of 'Lestrygonians' and a long series of similar, but always subtly different and thoroughly nuanced moments in the text is a comic sublimity salient to the moment of the discovery of adrenaline and the arrival of mass electrification: an annotation of the physical signs of stress and excitement, scientifically observed, with the intertwining of the pre-conscious more-or-less bodily pre-thoughts incited by those signs of stress. All this is done with a telegraphese whose speed matches the events described and whose elisions mark moments of pure adrenaline. All are key moments propelling the novel, and usually covert enactments of private trauma faced in the public sphere. Each is adrenaline-driven. Usually we imagine that new technologies and the cultural formations that go with them will devolve first onto wholly public life, while that of home, family, sex, will be dealt with under older, more archaic and, in this case, slower modes of representation. Joyce,

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revolutionary, turns this on its head: for the text's intimate encounters his language is based on the most advanced medical thinking of the day, on how the human organism subsists in the new speed era: he works out a literary counterpoint – that is, an aesthetics – to adrenaline, and even to electricity. He goes on to attend, in his account of Bloom's heightened nervousness, to the physical expenditure of Bloom's energy. Finally, he delineates the means by which the apparently instinctive behaviour induced by the adrenaline surge in fact gravitates towards a fascination with objects and a belief in their magic, which mimics the protocols of consumerist behaviour and desire.

So, back to the nymph, fetish object, voyeur, art in the era of mechanical reproduction, ghost or electrified automaton, who, eating electricity, flashes a sexuality that is android in its modernity. Joyce in the era of 'the increased velocity of modern life' represents not work but intimacy in speed-driven adrenaline-soaked, and electrified, terms. He does not necessarily endorse this accession to acute nervousness or acute energy: Boylan, the novel's blackguard, at whom we readers tend to snicker when Molly later asserts that he has less poetry than a cabbage, is 'Boylan with impatience', the novel's one real speed-king. ('"I'm off", said Boylan with impatience. He slid his chalice brisk away, grasped his change' (*U* 11: 426–7), as he takes off for this sexual rendezvous with Molly in Eccles St.) *Flanerie* in Bloom's case in particular marks an adherence to an older slower rhythm of energy expenditure. But *Ulysses* does not imply that speed, embodied in the human subject, is exciting. Bloom may or may not be a masochist, but he seeks out stress because the rush of adrenaline is another kind of pleasure. Joyce's adrenaline aesthetics brings the new world order of speed and energy technology and schedules, and even electricity, into the innermost intimacies of Bloom's life. It subjects even – or, above all – sexuality to a new modernist energised, even electrified, regime of space and time, and it extracts pleasure from it. Not love, not desire, but electric nymphs and adrenaline overdrive. In Bloom's own diagnosis, 'Moment more, my heart'.

Arrest and Movement[1]

three excerpts

Timothy Druckrey

1. The title *Arrest and Movement* is borrowed from T.S. Elliot's poem 'Burnt Norton' published in *The Four Quartets* (1943). It is also directly influenced by Henriette Antonia Groenewegen-Frankfort's book *Arrest and Movement: An Essay on Space and Time in the Representational Art of the Ancient Near East* (Cambridge, Mass.: Harvard University Press, 1987) [first published in 1951].

I

Image as time, time as image, time as memory, time as effect, time liberated from linear causality, time emptied of succession, time reconstituted, time as 'real', time as 'virtual', time compressed, intensive time… there is no doubt that the conceptualisation of temporality in the twentieth century was crumbling into forms only expressed by contingent means – the cut, montage, super-imposition, flash-back, non-linearity, special effects, dislocation, compression, multiplicity, reversibility, et cetera.

In this sense, spurred on by the collapse of the chronicity of time, by its radical conditionality, a revised theory of media temporality is necessary, one coincident with the development of communication, instantaneous exchange, or probability; *media time*, a time delineated by formulations unimagined by the dilettantes of merely digital cinema, the grandiose dabblers of crass immersions, the supercilious engineers of 'time-based' media as an end in itself. A theory of *media time* would refocus attention away from the nonsensical assumption that the objective of the media arts is merely to regenerate or reconstitute some variation on temporal representation enveloped in cinematic succession, scientific notions of evolving form, rendered visual processes, 'open-closure', or just plain old sensory overload.

Between the cinema and the moving image a difference is emerging that emphasises temporal formations, that challenges assumptions about the relationship between the photographic and the cinematic – but more as a discourse that interrogates feasible temporalities, ostensible temporalities, probable temporalities, indeterminate temporalities, combinatorial temporalities. This break from the cause and effect limitations of much cinema studies acknowledges the kind of temporal layering made possible not just as an after-effect of the digital, but of an investigation of the performative, ironic, situational, fugitive, contingent forms in which a link can be made between the image and its ability to express time itself not merely as an effect (as Mary Ann Doane argues in *The Emergence of Cinematic Time*, 2002), not merely as a framework, but as a full subject.

out into a timeless region 634;

A full assessment of the temporal trajectory of the image would necessitate a rethinking of the many histories of the pre-cinema, a rethinking of the origins and presumptions of photography, and an integrated analysis of the nineteenth century's 'frenzy' for both visibility and emerging temporal regimes enveloping and transforming modern experience. Suffice it to suggest that the rapid-fire image technologies of the day, the pre-cinema in the eighteenth century (that demonstrated conclusively that the trajectory of representational practices were time-based), photography in the nineteenth century (which triumphed over the instantaneous ocular trace with its optical substitute), and early cinema in the twentieth century (that temporalised both recording and reception), provided an accelerating correlate to cultures inebriated by temporality, mobility, and sciences exploding every convention of fixed, linear equilibrium. Time itself became the central code in a new chrono-scopic regime, the gaze and the clock, the shutter and the stop-watch linked in an attempt to penetrate the uncanny, imperceptible or contingent durations in everything from astrophysics to zoology.

In the essay, 'Chronocracy', Peter Weibel offered important comments on the political economy of time. Weibel's text occurred in conjunction with a lecture at the Dutch Electronic Art Festival in 2000, *Machine Times*.[2] In departures from his prepared text, Weibel pointedly identified the kinds of temporal reshuffling that figure so broadly in the media arts. Two examples were of particular relevance: Pierre Huyghe's installation *L' ellipse* (1998) and Sam Taylor-Wood's *Killing Time* (1994). Huyghe's *L' ellipse*, a three-screen projection, enacts a specific 'rupture' in cinema, the ellipse (the 'time' between cuts) by reconstituting 'lost time'. The centre screen is flanked by 'before' and 'after', and 'contains' the time suspended by them. More specifically the centre projection reinserts the specific ellipse in Wenders's film *Der Amerikanische Freund / American Friend* (1977) in which Bruno Ganz, twenty years older, completes the ellipse by precisely re-staging the duration and action eliminated from the film. Taylor-Wood's *Killing Time* (a four-screen projection)

