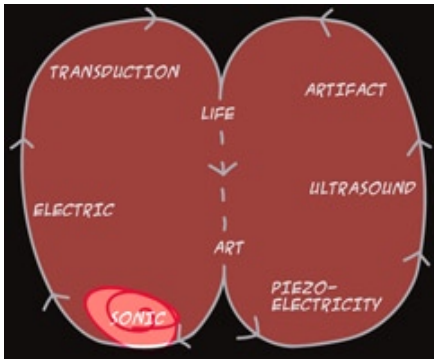


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Sonic Electric Transductions and the Art of Life

Today I want to work through a dynamic circularity of relation between phenomena, life and art that is pertinent to the practice of making art with the phenomena of life.



Sound

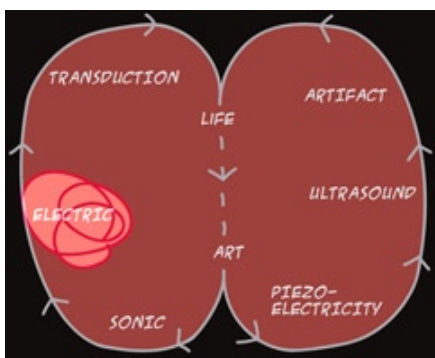
Sound is a periodic mechanical vibration. It travels as compressions and rarefactions of a medium. Without a medium it cannot travel. In the vacuum of space nobody can hear you scream.

Sound is what humans can hear. Our bodies experience sound most strongly through the ear which is the sensory organ tuned to perceive frequencies between 20Hz to 20,000kHz (the exact range depends on the individual and changes with age). Frequencies below 20Hz are referred to as infrasound, frequencies above 20kHz as ultrasound.

We also experience sound through our body. Bones vibrate at sonic frequencies and effect the way in which we hear the sound of our own voice. Alfred Tomatis a French ear nose and throat specialist referred to the skin as an undifferentiated ear.

Although we are not able to hear infra and ultrasound these frequencies still effect our physical well being.

Other organisms are tuned to sonic vibrations differently. Sensitivity to sound frequency and volume varies as do mechanisms of perception.



Electricity

Electricity is a general term referring to anything involving charge, current or voltage.

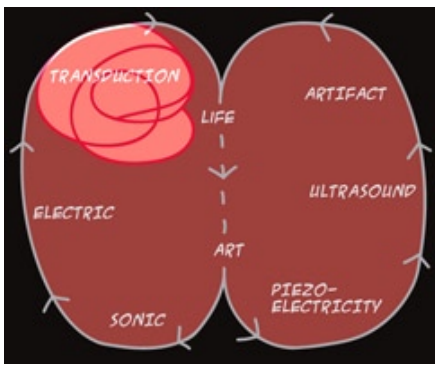
Charge is the property of some fundamental particles (for example an electron carries a negative charge). Current is the rate of flow of charge. Voltage is the difference in charge between two points that, if connected by a conductive wire, will cause current to flow between them.

The electric power that comes into our homes is in the form of alternating current or AC. AC alternates constantly between positive and negative poles. It is able to sustain this alternation due to the complementary relationship between electricity and magnetism. A time varying electric current causes a time varying magnetic field with causes a time varying electric current and so on. This creates what is known as an electromagnetic wave.

Unlike sound, an electromagnetic wave is able to propagate itself through space.

Living bodies are electric.

Boris Rajewsky one of the founders of the modern discipline of biophysics was convinced that living tissue reacts with 'uncanny preciscision' to all physical influences. Other than the well known phenomena of nerve impulses, brain waves and electrocardiographs research today is focussing on situations such as the relationship between extremely low frequency electromagnetic radiation and the DNA RNA transcription process in gene expression.



Transduction

A transducer is anything that transforms one type of energy into another. For example, a speaker transduces between electromagnetic and sonic energy. Alternating current flowing through a coil of wire causes an alternating magnetic field which causes the magnet inside the coil of wire to move back and forth which in turn moves the speaker cone in and out generating sound at a frequency equal to that of the original electromagnetic wave.

Curtis Roads states that:

“On a microscopic scale optical, mechanical and electromagnetic quanta are interlinked as elementary excitations.”

