

T H E
ARCHITECTURE
OF SOUND

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W H A T
ARCHITECTURE
DOES SOUND
ORCHESTRATE?

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MMXIII

Cymatics is the science that studies the geometric patterns created by sound vibrations. In the 1970's, Hans Jenny pioneered a new way of visualising sound. Jenny discovered that sound vibrations excite water into complex geometry when water is placed inside a loudspeaker. Inspired by cymatics, this project aims to investigate the correlation between sound and geometry.

I will explain how sound is omnipresent throughout the physical world. Parallel to this, everything in nature manifests from a geometric essence. I will then introduce Nicholas Hawksmoor, an influential architect in London in the early 18th Century, whose architecture celebrates the geometric proportions found in nature. I will delve into the concept of 'architecture as frozen music' and explain how and why I employed Hawksmoor's architecture as an instrument to investigate the relationship between sound, geometry and form. This project stems from my desire to understand the significance of sound within nature.

Einstein assures us that nothing is really solid. The molecules within matter are constantly vibrating. Sound is the vibration of molecules within any medium. Sound, therefore co-exists with vibration. All matter is sustained by pulses of vibration and emits an innate sound, whether audible or not. Sound is a creative force that holds the physical world in form.

By placing water inside a loudspeaker, one can observe the behaviour of water when it is vibrated with sound. It moves to and fro, uniting and separating, according to the vibratory surface of the speaker cone. Water flows in currents and these currents create a rotatory effect. Geometric shapes and patterns appear but are in a state of constant upheaval. The water is pushed outwards from the centre and inwards again from the outside, and at the same time, they pulsate. The

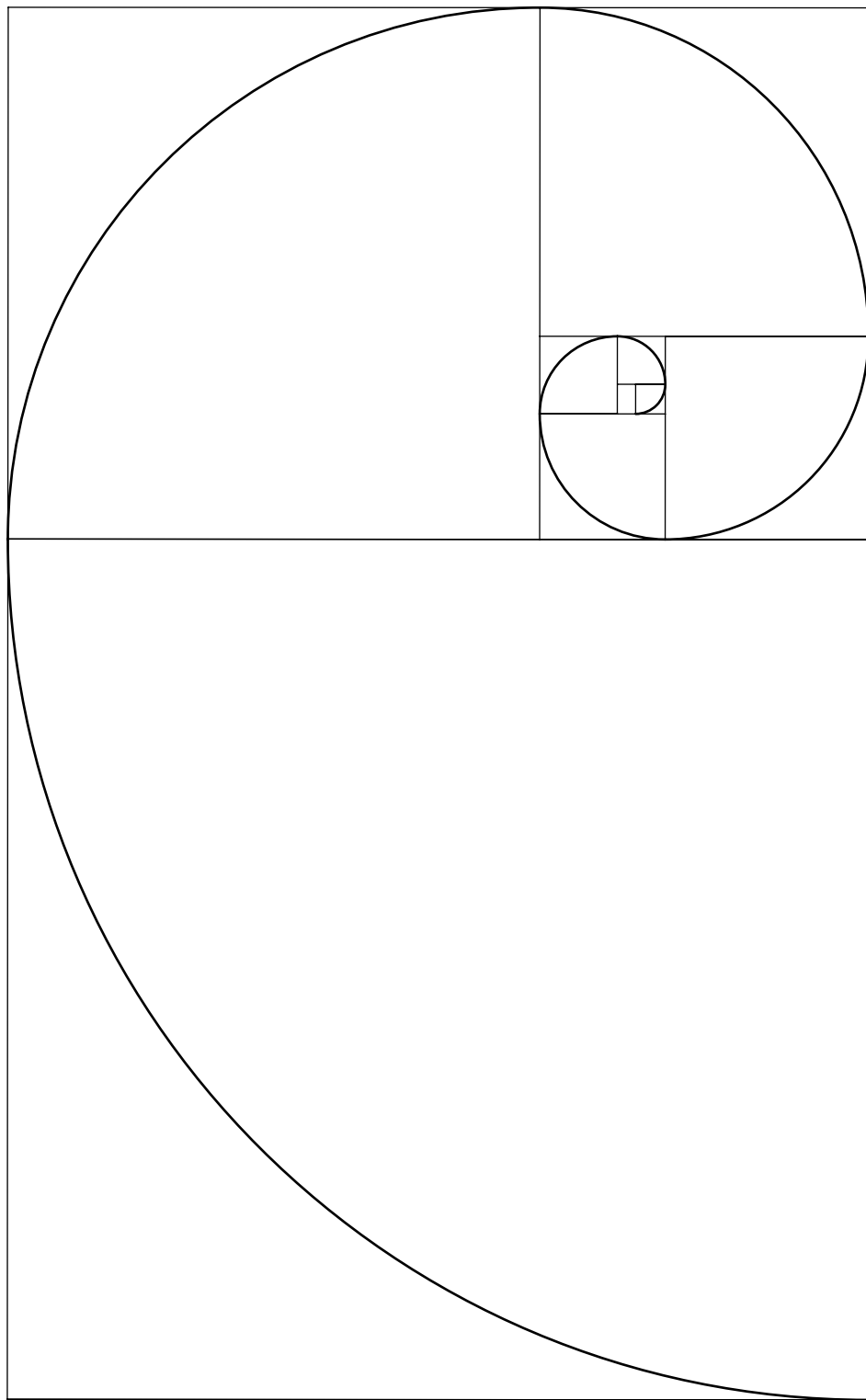
science of cymatics also reveals a connection between sound and form. It shows us that different sounds produces different shapes. Low frequencies form simple geometric shapes while high frequencies create more complex geometry. Why does sound orchestrate geometric laws?