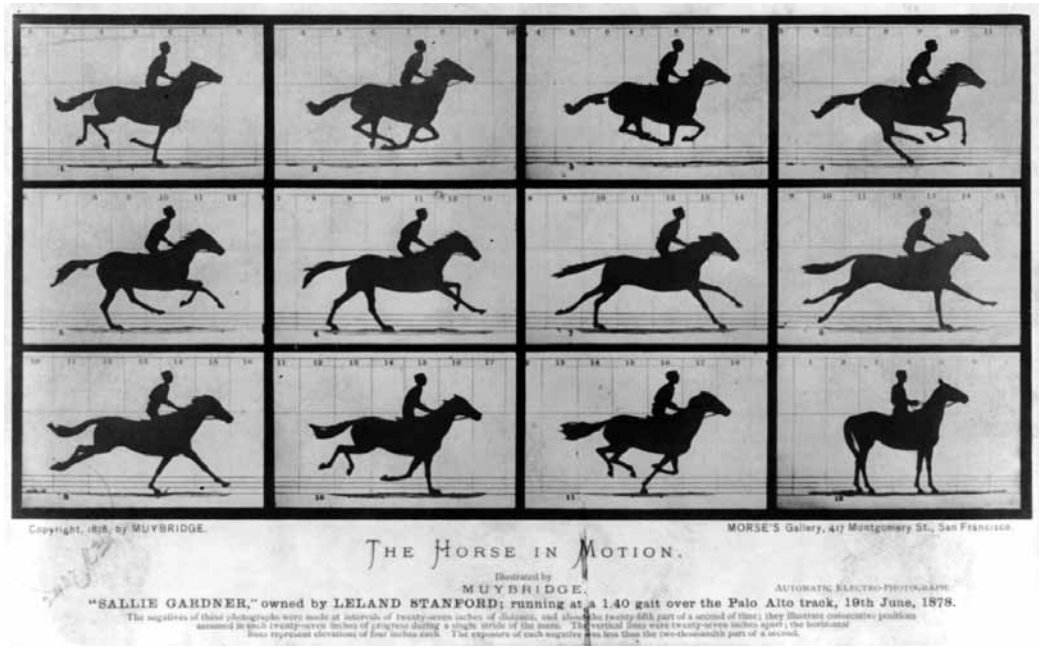
2. Peter Weibel, 'Chronocracy', in *Machine Times* (Rotterdam: NAi/V2_, 2000), pp. 150–77, p. 176.

is dramatised by an operatic soundtrack (Richard Strauss's *Elektra*). The four 'ordinary' characters, distracted and restless, inhabit nondescript domestic situations – yet intervene in an otherwise tedious flow by suddenly lip-synching to passages in the opera in an odd collision between the temporal expanse of the opera and the incidental drama of the unanticipated player privately staging a performance.

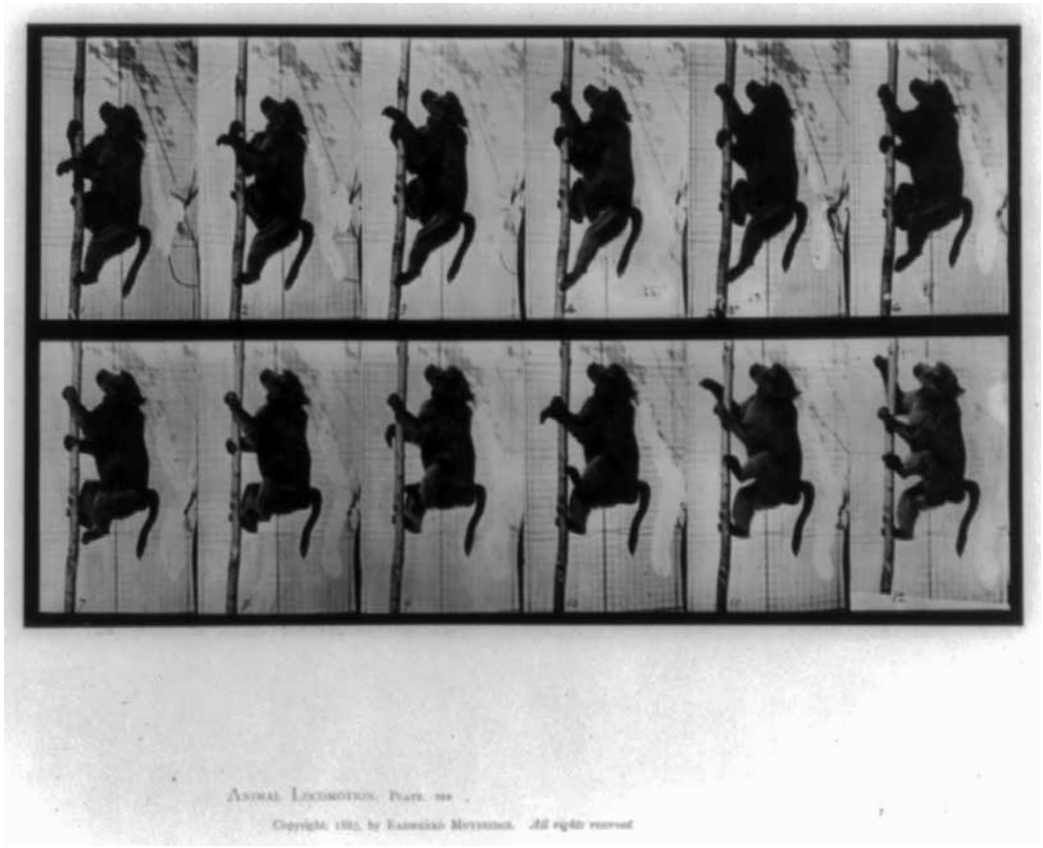
Weibel thus characterises 'elliptical time' as 'the basic structure of cinema' and outlined an economy of time that directly identified it as the 'abstract element' of the division between 'industrial' and 'personal' temporalities. The 'orchestration of time' was a reciprocal engagement with production and consumption.

II

It is important to acknowledge that the shift from analogue to digital technologies is playing a decisive role beyond the production, formulation, and distribution of images. It demands a rethinking of spectatorship and narrative formations beyond those invoked or constrained by adaptations of traditional cinema theory. For our purposes, the most significant shift lies within the implications of temporalities that are increasingly open-ended, contingent and perhaps unconditional – what might be called anti-chronological, or perhaps suspended chronologies, time that disappoints succession, time that is anti-illusionistic or that might be identified as temporal elision propagated within the framework of a differentiated chronotropic *dispositif*. In this sense the recurring theories of the apparatus remain static – lingering in material cause and effect models. This is evident even in Giorgio Agamben's argument in the essay, 'What is an Apparatus?', in which he continues to suggest that '[t]his is the reason why apparatuses must always imply a process of subjectification, that is to say, they must produce their subject'.[3] But the process of 'subjectification' is less the issue here than looking merely at the substantive conception of the apparatus (or at the histories of the ideology of the apparatus since Foucault). It is reconceptualising temporalities as constitutive frameworks not of the legitimating strategies of chronometrics, but of a kind of Deleuzian 'crystallisation' – however one in which the classical movement/time reciprocity is less relevant than formulations of temporal



Eadward Muybridge, *The Horse in motion*. Sallie Gardner, owned by Leland Stanford; running at a 1:40 gait over the Palo Alto track, 19 June 1878.



Eadward Muybridge, electro-photographic investigation showing a baboon climbing a pole. From *Animal Locomotion*, 1887.

Eadward Muybridge, Electro-photographic investigation showing a series of consecutive images of a woman carrying vessels up and down steps. From *Animal Locomotion*, 1887.

Shape of Films to Come, screen shot of CBS documentary of **EXPO 67.**

Philipp Lachenmann, still from *SHU*, 2002/2008.

these corridors
lead to other
times 636;

Feasible temporalities, ostensible temporalities, probable temporalities, indeterminate temporalities, combinatorial temporalities.

flow. This flow is expressed in elided, compressed, relativised, disintegrated, 'probabilised', indeterminate, subversive, unstable, asynchronous temporalities that are a mix of succession, reversibility and contiguity. What emerges in this temporal cut or interstice is not mere stasis but rather shattered narrativisations – like the 'blasted allegories' of post-modernism – whose drive is not towards fulfilment or resolution but towards more immediate and/or circumstantial consequences or *events*.