The world exists in a perpetual state of transduction.

In the biological sciences transduction refers to the viral transfer of DNA between bacteria or to “the transformation of sensory stimulus energy into a cellular signal”.

Transduced DNA is information transformed. Information, according to Bateson, is a difference that makes a difference. Information incorporates movement. Movement takes energy. Energy in transduction becomes information. DNA is not a static code. It functions as information only in its relationship to the RNA transcription, protein translation process. The transduction of DNA is a movement that adumbrates potential.

“Potential, according to Brian Massumi, is the immanence of a thing to its still indeterminate variation...”

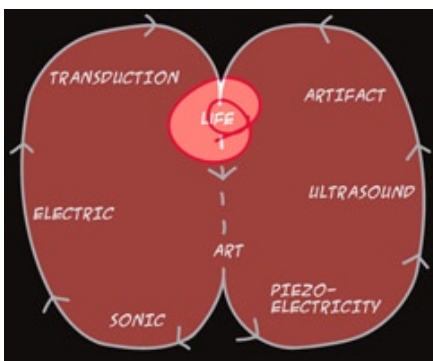
Similarly, the transcription of a sensory stimulus into a cellular signal is a transformation of energy that operates as information. The ossicle bones in my ear resonate with the sound of my voice. As they move back and forward with the sonic vibrations they impact the tympanic membrane which in turn causes waves to form in the fluid of my inner ear. Fine hairs in this fluid connect to nerves in my cerebral cortex and transform this vibrational energy into what I perceive as sound.

Transduction is part of the process of life and continues out into process with world. In order to transduce there must be a tuned relationship between the protein and its receptor, between life and world.

Here I quote from a paper entitled 'Initial Interactions in Electromagnetic Field Induced Biosynthesis':

"The frequency response of several electromagnetic field sensitive biological systems suggests that electromagnetic fields require repetition and are most effective at frequencies that coincide with the natural rhythms of the processes affected."

There is rhythm to life. Life sediments as an artifact of rhythm.



Life

Theoretical biologists Maturana and Varela use the term autopoiesis to describe the minimal criteria for life. Varela defines an autopoietic system as:

"one that continuously produces the components that specify it, while at the same time realising it (the system) as a concrete unity in space and time, which makes the network of production components possible."

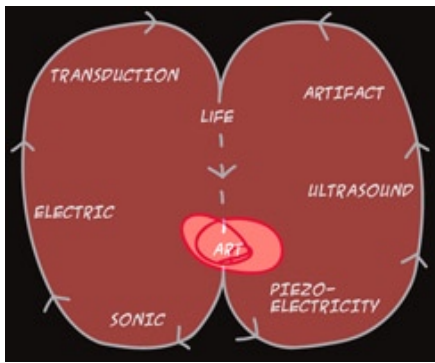
French philosopher of science Gilbert Simondon distinguishes between a physical individual and a living being. Where as the physical individual, such as a crystal, engages with information only at its exterior boundary "a living being grows from both the inside and the outside, the entire contents of its inner space are in topological contact with the contents of exterior space." Deleuze.

Life is constantly in formation. Life informs itself.

A living body constitutes itself through biosynthetic processes which in-corporate a relation to environmental phenomena.

After the egg is fertilised, DNA from the mother is translated into proteins which establish differential forces of attraction between cells. This causes the cells to group together according to a hierarchy of affinities. Positional relationships are relayed back to the nuclear DNA via various signalling mechanisms. This in turn triggers the DNA to encode for new proteins which cause further differentiation of the cells into particular tissue types.

A body produces its own environment. Which came first the chicken or the egg?



Art

In 1917 Victor Schlovsky introduced the concept of defamiliarisation, or 'making strange' to describe the way in which a work of art operates to fracture habitual relations to the world.

Schlovsky says:

"A work is created "artistically" so that its perception is impeded and the greatest possible effect is produced through the slowness of the perception. As a result of

this lingering, the object is perceived not in its extension in space, but, so to speak, in its continuity."

Art is not solely or even primarily an aesthetic practice but uses the aesthetic as one of its tools of defamiliarisation. Art is a laying bare, not of what is, but, an opening up to the process of what can be.

