A Different Engine

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ABSTRACT.

A Different Engine is a kaleidoscopic look at the origins of the digital, driven by pattern making in textiles and music. The paper examines the historical exchange of concepts, images and technologies between East and West via the overland and maritime Silk Trade routes. The paper will reference the importance of the Arabic traditions of Astronomy, Mathematics and Navigation showing how these facilitated this trade, as well as prompting the Renaissance in Europe.

By employing the metaphor of pattern making and the weave of fabrics traded along the silk route the paper will examine the provenance of computer control which can be traced to the early industrial practices textile production, where loom operating instructions were encoded as a series of punch cards, in essence 'digitising' weaving patterns in Jacquard looms.

The virtues of this novel punch card system were not lost on Charles Babbage who adopted them to drive his Difference Engine, from where they were rapidly adapted to automate mechanical music devices, the punch patterns becoming, in effect a form of graphical score capable of sequencing music boxes' barrel organs and later Pianolas.

The Pianola (or Player Piano) was the most sophisticated manifestation of this development and in terms of reproduction quality was far superior to the nascent technologies of audio recording and transcription, such as the Edison Wax Cylinder or disc based Phonography, by virtue of being able to not simply encode musical pitch but also performance characteristics.

Ironically it was the punch card and subsequent punch tape technology that enabled the birth of the modern computer and its entwined history with music.

The first public performance of computer generated music was demonstrated at the Australian Computer Conference in 1951 by a team from CSIRAC (council for Scientific and Industrial Research Automatic Computer) who fed their massive computer with spools of punched paper.

THREE THOUGHTS ABOUT CODE; SIGNAL AND NOISE - DISAMBIGUATION.

Echo's cries rehearse the utterance of others, departing as counterfeits without significance, returning diminished and disembodied ~ orphaned sounds.

Narcissus swoons as he reaches out to caress the face that has him bewitched. As his fingers glance the perfect image it transforms into an animated mandala, formed of concentric algorithms far more complex than his melancholia.

Smoke curls up from the Beacon Hill, answered in the distance by another and yet still another. A King has died, an Armada has breached the horizon. In every case a presaged message is unleashed ~ only the timing is significant.

Stepping forward through the logic and logistics of the Enlightenment, writing ousts memory and unlike the transient voice, it has the ability to transpose and transport itself ~ it flies and it endures. But like everything it is subject to the 3rd law of thermodynamics, its clarion voice fading with distance. Poured into channels of Copper or sparked into the Æther language swims in an Ocean of Noise in constant fear of corruption, desperate for disambiguation.

The message is quantised, fundamental particles taking the form of semaphore flags, dots and dashes, the texture of Braille. Speech and spelling are rehabilitated as military jingo-jargon, Alpha, Bravo, Charlies.

DISTANCE AND TRUTH - COMPRESSION.

It is one thing to speak with clarity and be heard over distance (or perhaps even time) but it is another to say a lot and say it fast. The goal of Telematics is to be coherent and robust, economical and fast. Our thoughts, already expressed as serial icons or codes, are now to be compressed into a form that is both necessary and sufficient for the purpose.

Lacking a written language and acknowledging the frailty of memory the ancient Peruvians developed the Quipos, delicate arrays of twisted and knotted threads encoding vital communal information. Marconi

abbreviated standard business procedures to save bandwidth and Mawson, who established the first radio communication from Antarctica compressed the limited range of explorer narratives into a code-book, "R-776" meaning I have grown a beard for example.