III

Flowing images, flowing information, flowing texts, information flows, economic flows, routes, signals, traces, porous borders, currents, boundaries – the metaphors for the current 'state' of the post-industrial, post-electronic, post-modern circuit we inhabit is enveloped in forms of contingency and mobility. Unremitting transience has substituted itself for stasis. Forms of representation undergo constant transformation to account for shifting conditions. This has become as increasingly true for economics as it has for the kind of instantaneous valuation of the crescendo of events that eclipse judgement as they disappear into the subliminal; memories that are barely formed. In order to grasp the situation, reflection now comes in the forms of interference, rupture, or cut – a chrono-interface. This comports with emerging notions that we are embedded in mental states of 'continuous partial attention' – interstices between perception and cognition, awareness and understanding, seeing and acting – Deleuze's 'chronic time', or what Virilio calls 'the dictatorship of the short-term, the tyranny of real-time',[4] a time emptied of its urgency – or perhaps representability!

Media-time is not apodictically bound to the stable, the fixed, or the certain. It is time that exceeds, extends, shatters normal perceptual limits, it is time freed of its parasitic dependence on the clock, time unburdened of its cinematic addiction.

3. Giorgio Agamben, *What is an Apparatus?* (Stanford: Stanford University Press, 2009), p. 11.
4. Paul Virilio, *Lost Dimension*, (New York: Semiotext(e)) 1991, p. 31

This text consists of three short excerpts from Timothy Druckrey's essay 'Arrest and Movement' which will be published in Rania Gaafar and Martin Schulz, eds., *Technology and Desire – The Transgressive Art of Moving Images* (Bristol & Chicago: Intellect Press, 2012). Excerpted with kind permission of the author and publisher.

Time's own praetorians 745;

Trapped in Time

Omar
Muñoz-Cremers

Opening up time

If it were possible for me to kill one of my own grandparents, would I continue to exist in my own time? Would it be a good idea to save millions of people by eliminating Hitler when he was a young man? How about travelling to the year 3014 to collect medication to treat cancer? What would actually happen if I met myself in the past? Besides telepathy, contact with extraterrestrial life, robotics, alternative histories and virtual reality, the notion of humans travelling through time is without a doubt one of *the* most prevalent thematic cornerstones in science fiction, if not the most popular topic of the genre. Why is this idea so popular? Science fiction is a genre that exists because of limitations: the boundaries of perception, knowledge and natural laws that define our existence. It attempts to transform, manipulate or breach the borders of the imagination, freeing it to soar above the restrictions of everyday life.

It is difficult to track and research, but it is quite possible that ideas and fantasies about time travel form an archetype that is possibly even related to shame, or result from analysing situations that people hoped might have turned out differently, if only they could go back in time; or, when it comes to the future, the fear of death and the idea that people can overcome it. As we will discover, time travel provides writers with a unique freedom, which in adventurous hands can provide a unique and pleasurable reading experience. In a way it as if this pleasure is doubled because reading (and watching a film) already is a cognitive journey through time. As Marcel Proust stated in *A la recherche du temps perdu* (*In Search of Lost Time*), literature is the only time machine that has proved effective thus far. The idea of time travel is also the area where science fiction shares the most common ground with classical philosophy. Even an uncomplicated explanation of the problem of time, or the slightest hint that it is susceptible to manipulation, triggers the question: What is reality? This is probably of little significance to most writers compared to the possibilities that time travel offers when it comes to being able to manipulate a particular component of reality, enabling writers to incorporate unpredictable twists and turns in a story.

displaced *along the time axis* 781;

Because we have identified time travel as a cornerstone of the genre it is impossible to provide a complete overview of all the different variations on time travel that science fiction has come up with in the last two centuries. My hypothesis is that time travel took off at the beginning of the twentieth century in parallel with Einstein's liberating discoveries, and blossomed in the 1960s and 70s, only to lose significance thereafter, despite populist interpretations in successful American films. After this, interest in time travel appeared to fade away; the way in which Stephen King's recently published book *11/22/63* was received as the (temporary) rediscovery of a supposedly lost art form reinforces this conclusion. Travelling through time has become retro, even though countless more stories about time travel will be written for consumers of the enduring stories written by formulaic writers, and popular children's and teenage books.

The birth of the machine

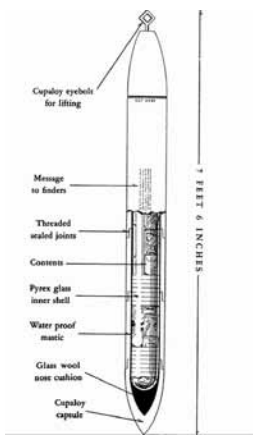
Inevitably, the name H.G. Wells looms large in any discussion of science fiction. Wells' fame as a science fiction pioneer is largely attributable to his 1895 novel *The Time Machine*. As so often happens, what we have come to regard as a seminal work was actually preceded by other, often forgotten, stories that deal with the same subject. Wells was certainly not the first person to write a story about time travel; indeed, *The Time Machine* is not even his first foray into the subject. But he probably was the first person to suggest that a machine could be used to travel through time. The idea of a time machine did not exist before this. Prior to *The Time Machine* a journey through time mostly came about by having the main character fall asleep and being mysteriously transported to another period in time. An alternative could be a blow to the head, as in Mark Twain's amusing story *A Connecticut Yankee in King Arthur's Court* (1889). This 'natural' way of travelling through time disappeared almost entirely after Wells' story was published. Olaf Stapledon's *Starmaker* (1937) is the only classical time travel tale that that has the narrator disappear into the future in this way, becoming a passive consciousness that will observe interplanetary evolution over billions of years.

There is a strange tradition in science fiction of criticising the style of each and every popular or progressive author. Wells himself rarely escaped this scrutiny. Nonetheless, there are very few books that conjure up such memorable, vivid and powerful images as *The Time Machine*. These are achieved through a strange sense of melancholy, both about the rise and collapse of the class struggle and the futility of life on earth, which becomes apparent as the protagonist continues to journey forward in time and witnesses the slow death of the sun. For a person like Wells with a mildly positive view of Socialism, the future as a destination was obvious at the end of the nineteenth century. Wells did not have to lose himself in the labyrinth of the past to present his core messages about decadence, degeneration and the ghastly consequences of the class struggle. When the main character finally visits the past at the end of the book he does not return. The narrator closes with a scenario in which the time traveller is lost in a prehistoric landscape, thereby subtly touching on one of the fears that is inherent to the phenomenon and which preys on every time traveller's mind: the impossibility of returning to his own time.

Love of paradoxes

The rise of science fiction as a self-assured literary genre – particularly in America under the inspiring leadership of John W. Campbell of the *Astounding Science Fiction* magazine (later *Analog Science Fact & Fiction*) – ignited a creative explosion that seemingly offered endless possibilities. Besides Isaac Asimov and Arthur C. Clarke, Robert A. Heinlein emerged in what would later be called the 'Golden Age of Science Fiction' as an innovator who introduced a certain degree of chaos to time travel. He investigated the possibility of time travel that resulted in paradoxes. His short story *By His Bootstraps* (1941) describes a situation where, by means of travelling through time, a loop comes into existence without having been created at any single identifiable point in time. Through the years this ontological paradox has become better known as the 'bootstrap paradox'.