The contingency of life makes being alive an art. The art of being alive is process with world. Process with world means opening yourself up to your infinite potential to vary.

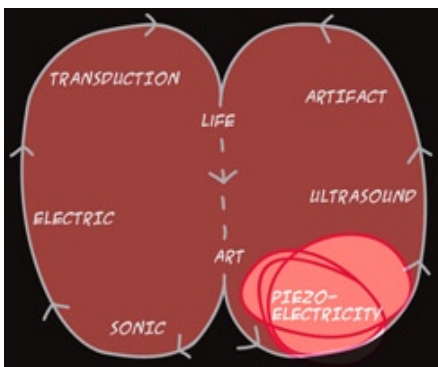
Schlovsky goes on to say:

"...for in reality the problem is not one of complicating the rhythm but of disordering the rhythm - a disordering which cannot be predicted. Should the disordering of rhythm become a convention, it would be ineffective as a procedure.."

The art of life is to draw attention to the indeterminate, contingent and process based nature of life. In order to do so the rhythms of habit, perhaps the very rhythms that define life, must be disrupted. Once disrupted a choice of how to resume must be made. There is potential to vary. We are forced to take responsibility for our choice. An ethics of relation to life is required. Life is potentially variable.

In my own practice I have become very interested in the way in which the dynamic circularity of life and world can be made strange. How is it possible to lay bare the transductive relations which sediment the matter of life?

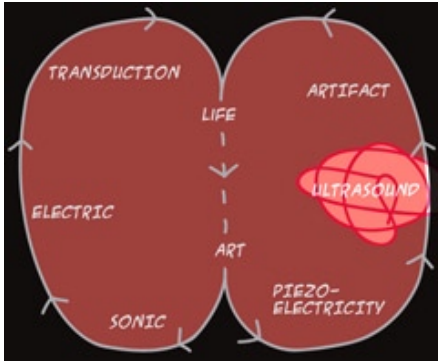
Piezoelectricity



Piezoelectricity is a characteristic of certain materials such that when they are subjected to time varying mechanical pressure (such as a sound wave) they emit a corresponding electromagnetic wave and, in complement, when they are subjected to an alternating current they vibrate mechanically at a corresponding frequency. Piezoelectric materials are transducers. They are used in many devices including in some record pickups and as high frequency speakers. Bone is piezoelectric.

The piezoelectric nature of the bone matrix was discovered by two Japanese researchers Yasuda and Fukada in the mid 1950s. The component of bone which causes the piezoelectric effect is collagen defined on a Google search as a “a tough, fibrous protein forming an important part of skin, tendons, bones, cartilage, and other connective tissues; collagen helps hold together the cells and tissues of the body.”.

It has been suggested that the electric properties of bone, which as well as piezoelectricity include DC currents in wet bone, contribute to its ability to regenerate and heal fractures. Contrary to popular perception perhaps, bone is not a static thing. Bones are the organs of the skeletal system. There are three main types of cell responsible for the reabsorption and generation of the bone matrix. Osteoblasts, osteoclasts and osteocytes. Osteoclasts secrete the mineralized bone matrix and osteoclasts reabsorb the bone matrix in a constant process of bone remodelling during growth. Osteocytes are differentiated osteoblasts that have become embedded in the bone matrix. They are able to secrete matrix and, to a limited extent, reabsorb it. In the 19th Century a surgeon named Wolff proposed that bone was modelled according to physical stress, such that bone matrix was deposited in sites where there was greater stress and absorbed from sites of lesser stress. This has become known as Wolff’s Law. Proponents of the electrical properties of bone have held that the piezoelectric effect is responsible for the transduction of mechanical stress into electrical signals which stimulate bone remodelling.



Ultrasound.

Ultrasound, a mechanical vibration higher in frequency than 20kHz or the upper limit of human hearing, is used in many industrial and diagnostic devices. Due to their ability to vibrate coherently at very high frequencies, one of the main applications of piezoelectric materials is in devices for the generation and reception of ultrasound. Although the piezoelectric coefficient in bone is very low compared to specially manufactured piezoelectric ceramics I do have a scientific a paper which details the

construction of ultrasonic transducers from dry bone. I also have a paper which discusses the use of ultrasound in the promotion of bone growth and healing.