fig. 1

Sacred geometry is the study of geometric patterns found in nature. The golden ratio often referred to as the blueprint of creation, it contains many mysterious elements that elegantly describe many phenomena such as the growth of plants, the proportions of the human body, the orbit of the planets, and the structure of crystals. It is approximately 1 to 1.618 and is also expressed in a sequence of numbers called the Fibbonacci sequence. Each number in the sequence is the sum of the two preceding numbers starting with the root number 1. Here are the beginning of the sequence 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144 etc.

Nicholas Hawksmoor was an architect and freemason in the early 18th Century. His architecture demonstrates his skill at evoking a mood through form, shadow, and height. I employed his churches as a metaphor for the natural world of form as they are testament to the expression of sacred geometry. Sacred geometry has been preserved in circles of freemasonry throughout history. It has left its traces in other cultures such as the Great Pyramid in Egypt, the gothic architecture of European churches and cathedrals such as Chartres and the Parthenon in ancient Athens.

The golden section is the most aesthetically pleasing ratio to the eye but also to the ear. Greek philosopher Pythagoras discovered a wonderful mathematical relation between the harmonic notes in music. He noticed that by depressing a string in different positions on the fingerboard of a string instrument, harmonic sounds were created. Some notes sounded



better than others. At each depression, the string is divided in two different lengths and the ratio between these lengths were measured by Pythagoras. He marked down all the ratios that sounded harmonically well together. The musical ratios discovered by Pythagoras are the same ratios of the Fibonacci sequence. If you take a number out of the Fibonacci sequence and its successor and you have the musical ratio found by Pythagoras. For example, 3:2, 5:3, 8:5, 13:8, 21:13, 34:21

The concept of architecture as frozen music and music as liquid architecture, first formulated by Goethe in the 18th Century encapsulates the essence of this project. It describes how music and architecture employ the golden ratio; the geometric code found throughout nature, to express harmony.

Just as science relies on this proportion to describe nature, the simple ratios of the classical music intervals are considered an outward expression of a harmony that in essence guides all natural relations. The phrase architecture is frozen music describes how musical ratios were incorporated into proportions of Hawksmoor's architecture. I employed four of his churches in London to explore the relationship between sound and sacred geometry; St. George in Bloomsbury, St. Anne's in Limehouse, Christchurch in Spitalfields, and St. George-in-the-East in Wapping.

fig.2-5

Form is the organization of energy at certain rates of vibration. To investigate the concept that sound co-exists with form, I recorded the resonant frequency of these churches. (Refer to uploaded audio files) Renowned for their outstanding acoustics, these churches were designed as sonic environments and are still used today by orchestras for rehearsals and concerts. The resonant frequency of a space is the tendency of space to produce oscillations of certain frequencies at a higher amplitude or volume to others. Everything in the church is vibrating at different frequencies. There are many factors that effect