The compression of meaning and emotion is recirculating today in the form of emoticons, happiness a single condition reduced to a smiling PacMan.
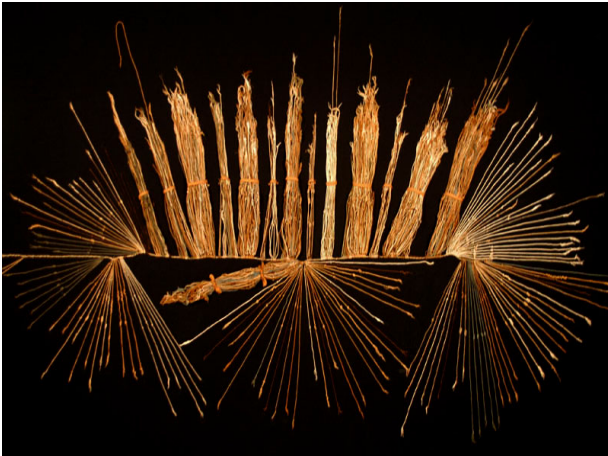

Fig.1 South American Quipos, Anon.

KNOWLEDGE IS POWER; ENCRYPTION.

Sensitive messages have always been jealously guarded to ensure their privacy and security, never more so than in times of conflict. However, the air, airtime and airspace are open and permeable, available and exposed, as are the transmission technologies which propagate them. The solution to such vulnerability is encryption, the rendering of the unambiguous and compressed into a cryptic form, publicly flaunting itself but impenetrable without a key.

The *Romeo Alpha Foxtrot* (Royal Air Force) held back whilst the Luftwaffe destroyed the city of Coventry in order not to give the Enigma Machine code breaker's game away, a sacrifice that subsequently sealed the demise of the Afrika Korps through intercepted intelligence, and also initiated horrific reprisal raids on Dreseden.

Across the Atlantic, US army communications were conducted in the unique and modern alphabet of the Cherokee Nation ~ a tongue difficult for the enemy to acquire. In London, at the outbreak of hostilities the BBC panicked over the real possibility of Oxbridge trained upper-class Germans broadcasting ersatz programmes in perfect King's English.

Their solution was to install Wilfred Pickles as the voice of London Calling. Pickles, a Yorkshireman broke the mould of BBC voice types, with his broad northern accent, impossible even for a Home Counties resident to copy or perhaps understand, in this instance encrypting not the message per se but the vector of delivery.

Figure 2. Wilfred Pickles (BBC Archive).

VIGNETTES OF THE UR-DIGITAL; THE SWITCH.

Arabia played a fundamental role in connecting the Orient and the Occident via the braided routes of the Silk Route Caravans. These physical pathways also created circuits of transmission of ideas, of technologies and product between East and West. Arabia was also the focal point of trade sea routes, plying between China, India and Europa where the mathematical and astronomical skills of Islamic navigators took pride of place on Chinese Treasure fleets. Viewed in this context Arabia played the role of a gatekeeper of knowledge, rekindling the fires of inventiveness and philosophy in Europa after the deep sleep of the Middle Ages.

The Silk Route becomes a resonant metaphor, a vast entwined network of dusty desert road and sparkling blue sea-ways, the careful and laborious haulage of precious of commodities, all manifestation of luxury embodied as Silk. But what in essence is silk? - a flow of pattern, a flow of intertwined fibres carrying symbolic memories, technological memories and the physical traces of intensive human labour and skill.

TEXTO.

Silk is text and text is the keeper of memory and knowledge. The Latin to weave is *texo,* more broadly to twine together, to plait, to construct and to build. *Textere* is to compose whilst *textus* is texture. We carry on spinning yarns, knitting our brows, sowing things up and weaving tales. We weave webs of lies and fabrications. The text is a fabric and fabric is a text that travels on the back of a camel across the dunes, and rides the swells in the South China Sea.

MEMORY MACHINES.

Her hands moves, slowly but inexorably to hover above the keyboard, then gently release to work the keys and the first notes rise from the Organ. She does this perfectly and always with an inscrutable expression. Of course this is the only thing she can do, she is a memory machine, an early automat built between 1768 and 1774 by the Jaquet-Droz family in Neuchâtel. She is remarkable in that she does not mime to an encoded music (i.e. a hidden music box) but she holds in her 'memory' the actions of performance, the movements of head, eyes thorax, arms and digits on the fully functional keyboard, she is a true android performer.