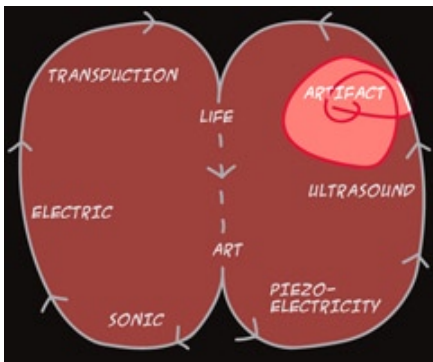
So what is my point?

I am interested here in a continuity of relation. The transductive relationship between piezoelectricity and ultrasound creates a material continuity between different life forming modalities.

Ultrasound is used in pregnancy to monitor the development of the fetus. It is also used to create images of the ocean floor, to detect enemy submarines, to detect fractures or irregularities in manufactured materials and it is used in industrial cleaning. There is a similarity of effect in all these applications which is the creation of boundary or form. A pregnancy ultrasound is used to designate foreground and background, to situate the fetus as an entity ontologically separate from its mother. A marine sonar system is used

construct differing densities of matter that can be read as rock substrate, vegetable matter, fish or enemy approaching. Ultrasonic diagnosis of material fractures situates discontinuities. Ultrasonic cleaning separates what is intended to cohere from what is not.

Just as life informs itself biologically in a transductive relation with phenomena so the relationship between bodies, both living and non-living, is informed by phenomenal manipulations. Life and non-life are specified in a transductive coupling with the human perceptual bandwidth. But what do we perceive? A tuned relationship between phenomena and boundary?



Artifact

The term artifact has two meanings. Firstly, it is an object made by humans that often has some cultural or historical significance attached to it. Secondly, it can be defined as the unintended result of a transductive process, a residue in the outcome due to relations inherent to the process. For example pixelation in digital images. In a Google search on the term I came across this explanation of the term: a peculiar test or experimental result which is due to some unusual detail

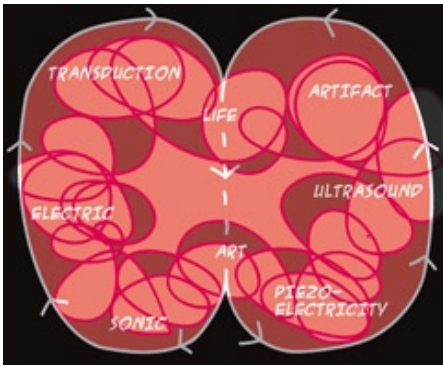
in the procedure which invalidates the usual interpretation of the test or experiment.

Example: our blood sugar appears to be lethally low on the glucose oxidase blood sugar test and lethally high on the orthotoluidine blood sugar test.”

In both these definitions an artifact allows us to discern something about the process (physical and cultural, historical and technological) that created it but not necessarily of some preformed existent.

An artifact is an event that occurs in our sensory temporal realm as the result of something beyond it. To conceal an artifact is to conceal process and history. To reveal is to travel into process beyond the limits of our sense and time. The nature of life is both concealed and revealed in an artifact. An artifact reveals the performance of its own constitution. An iteration of reflected points and a sweeping motion reveal a continuity of boundary. The frequency of reflected waves conceals movement. The artifact comes into being.

Life is an artifact of a revealing and concealing rhythm, it comes into being as the residue of transduction. Life reveals a process beyond itself. As an artifact that constantly reforms itself, life has many beyonds. As a tuned relationship with world, life is often unable to perceive what is beyond it.



Reiterate

Which brings me back to the beginning.

I could reiterate but that would mean travelling the

loop again. Forming and reforming. Making strange.

Heidegger says that humans are the uncanniest of the

uncanny, the strangest of the strange precisely because

they have some sense of their own beginning but they

are never able to fully access it. Freud talks about the

uncanny as being a fold of life and death, non-life and

life which is somehow strangely familiar. The uncanny is

something unsettling which we are unable to separate ourselves from. Life is contingent.

We are a fold of life and non-life, life and death, process with world.