6

fig.2



fig. 3





fig.5

fig. 6

the resonance of each church such as the volume of the space, the people inside the space, and the materials that make up the space. Inspired by Alvin Lucier, a music composer in the 1960's, who discovered a technique to record the resonant frequencies of a space. I began by recording the silence of each church for approximately seven minutes. I then played this recording back into the church while re-recording it. I repeated this process over and over again until the resonance of the space became audible, causing each church to reverberate, generating a physical experience of resonance.

fig. 7

Building my own cymatic experiment enabled me to see the hidden geometry behind these resonant frequencies, hence translating sound into liquid architecture. This experiment consists of a 15" speaker cone, which I vacuum-formed with thin plastic to allow me to put water inside. The speaker is then powered by a 450 watt amplifier that I made. When frequencies are played through the speaker the water begins to move and arranges itself into geometric patterns. In order to see the liquid patterns I used an angle poise light. This light source shining onto the water causes a highlight to be reflected back where the peak of a wave occurs and no light to be reflected where there is a trough, creating a web-like image of light trails. The cymatic patterns I generated from the resonant frequencies of these churches produce striking geometric shapes.

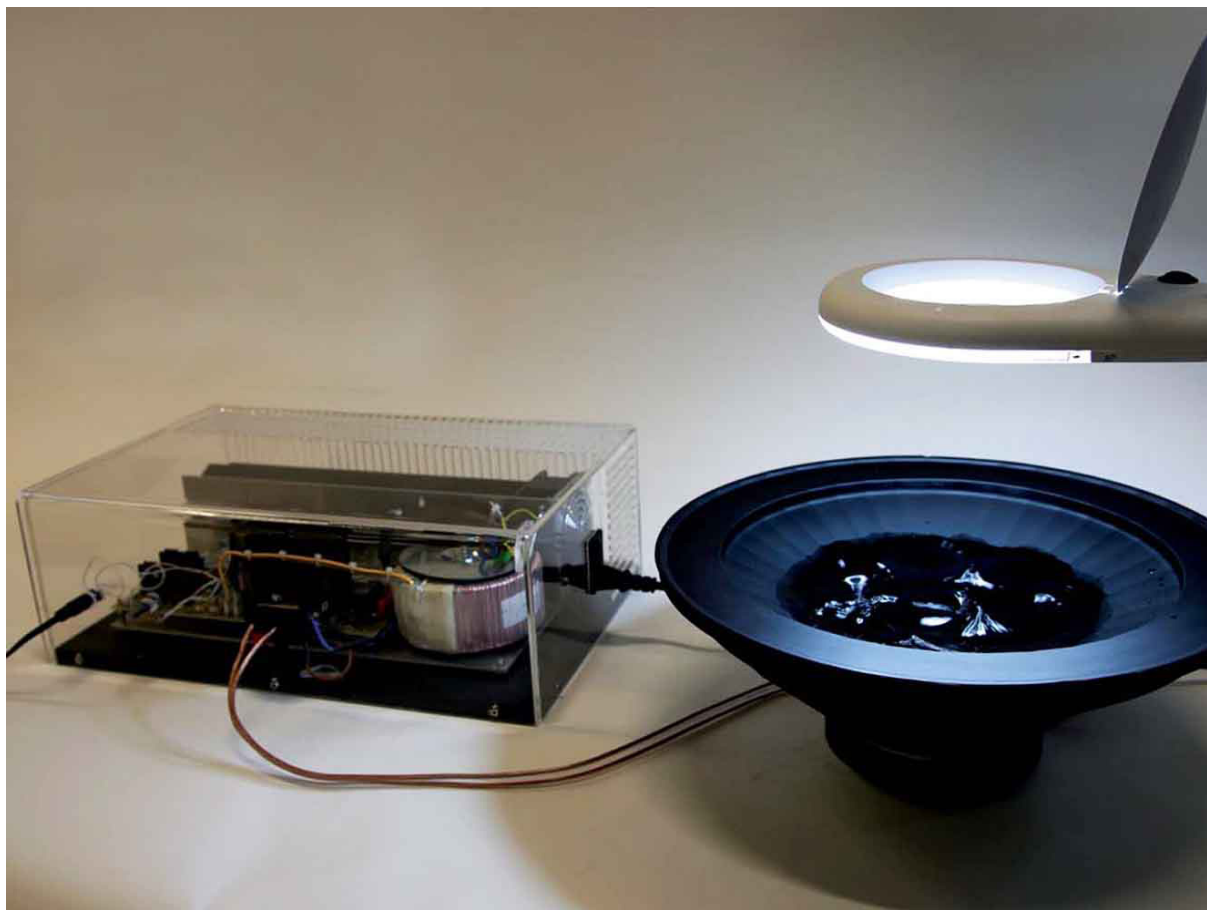
fig. 10-13

Inspired by how masonry transcends language, time and culture, I engraved these sound glyphs onto stone tablets, the very stone that Hawksmoor used to construct these buildings. Hence, transforming liquid architecture back into frozen music.