This loop returns in a bizarre way in the later story *–All You Zombies–* (1958) in which Heinlein introduces another important innovation to the time travel narrative:



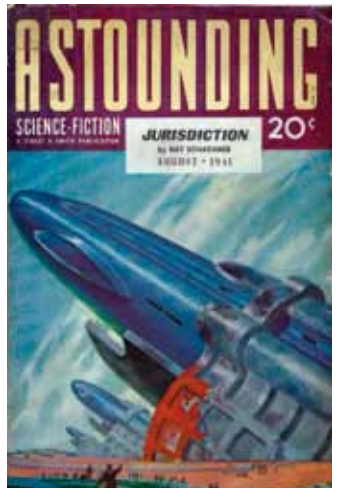
early epics of time-travel 1060;

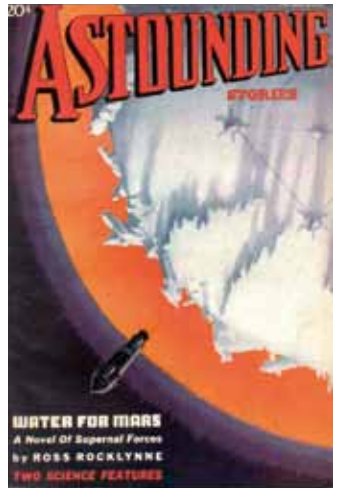
sex. In doing this he not only displayed a significant understanding of psychology, but came up with new scenarios that made time travel an even more perilous undertaking. *–All You Zombies–* is entertaining and well thought-out in the way in which the main character manages to arrange to be his own mother and his own father by travelling through time (the scenario that evidently always has to be adhered to). But at the same time it ends on a markedly sombre note, a shadow that falls over the psyche, a fatigue that brings with it doubts about the existence of others and of the prevailing reality itself. The psychology of time travel was announced.

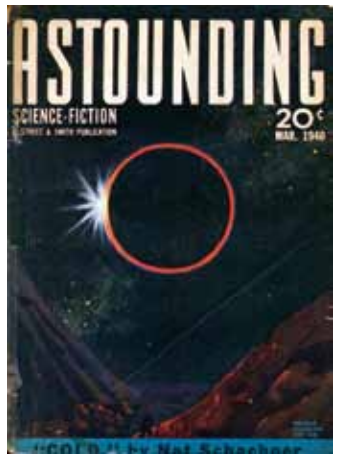
Madness and reality

Heinlein is an enigmatic figure; he is an ex-soldier with fascistic tendencies as well as an anti-racist libertarian whose ideas about free love as propagated in *Stranger in a Strange Land* (1961) met with a huge response in the 1960s. This is also the period in which time travel attained a previously unknown complexity – whether or not compounded by many authors' experiments with the then ubiquitous LSD – that made the elasticity of time directly tangible. Stories by Philip K. Dick, the reluctant science fiction hero of the drugs culture, rarely involve a time machine. Dick takes us into the uncertainty of consciousness, and thereby raises the obvious question: What is reality? Time travel in Dick's stories is the result of a psychological aberration or a side effect of drug use. *Now Wait For Last Year* (1966) introduces the drug JJ-189 that temporarily launches the user one year into the future. But nothing is simple in Dick's worlds: JJ-189 is poisonous and incredibly addictive. Confusion creeps in when his characters become permeable – in characteristic Dick fashion – and start losing their grip on reality (a grip they probably never really had). In essence Dick's stories contain no adventure, no curiosity that has to be satisfied with a flirtation with time. Individuals cannot control the shifts in time and they are always part of changing realities. Time travel is madness.

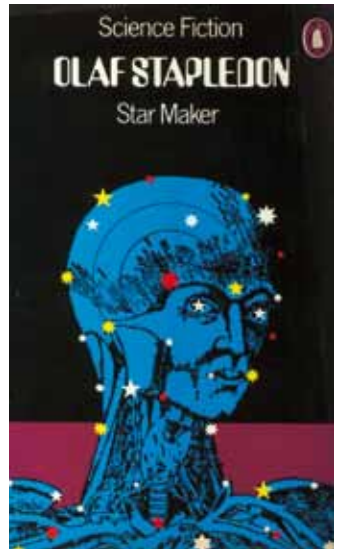
Dick's pessimism during the rise of the counterculture was adopted by a genre that only twenty years earlier had propagated technological advances that would inevitably result in advances for humankind. One would have

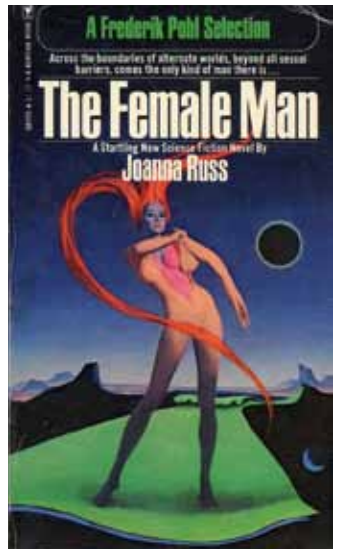


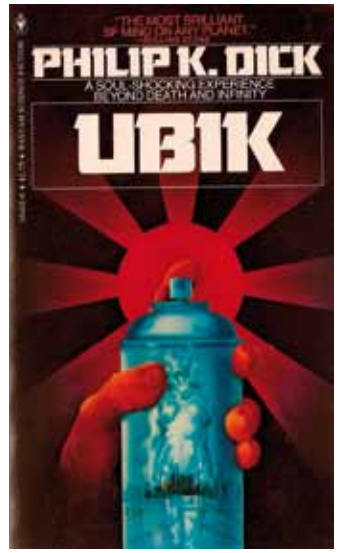


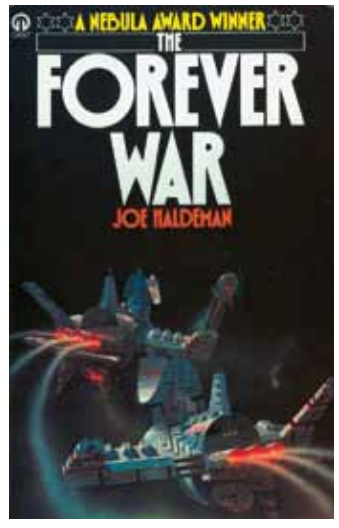


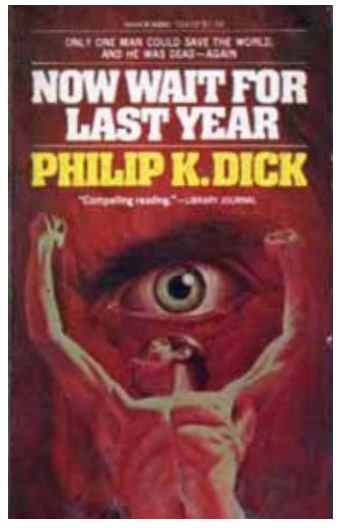
Selection of covers of *Astounding Science-Fiction*, later *Analog Science Fact & Fiction*.
Right (from left to right): Cover for the Penguin reprint of Olaf Stapledon, *Starmaker,* 1937. Joanna Russ, *The Female Man*, 1975. Philip K. Dick, *Ubik,* 1969. Joe Haldeman, *The Forever War*, 1974. Philip K. Dick, *Now Wait For Last Year*, 1966. Robert Silverberg, *Up The Line*, 1969. Film poster for Robert A. Heinlein, *Stranger in a Strange Land*, 1961. J.G. Ballard, *The Crystal World*, 1966. Cover for a pocket re-issue of H.G. Wells' *The Time Machine*, 1895.