Figure 3. Jaquet-Droz mechanical musician (Ars et Metiers).

JEAN-MARIE JACQUARD.

Jean-Marie Jaquard developed Bouchon's concept into a robust system that employed chains of perforated cards (one card for each operation of the shuttle - with up to 30,000 individual cards for a single design). This eliminated the second person on the loom (the 'draw boy who's task it was to laboriously select the warp threads) making European looms more competitive with Chinese hand operated machines.

This technology revolutionised weaving but at the same time caused massive social labour disruption (akin to the more recent digital revolution in news and publishing)but most importantly the technological system for encoding information diffused into other areas.

It was not long before the idea of encoding pattern and/or numerical data was taken up by Babbage[1] in England (1822) and later by Hollerith[2] in the USA (1889 onwards).
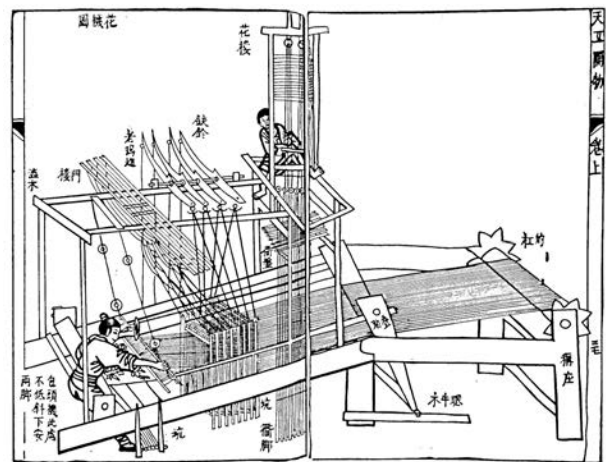

Figure 4. Traditional Chinese drawbar silk loom (Roads to Zanadu).

BASIL BOUCHON.

Basil Bouchon was as fascinated by these early clockwork musical automata as he was worried by the fierce competition in the Silk trade, where the genuine article (silk from China) was still cheaper than his Lyon based silk factory could produce.

Indeed his looms were based on the Chinese two person draw bar system which demanded a skilled and fallible "draw-boy" to set the complex patterns. Bouchon, determined to modernise and eliminate his overheads, began to experiment with a mechanism that employed punched paper rolls to control the loom patterns.

Bouchon only ever managed a proof of concept, but his experiments were not in vain. His paper roll system was taken back into the world of music to eventually become the pianola (Player Piano). More importantly they sparked the imagination of another master silk weaver from Lyon, Jean-Marie Jacqard.

PLAYER PIANOS, MICROPHONES AND GLENN GOULD.

But let us not loose the musical thread so quickly. The Player Piano (Pianola) differs from the Piano, from sheet music notation and from a recorded performance in that the smooth rolls of punched paper and the associated pneumatic vascular system, not only encode the music but also the performance values (the precursor of MIDI). Such encoding of content and delivery is reminiscent of Glen Gould, that irascible Canadian virtuoso, who held rehearsal in distain and wasn't too keen on performing in public.

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[1] Babbage - The Difference Engine (1820's to 1860's) 1822 paper "Note on the application of machinery to the computation of astronomical and mathematical tables" funded by the British Government. Essentially a mechanical (hand cranked computer).

[2] . Hollerith An Electric Tabulating System (1889)Columbia University PhD thesis - data tabulation. Founded the 'Tabulating Machine Company' which later merged with IBM. Basically an electrical data tabulation system employing punch cards built under contract to the US census department - later used by the National Socialists in Germany prior to and during WWII.

Gould much preferred the recording studio and could be said to have a love affair with the microphone (and of course the subsequent editing process) the technically manipulated results of which, made his recorded performances for the CBS quite outstanding but possibly impossible to match in a live context.

THE DARK SIDE.

Like Nature, digitisation is indifferent - it can be applied anywhere and anyhow. Hermann Hollerith submitted his PhD thesis "An Electric Tabulating System" to Columbia University in1889.