Science is now emerging as the ultimate fuel in how our society perceives the world in which we live. It is been used as a tool for discovery and is also becoming a vital source of inspi-



fig.6



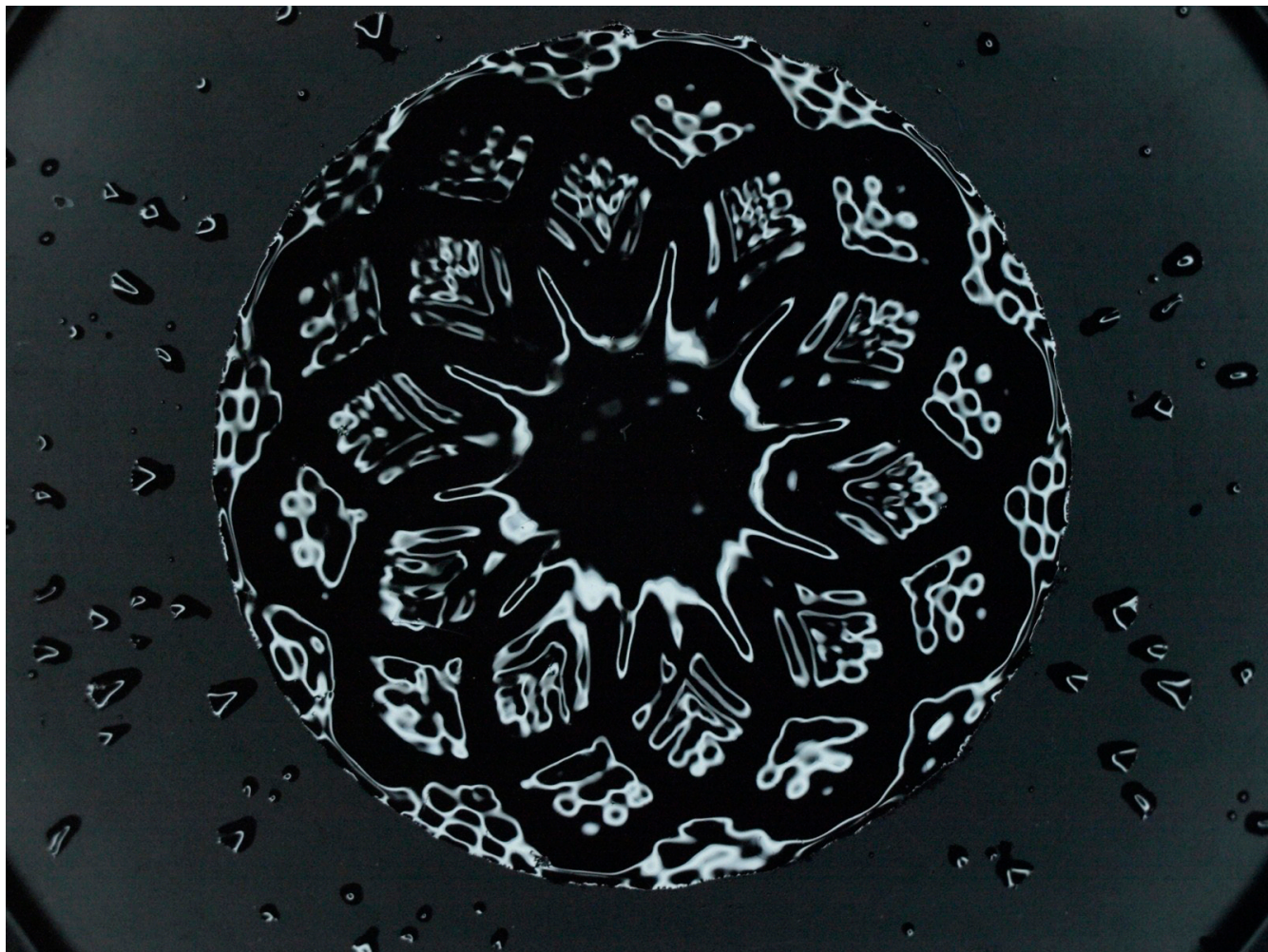
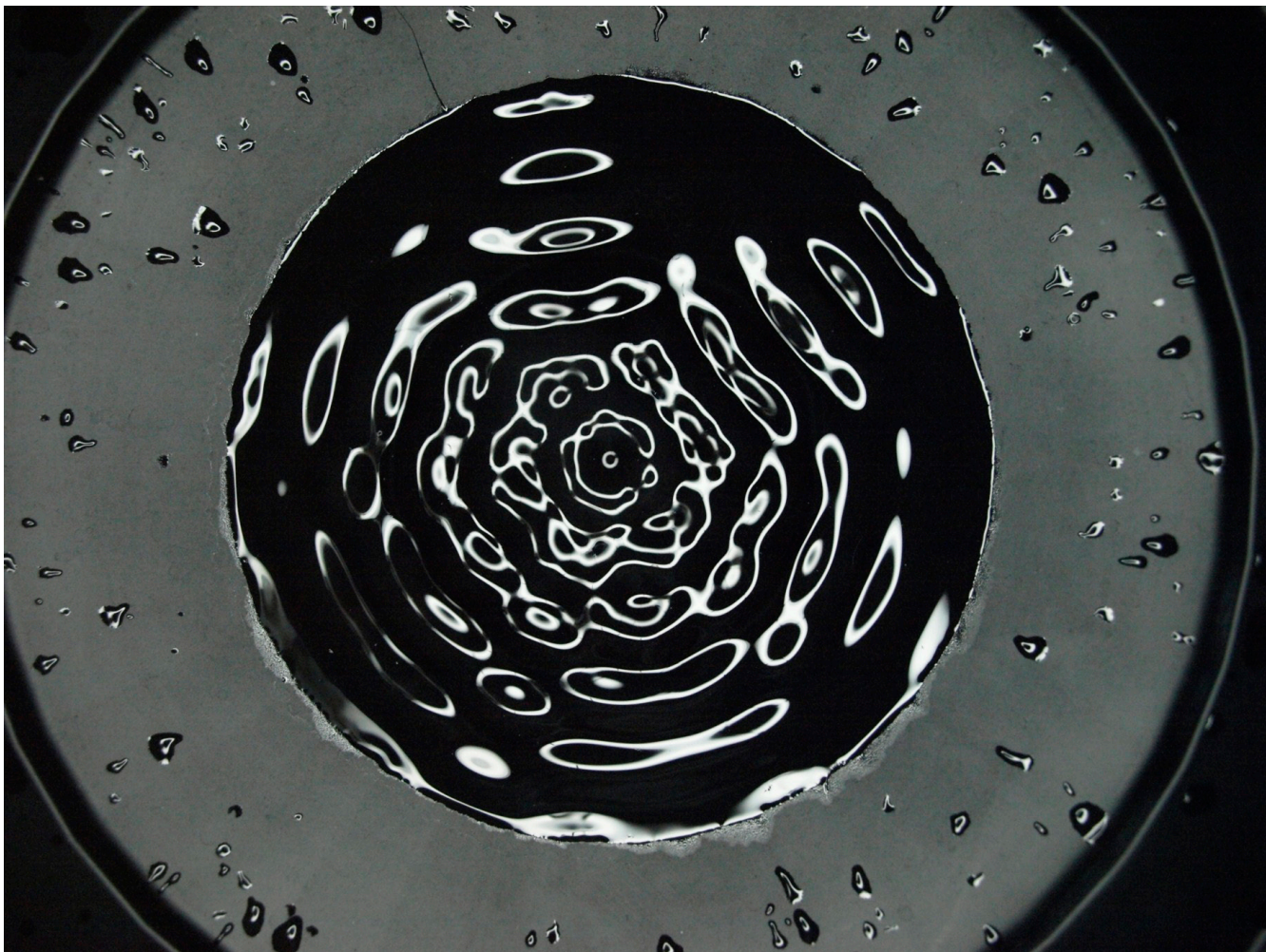