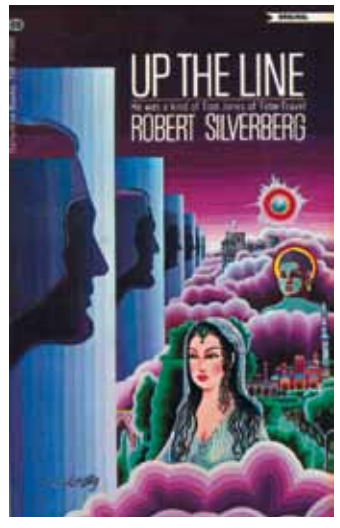


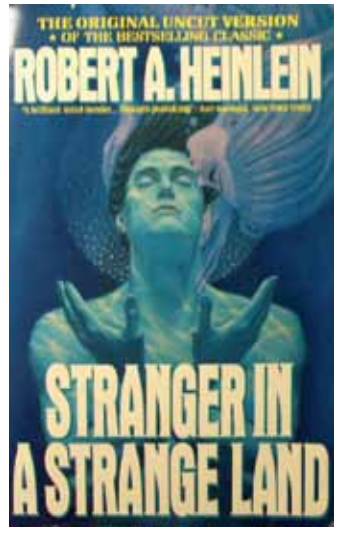


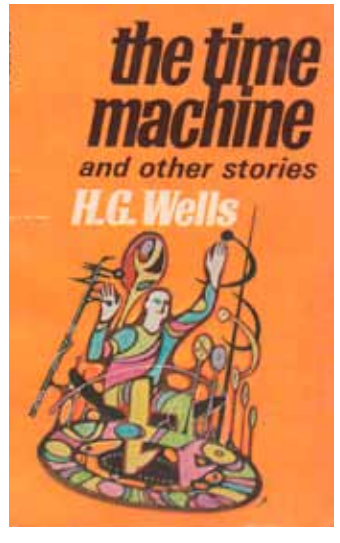












Selection of covers of *New Worlds Science Fiction*.

Even an uncomplicated explanation of the problem of time, or the slightest hint that it is susceptible to manipulation, triggers the question: What is reality?

one
compassionate
time-machine
story 1060;

thought that the counterculture would have embraced this positive outlook, but science fiction authors are sensitive (or perhaps attracted?) to the shady side of drugs, authoritarian violence and the associated setting up of the control society, preferably with the aid of Big Business and all manner of entertainment that imposes a new illusion on reality.

The best science fiction treatment of the Vietnam War, Joe Haldeman's *The Forever War* (1974), cleverly uses time travel to highlight the distance between soldiers and the home front. The book uses the scenario of an interplanetary war to ingeniously demonstrate the consequences of the theory of relativity. The time dilation that happens each time the units heading to the front make a leap at light speed means that they 'gain' increasingly more time in relation to the earth. During the story the earth becomes stranger and stranger for the veterans who initially were lauded as heroes but rapidly come to be viewed as misfits who no longer understand the daily life and social changes. The more tours of duty, the more archaic their speech sounds to new recruits. Estrangement has rarely been described so vividly.

A few years earlier Robert Silverberg, a master in honing popular science fiction themes with his characteristic blend of realistic humanity and humour, also explored the notion of time travel. *Up The Line* (1969) is for many reasons the ultimate time travel story. No other story is so open about the sexual prospects of travelling back to the past (early in the story the main character is told, 'You haven't lived until you've laid one of your own ancestors'), while simultaneously being incisive about practical problems involved in time travel. At first, Christ's crucifixion is only witnessed by a smattering of people, but the number of spectators grows into a large crowd, and the tourist guides keep a sharp eye on the other groups to see if other, co-existing versions of themselves are present in the same space and time. No other story derails time travel with paradoxes so bizarre they are impossible to unravel. After reading *Up The Line* it is obvious that time travel cannot be a rational pursuit, and that it inevitably ends in catastrophe because human cravings, coupled with boredom and stupidity, will never be able to cope with such radical technology.

time travel in the name of love 1060;

Time travel as the art of the soul

During the same period, a distinct form of science fiction developed in Europe with the English magazine *New Worlds* as the hub. Although New Worlds shared many themes in common with American science fiction, consistent with the ongoing trans-Atlantic exchange, and published works by adventurous young American authors such as Samuel R. Delany, Thomas Disch and Thomas Pynchon, European readers preferred a certain artistic sensibility that can be traced directly back to Surrealism. The British author J.G. Ballard played a pivotal role in establishing this relationship between Surrealism and science fiction. Not only did *New Worlds* publish most of his short stories, but he also wrote a number of essays about art and the potential of science fiction. The aesthetic line that Ballard sought to associate himself with runs roughly from Alfred Jarry's pseudo-scientific blueprint for a time machine in *Commentair pour servir à la construction pratique de la machine à explorer le temps* (1899) and Salvador Dali's melting clocks in *La persistencia de la memoria* (1931) to Alain Resnais' *L'Année dernière à Marienbad* (1961) and Chris Markers *La Jetée* (1962). In an article he wrote titled 'Which Way To Inner Space?' that was published in *New Worlds* in 1962, Ballard described the possibilities these examples offer for an alternative approach to time in science fiction: '…instead of treating time like a sort of glorified scenic railway, I'd like to see it used for what it is, one of the perspectives of the personality, and the elaboration of concepts such as the time zone, deep time and archaeopsychic time. I'd like to see more psycholiterary ideas, more metabiological and metachemical concepts, private time systems, synthetic psychologies and space times, more of the remote, sombre half worlds one glimpses in the paintings of schizophrenics; all in all a complete speculative poetry and fantasy of science.'

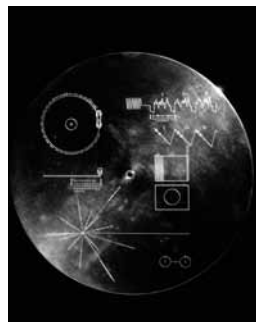
The exceptional film *La Jetée* forms a bridge between science fiction that makes use of time paradoxes (the main character sees himself dying as a child, precisely this powerful memory enables him, as an adult, to travel through time) and time travel that extends beyond the restraints of physics, a domain that is open to imagination, dreams, memories and the very real danger of madness.

Many of Ballard's works from the 1960s play out in this interwoven domain of the outer world and inner experience. A story like *The Crystal World* (1966, with a painting by Max Ernst on the cover of the first edition) serves as an arbitrary example. The strange crystallised jungle in the story forms the backdrop to a landscape outside of time; this is a place where time has definitely come to an end. The gradual process of crystallisation, which for much of the story is perceived as fascinating as well as threatening, is what provokes a characteristic 'unnatural' reaction from Ballard's characters near the end of the story: instead of fleeing, they embrace the uncertainty associated with a new phenomenon, seduced by the promises of transformation.

Lost for ever

Ballard's style was so distinctive that his influence in this area of science fiction has remained limited. Instead it is his ethos of innovation that earned him – even for new generations – the status of a permanent outsider. This meant that *New Worlds* became a magazine where authors could publish stories that were elsewhere regarded as too difficult or too avant-garde. In hindsight, much of the experimental science fiction from that period was related to this magazine, but a great deal of it did not survive as long as was expected. It served as a creative catalyser that kick-started many an author's career and would have a long-lasting influence. (The cyberpunk of the 1980s was in many ways a logical continuation.) Science fiction slowly changed during the 1970s. The oil crisis and the scaling back of space exploration undoubtedly had a restraining influence on the technological predictions that people had made until then. Many of the far-reaching innovations, including time travel, must have seemed less plausible because of this.