He was subsequently employed by the US Census Department at the end of the C19th to develop an efficient census evaluation system. In 1896 he founded the 'Tabulating Machine Company' which later merged to become IBM in 1924.

In 1910 the Deutsche Hollerith Maschienen Gesellschaft began operation in Berlin under licence from Hollerith. We can picture Herr Doktor Korherr, loading a batch of census cards into the Hollerith Machine. The year1939 and the National Socialist Census Office has perfected a system to capture the biological make up of each family in the German Reich. We all know the outcome!

Figure 5. poster for the Deutsche Hollerith Maschienen Gesellschaft.

A REPRISE.

To recap - the provenance of computer control was originally devised as a sequence of punch cards, encoding weaving patterns to operate industrial revolution Jaquard looms.

The virtues of the punch card system were not lost on Charles Babbage who adopted them to drive his Difference Engine and they were rapidly adapted to automate mechanical music devices, punch patterns becoming, in effect, a form of graphical score capable of sequencing music boxes' barrel organs and later Pianolas.

The Pianola, or Player Piano, was the most sophisticated manifestation of this development and in terms of reproduction quality was far superior to the nascent technologies of audio recording and transcription, such as the Edison Wax Cylinder or disc based Phonography, by virtue of being able to encode, not simply musical pitch but also performance characteristics. It was textile and musical patterns manifest as punch card sequences that enabled the birth of the modern computer and entwined its history with music. The first public performance of computer generated music was demonstrated at the Australian Computer Conference in 1951 by a team from CSIRAC (council for Scientific and Industrial Research Automatic Computer).The CSIRAC fed upon spools of paper punch tape.

The world's first true computer, COLOSSUS was installed in 1944 at Bletchley Park for cryptanalysis of the German Geheimschreiber, an in-line cipher teletype machine. This was followed closely by ENIAC, a US military, numerical integrator and computer used to calculate ballistics and the Atom Bomb.

But on the side of light, CSIRAC 1951[3], the first public performance of Computer generate music, Sydney.
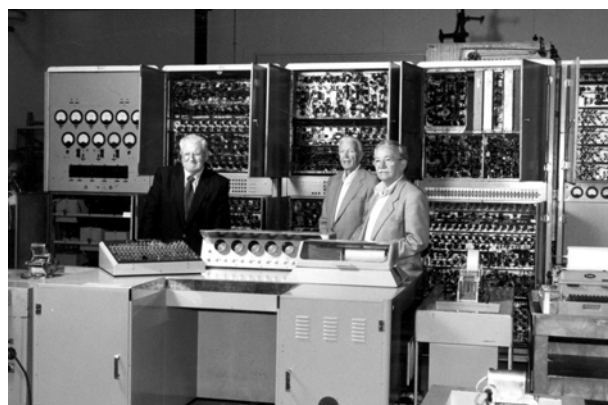

Figure 6. CSIRAC in Sydney 1951 (CSIRO).

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[3] see - Paul Doornbusch. http://www.doornbusch.net/CSIRAC/

SOME THOUGHTS ABOUT CODE AND LIFE; JOE DAVIS AND MALUS ECCLESIA NIGEL HELYER AND GENEMUSIK.

As an end-piece let us consider that other revolution in encoding discovered during the twentieth century, DNA.

In 2003 artists Joe Davis and Nigel Helyer exchanged a series of ideas for encrypting information in DNA. Davis pursuing textual codes and Helyer musical.

At that time Helyer, working under the aegis SymbioticA, collaborated with the School of Agricultural Science (University of Western Australia) to develop a proof of concept designed to translate music into DNA which when inserted into Bacteria was able to be re-mixed and subsequently extracted and de-coded into novel musical forms.