fig. 8



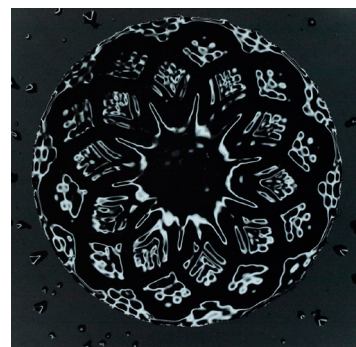
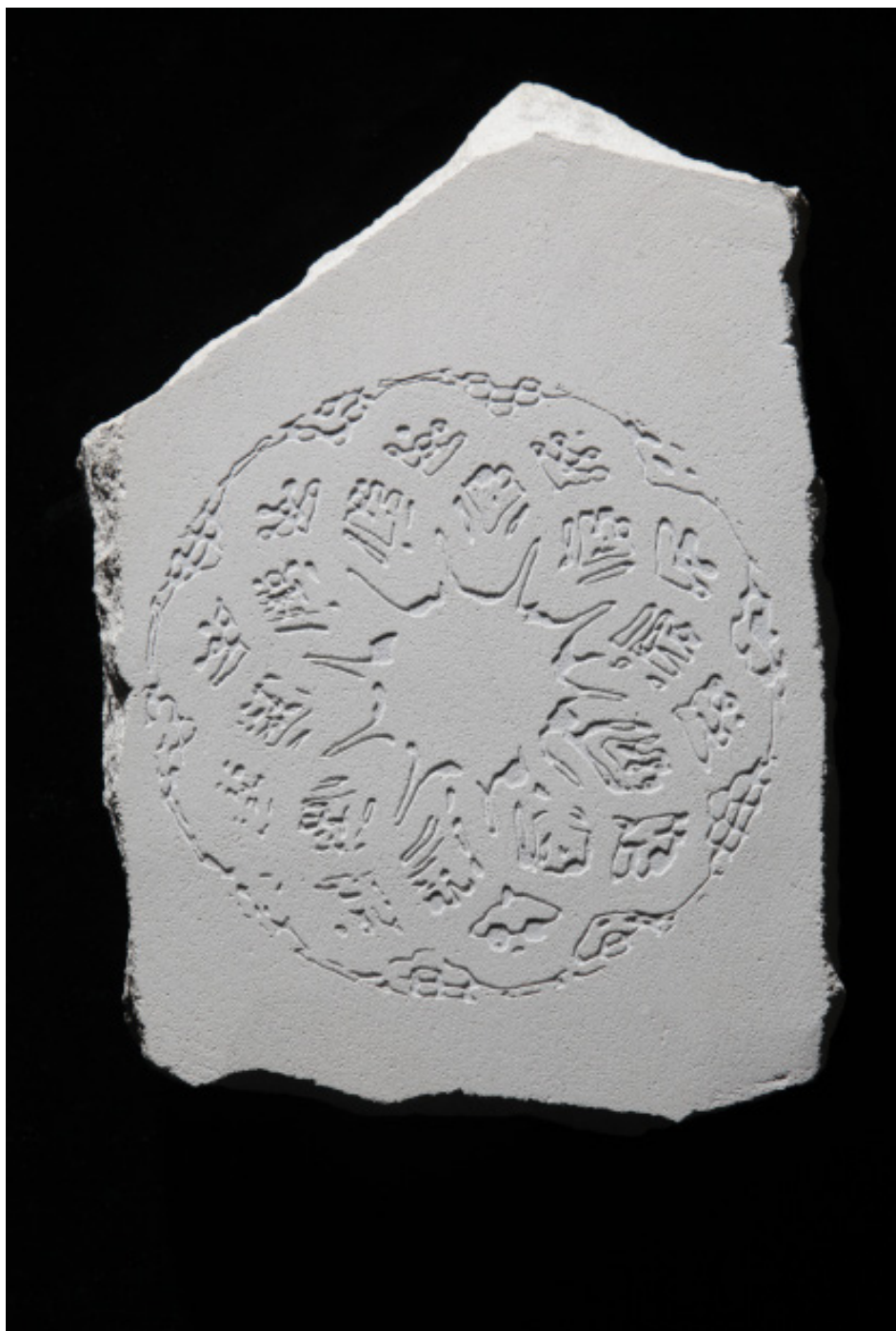