Moreover, the wider public was beginning to get to grips with the mysteries of quantum mechanics. The resulting theories of parallel universes, based on the work of the American physicist Hugh Everett, essentially heralded the end of time travel as a literary theme. In these theories, reality branches off into countless worlds instead of forming a continuous timeline. The consequences for time travel literature were disastrous. In this cosmology,



the terrible flood of time 1060;

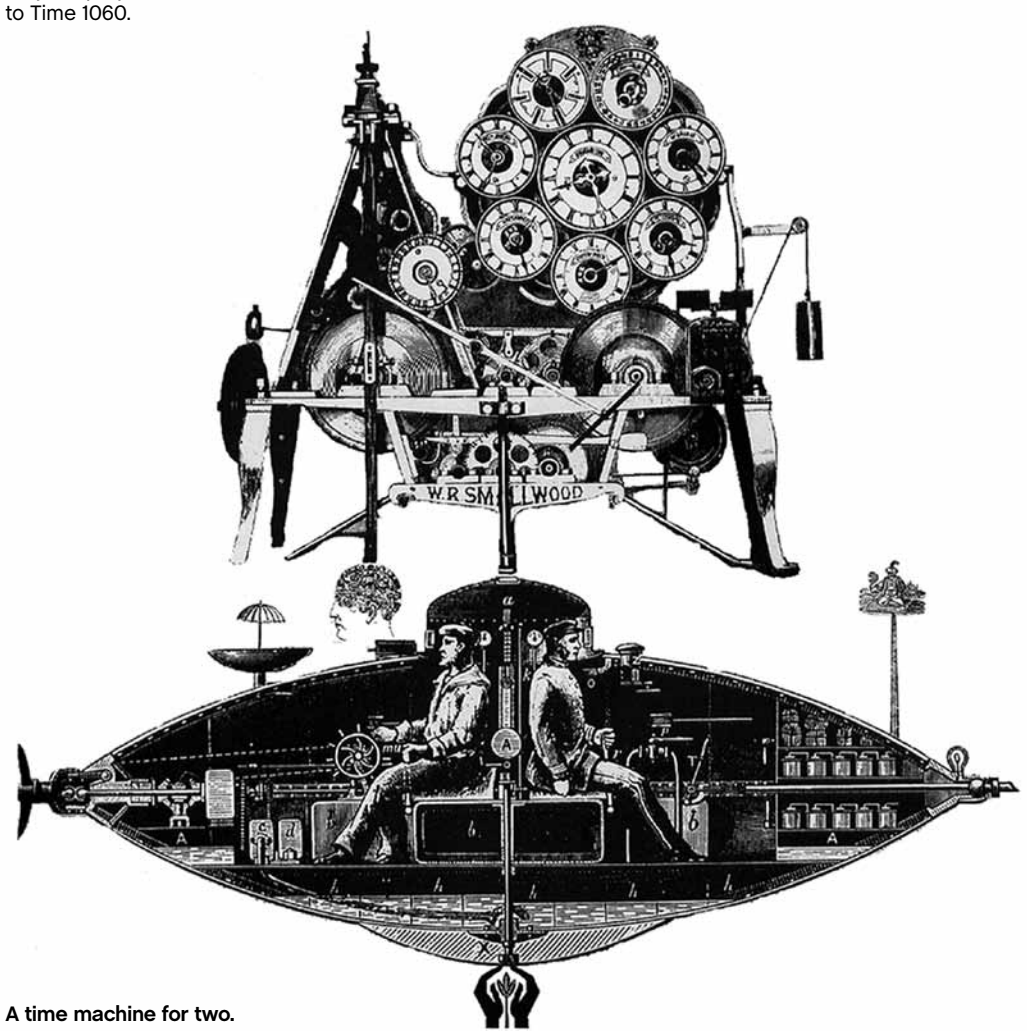
every journey through time would cause a split in reality and create a new and unique universe (that cannot communicate with any other universe). This meant that paradoxes fell out of favour, because no changes can be made to a past (or future) that could have an influence on the 'original' present from which they departed. Time travel was reduced to wandering through an infinite multi-verse from which a return is impossible. Time tourists will never exist.

Back to the future

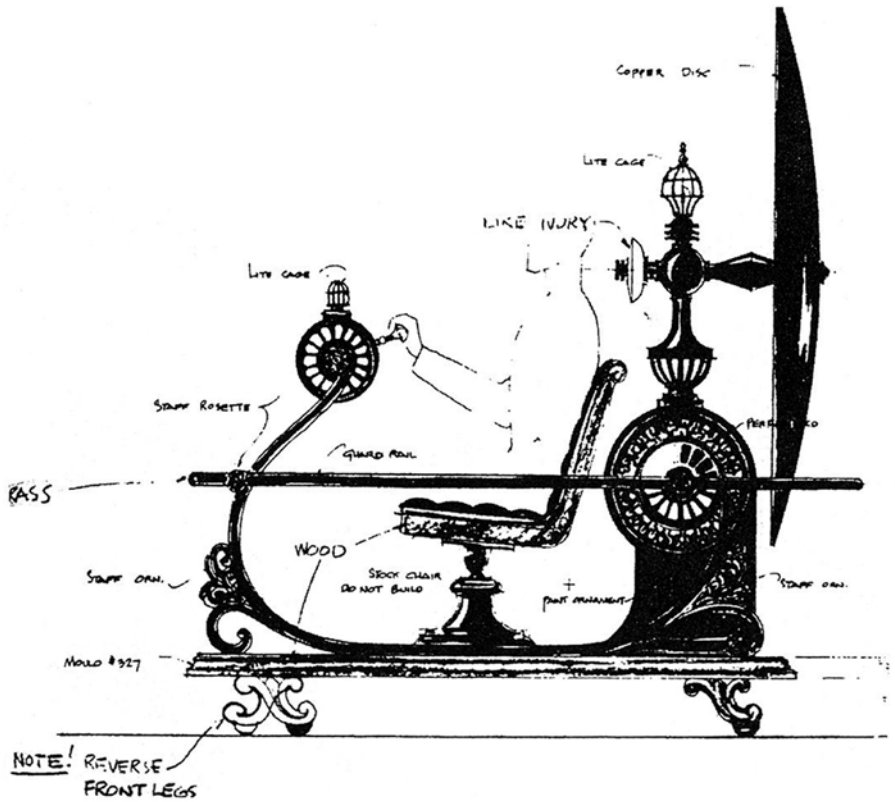
Science fiction could react in two ways to these breathtaking insights produced by the theory of parallel universes. The first could be to freely interpret them by incorporating the notion of parallel universes, but allowing communication between them. *The Female Man* (1975) by Joanna Russ is an elegant example of this because of the way in which four women from four different times and realities are brought together. A second approach could be to ignore their existence entirely. The power of paradoxes and the single timeline had become a powerful plot device that was difficult to abandon. As so often happens, science fiction themes or genres that have lost their literary power are given a second life in Hollywood and it is there, strangely enough, that they frequently take their most iconic form. *Terminator* (1984) used classical paradoxes: the rebel leader from a future human-machine war sends a colleague back to the past to protect his mother from a robot that has also been sent backwards in time to kill her before she can give birth. In the future, this guardian falls in love with the woman who will become the rebel leader's biological father, and parts of the defeated robot would set in motion technological advances that would trigger the nuclear war that caused the human-machine war. *Back To The Future* (1985) is an equally effective but much more humorous film portraying the problems a time traveller can cause for himself if he changes things in the past that are related to his parents, and could obliterate his own existence in the present. This is visualised beautifully by a family photograph that he has taken with him to the past in which the main character slowly fades as his own birth become less and less likely.