Fast-forward eleven years and Davis is en-train of realising his Malus Ecclesia[4] project at the Harvard Medical School. Davis plans to transpose the fount of all human knowledge, Wikipedia (sic) within the junk DNA of an ancient strain of Apple. Malus in Latin represents both Apple and Evil (whereas Ecclesia refers to Church - and pays an Homage to George Church the Harvard Professor with whom Davis is working).

This reprise of the Garden of Eden scenario, Davis will ultimately fill a grove of grafted apple trees which will presumably contain all branches of Knowledge. However the apples may be covered by an indictment on consumption, this time not by Jehovah but by the US food and drug administration!

Figure 7. Dr's Helyer and Albertyn at the UFS Microbiology Lab, Bloemfontien SA with GeneMusik bacterial cultures.

In a similar manner Helyer has nurtured his interest in the parallelism between Genes, Memes and Musical Notation as mnemonic structures capable of evolution and the embodiment of memory.

In 2014 GeneMusiK[5] rides again to create a re-mix of cultural, social and biological pathways. Working in South Africa with indigenous musicians GeneMusiK hybridises local ethnic music with the epitome of the western musical tradition, the string Quartet via the transformations of musical and genetic codes within Bacterial cultures. Musical patterns of the indigenous San peoples are genetically transformed to infiltrate the formal notation and performance values of western art music.

Figure 8. Drawing of a San Bushman playing the Gorah with musical annotation, from Travels in the Interior of Southern Africa, Burchill.

A THOUGHT ABOUT SOUND AND LIFE; UNDER THE ICECAP.

And a final thought about data. Under the IceCap[6] is a long-term collaboration between Artist Nigel Helyer and Marine Scientist Dr Mary-Anne Lea at the Institute for Marine and Antarctic Studies, University of Tasmania (Hobart).

In a nut-shell the project team renders complex environmental bio-logging data-sets collected by Southern Elephant Seals[7] on their extended under-ice dives and long open ocean transits into 4D cartographic animations, sonifications and graphical music scores, which are used to generate live public performances.

Our decision to interpret environmental data via an

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[4] see http://www.newyorker.com/tech/elements/object-of-interest-the-twice-forbidden-fruit

[5] see - http://www.sonicobjects.com/index.php/projects/more/eine_kleine_genemusik

[6] see - http://www.sonicobjects.com/index.php/projects/more/bio_logging

[7] Southern Antarctic seals can dive to 2000 metres, stay down for 2 hours and make ocean transits of many thousand Kilometres.

aural process is based upon a hunch that musicians have the best pattern-recognition 'wet-ware' around and that our aural sensibility is in fact more finely tuned to detect variations in pattern and recognise subliminal differences, than our visual sense.

Figure 9. Elephant Seals with BioLogging device, IMAS/UTAS.

The byeline for the Institute of Marine and Antarctic Studies is *Turning Nature into Knowledge*. The Under the IceCap project supplies a second line *Turning Knowledge into Culture* encapsulating a powerful Art and Science synthesis. The primary aim of the project is to produce creative work which is compelling and affective but which is simultaneously a work of scientific utility - hopefully tapping into both sides of the brain! The key focus is to illuminate the relationship of the environmental knowledge generated from Antarctic bio-logging data with the Anthropogenic changes in the biosphere.
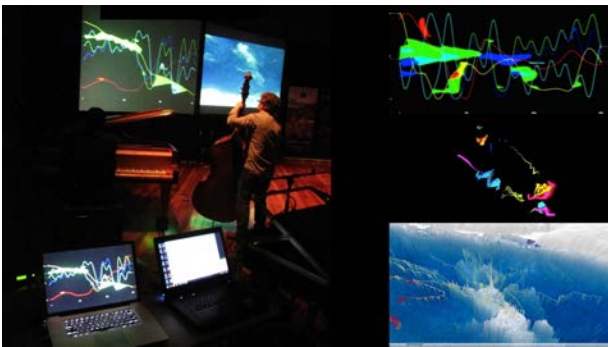

Figure 10. Under the Icecap live performance with data-visualisation screen shots. Helyer.

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