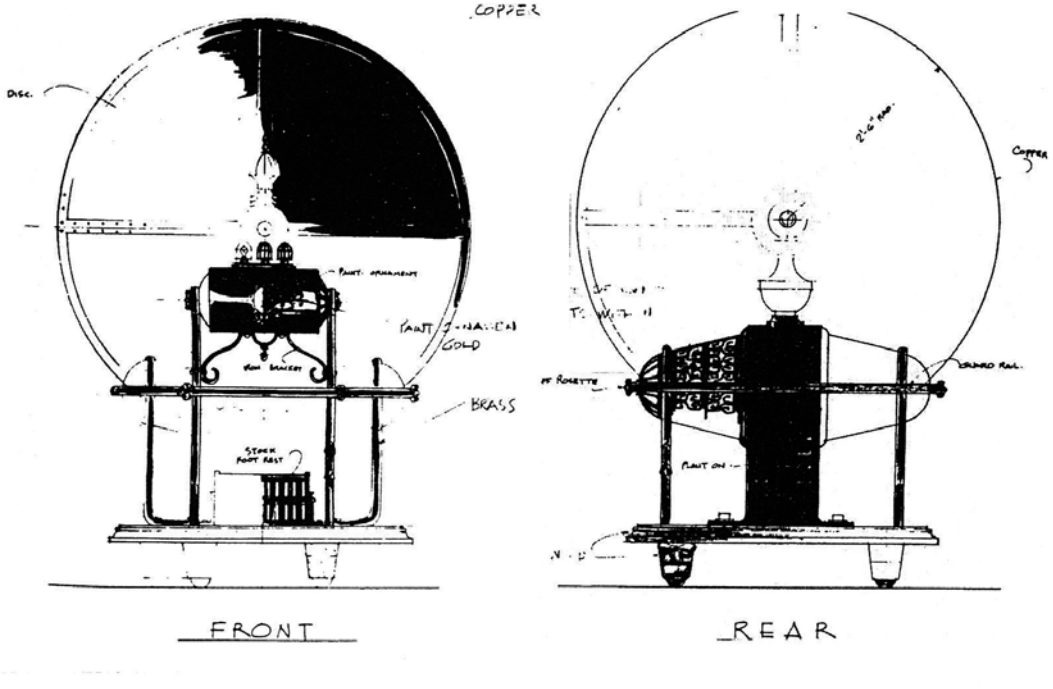
Ultimately the films mentioned above are blind alleys, exercises in old magic. Travelling *through* time seems to have been permanently replaced by the 'alternative history' genre that requires no scientific basis whatsoever. These 'alternative history' films are thought experiments that only require changing a pivotal historical moment. On a basic level this indicates a fundamental shift that has gained ground, especially in recent decades: the fading away of an idea of the future, combined with an increasing obsession with carefully selected episodes from the past. It is unusual in current popular science fiction to project events more than forty years into the future, something that was, for example, still widely done in 1970. Undoubtedly this is influenced by a subconscious pessimism or guilt that limits our ability to conceive of a non-catastrophic future, and imagining an original, functioning future apparently requires too much creativity. Should we look to the pure sciences for a glimmer of hope? Recent theories about neutrinos that can travel faster than the speed of light are not only a scientific puzzle with potentially far-reaching consequences; the also appeal to the suppressed imagination that yearns for the collapse of a paradigm, after which it is free to travel to unknown dimensions, experience them with new perceptions and once again become trapped in time.

they fell prey to Time 1060.



A time machine for two.





Original blueprints from 1959 by William Ferrari for the design of the time machine used in the 1960 film adaption of H.G. Wells' *Time Machine*, first published by David Hutchison in *Special Effects Photo Guidebook*, vol. 2 (1980).

How to Construct a Time Machine excerpt
Dr Faustroll (Alfred Jarry)

Functioning of the Machine

By gyrostatic action, the Machine is *transparent to successive intervals of time*. It does not endure or 'continue to be', but rather conserves its contents outside of Time, sheltered from all phenomena. If the Machine oscillates in Space, or even if the Explorer is upside down, he still sees distant objects normally and constantly in the same position, for since everything nearby is transparent, he has no point of reference.

Since he experiences no duration, no time elapses during a voyage no matter how long it is, *even if he has made a stop outside the Machine*. We have said that he does not undergo the passage of time except in the sense of friction or viscosity, an interval practically equivalent to that he would have passed through without ever entering the Machine.

Once set in motion, the Machine always moves toward the future. The Future is the normal succession of events; an apple is on the tree; it will fall. The Past is the inverse order: the apple falls — from the tree. The Present is non-existent, a tiny fraction of a phenomenon, smaller than an atom. The physical size of an atom is known to be 1.5×10^{-8} centimeters in diameter. No one has yet measured the fraction of a solar second that is equal to the Present.

Just as in Space a moving body must be smaller than its containing medium, the Machine, in order to move in duration, must be shorter in duration than Time, its containing medium — that is, it must be more immobile in the succession of events.

Now the Machine's immobility in Time is directly proportional to the rate of rotation of its gyrostats in Space. If t stands for the future, the speed in space or the slowness of duration necessary to explore the future will have to be a temporal quantity, V, such that

$$V < t$$

Whenever V approaches 0, the Machine veers back to the Present.
Movement into the Past consists in the perception of the reversibility of phenomena. One sees the apple bounce back up onto the tree, the dead man come to life, and the shot re-enter the cannon. This visual aspect of succession is well known to be theoretically obtainable by outdistancing light waves and then continuing to travel at a constant speed equal to that of light. The Machine, by contrast, transports the explorer through actual duration and not in search of images preserved in Space. He has only to accelerate to a point where the speed indicator (recall that the speed of the gyrostats and the slowness in duration of the Machine, that is the speed of events in the opposite direction, are synonymous) shows

$$V < -t$$

And he will continue with a rate of uniform acceleration that can be controlled almost according to Newton's formula for gravitation. For a past anterior to –t may be indicated by –t, and to reach it he must obtain on the dial a reading equivalent to

$$V < (< -t)$$

Excerpt from Alfred Jarry, *How to Construct a Time Machine*, translated by Roger Shattuck, with kind permission of Methuen Publishers, London. Originally published in French as 'Commentair pour servir à la construction pratique de la machine à explorer le temps', by Dr Faustroll, in *Mercure de France*–II–1899, pp. 387–96.

Biographies

Arie Altena (NL) co-curates the Sonic Acts Festival. He studied Literary Theory, also works for V2_Institute for Unstable Media, and writes on the intersections between new media, art, music, literature and technology.

For the past few years **Gilles Aubry** (CH) has mainly worked on sound installations and live performances, often using field recordings. His work is informed by a cultural, critical and ethnographic interest, as well as by formal experiment.

Nick Cain (UK) lives in London and contributes regularly to *The Wire*. His blog is theanswerisprobablyno.wordpress.com.

Bill Dietz (US) is a composer. Much of his recent work addresses the performance of listening and the genealogy of the concert. He studied composition and cultural studies and has lived and worked in Berlin since 2003, initially as Peter Ablinger's student and assistant. Subsequent collaborations include working with Christian von Borries and Chris Newman, and with Maryanne Amacher until 2009. He is the artistic director of Ensemble Zwischentöne. Along with Seth Josel and Chris Newman, he is MISS MOTH.

Timothy Druckrey (US) is Director of the Graduate Photographic and Electronic Media programme at the Maryland Institute, College of Art. He also works as a curator, writer and editor. He lectures internationally about the social impact of photography, electronic media, the transformation of representation, and communication in interactive and networked environments.

Enda Duffy (IE) is a Professor in the English Department at the University of California, Santa Barbara. He received his Ph.D. from Harvard University in 1990, and his central interests include post-colonial literature and cultures, modernism and postmodernism, Irish literature, cultural studies, and James Joyce. He is the author of *The Subaltern Ulysses* (1994), and of articles on post-colonial and modernist writing. His *Speed Handbook* (2009) explores how new concepts of space and technologies of speed have functioned geopolitically. It argues that access to intense new speeds for masses of people, with the arrival of the automobile and its instant acceptance, is a crucial sign of a new level of intensity that was offered to people in modernity. Speed revolutionised people's sense of space and territory. He is working on a history of energy and human stress.

George Dyson (US/CA) is a historian and a philosopher of science and the future. The son of physicist Freeman Dyson, George grew up in one of the most fervid hotbeds of scientific research in the Atomic Age. He spent his early adulthood living in a tree house, and designing and building Aleutian kayaks (chronicled in his book *Baidarka: The Kayak*, 1986). His 1997 book *Darwin Among the Machines* made a case for the Internet as a growing organism, an evolving life force. In 2002, he published a story from his extraordinary childhood, *Project Orion: The Atomic Spaceship 1957–1965*, about the drive to build a nuclear-powered rocket aimed at Saturn. His forthcoming book *Turing's Cathedral: The Origins of the Digital Universe* is the fruit of years of research into the history and future of computing.

David Edgerton (UK) is the founding director of the Centre for the History of Science, Technology and Medicine at the University of Manchester, where he is now Hans Rausing Professor. One of Britain's leading historians, Edgerton has published a number of works over 20 years, which challenge conventional analyses of science and technology. Significant publications are *Warfare State: Britain 1920–1970* (2005) and *The Shock of the Old: Technology and Global History Since 1900* (2006). He has written for such publications as *Prospect*, the *London Review of Books*, *Nature*, *Times Higher Education Supplement* and *The Guardian*, and has often appeared on television and radio.

Mark Fell (UK) is a multidisciplinary artist who, after studying experimental film and video art, reverted to earlier interests in computational technology, music and synthetic sound. His works *Multistablity* (2010) and *UL8* (2009) explore a number of unfamiliar timing and tuning systems. He has a particular interest in the relationship between music, sound, time, perception and cognition, which he explores in recorded works and gallery installations, often using multispatial speaker technologies, generative systems, geometry and light. His work in this area is characterised by 'non-illusion based' approaches to record production and surround-sound environments.

Robin Hayward (UK), tuba player and composer, has redefined the tuba's potential in the areas of noise and microtonality. His compositions for other instruments reflect a similar experimental, medium-specific approach. Composers such as Alvin Lucier and Christian Wolff have written pieces for him. His approach to the tuba has been documented on the solo CDs *Valve Division* (2006) and *States of Rushing* (2009), along with various collaborative releases. Active in many contemporary music ensembles including Phosphor and Kammerensemble Neue Musik Berlin, in 2005 he founded Zinc & Copper Works for continued research into brass instruments.

Catherine Christer Hennix (US/SE) is a composer, philosopher, mathematician and visual artist. In the 1960s and 1970s she worked with illustrious figures such as La Monte Young and Pandit Pran Nath who were very important for her own work. She has also frequently collaborated with the American anti-art philosopher, composer and violinist Henry Flynt, and drew inspiration from Japanese Gagaku music and the early vocal music of Perotinus and Leoninus. She was affiliated with MIT's AI Lab in the late 1970s, working with Marvin Minsky, and with the Institute for Language, Logic and Information of the University of Amsterdam. All her major compositions, including *The Electric Harpsichord*, (1976, re-released on CD by Die Schachtel in 2010) are regarded as part of an ongoing, endless cycle. She lives in Berlin, where after a long hiatus she has recently started to perform in public again.

Alfred Jarry (FR, 1873–1907) is the inventor of Pataphysics, and the author of such ground-breaking works as *Ubu Roi* (1896), *Le Surmâle* (1901), and *Gestes et opinions du docteur Faustroll, pataphysicien* (1898/1911), (*Exploits and Opinions of Dr. Faustroll, pataphysician*). He was also obsessed with his bicycle – a very expensive Clement Luxe 96 track bike that he rode everywhere. Bicycles, according to Jarry, allowed mankind to outstrip the process of biological evolution.

As a trombonist **Hilary Jeffery** (UK), plays in many different ensembles, ranging from Catherine Christer Hennix' Chora(s)san Time-Court Mirage and Zeitkratzer to the Kilimanjaro Darkjazz Ensemble. He works in and in-between the fields of improvised, electronic and contemporary composed music.

Omar Muñoz-Cremers (NL) is a science fiction author and essay writer who is interested in technology, literature, fashion, music, film and art.

Composer, performer and humanitarian **Pauline Oliveros** (US) is an important pioneer in American Music – and electronic music. She has explored sound for five decades, breaking new ground for herself and others. Through Deep Listening Pieces and earlier Sonic Meditations, Oliveros introduced the idea of incorporating all environmental sounds into musical performance. She has created a body of work – using improvisation, electronic music, ritual, teaching and meditation – with such breadth of vision that it profoundly affects those who experience it. Music critic John Rockwell wrote: 'On some level, music, sound, consciousness and religion are all one, and she would seem to be very close to that level.' In performance Oliveros plays an accordion, which has been re-tuned to two different systems of just intonation, and uses electronics to alter the sound of the accordion and explore the individual characteristics of each space she performs in.

Thomas Patteson (US) is a writer, musician, and educator whose work centres on music, technology, and twentieth-century aesthetics. He is writing a dissertation on experimental sound technologies in Germany during the Weimar Republic. His projects include the music blog *Acousmata* and the event series Experimental Culture.

Joel Ryan (US) is a composer, inventor and scientist. He is a pioneer in the design of musical instruments based on real-time digital signal processing. He currently works at STEIM in Amsterdam, tours with the Frankfurt Ballet, and is a teacher at the Institute of Sonology in The Hague. Starting from a scientific rather than a musical education, he moved into music by degrees

from physics via philosophy. Ryan seeks to bring concreteness to digital electronic media through the intelligent touch of the performer.

Hillel Schwartz (US) is a poet, translator, public arts consultant, and cultural historian. His 1000-page *Making Noise. From Babel to the Big Bang and Beyond* was published by Zone Books and is distributed by MIT Press (2011). He also is the author of *The Culture of the Copy: Striking Likenesses, Unreasonable Facsimiles* (1998).

Keith Fullerton Whitman (US) is a composer/performer *obsessed* with electronic music, from its mid-twentieth-century origins in Europe through its contemporary worldwide incarnation as digital music. He is currently working towards implementing a complete system for live performance of improvised electronic music that incorporates elements from nearly every era: a reel-to-reel tape machine, a selection of small 'jerry-rigged'/'circuit-bent' battery-powered sound-producing boxes, an analogue modular synthesiser, an early 'consumer' home-computer, and at the core, a contemporary computer running a custom-built Max/MSP-based modular system that controls these elements and acts as a central conduit into which their sounds are captured/collected, processed, then diffused to up to eight separate channels/speakers/amplifiers. He is also, at present, composing an as-yet untitled piece for the Egyptian *oud*, Serge and Doepfer Analog Modular Synthesisers, and computer control/processing. It is his first through-composed long-form work. He has been known to dabble in 'virtuoso dance music' under many stage names/pseudonyms, most notably Hrvatski.

Siegfried Zielinski (DE) holds the chair of Media Theory – with a focus on Archaeology and Variantology of Media – at the Institute for Time Based Media at the Berlin University of Arts. He co-edited the five-volume book series V*ariantology – Deep Time Relations of Arts, Sciences and Technologies.* His most recent monograph in English is *Deep Time of the Media – Towards an Archaeology of Hearing and Seeing by Technical Means* (2006).

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