fig. 10



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fig. 1 1

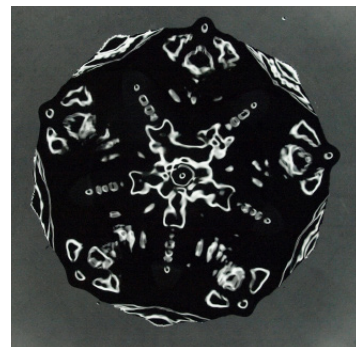
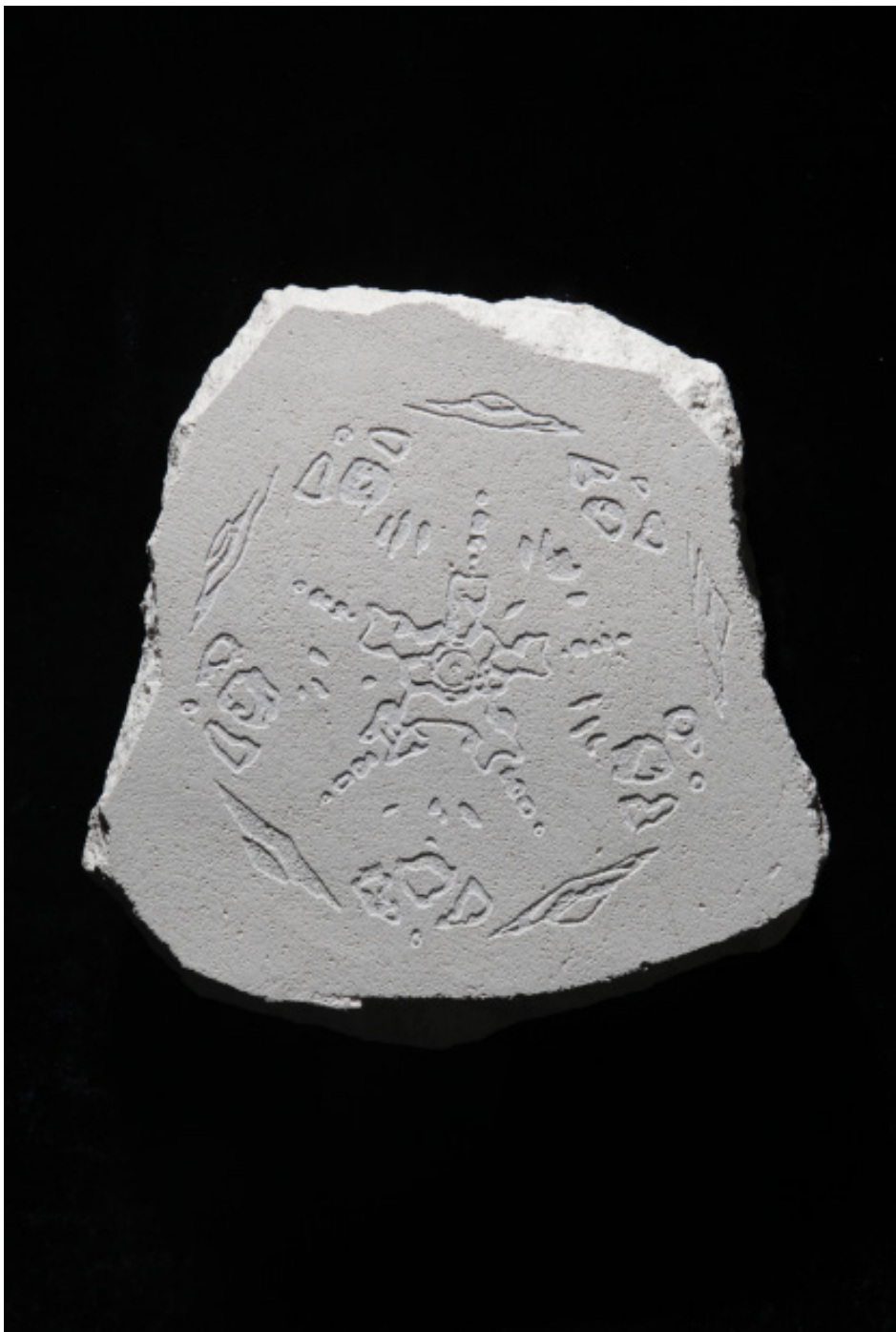
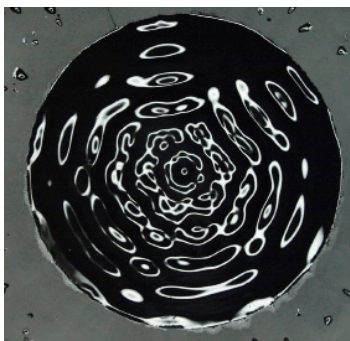


fig. 12

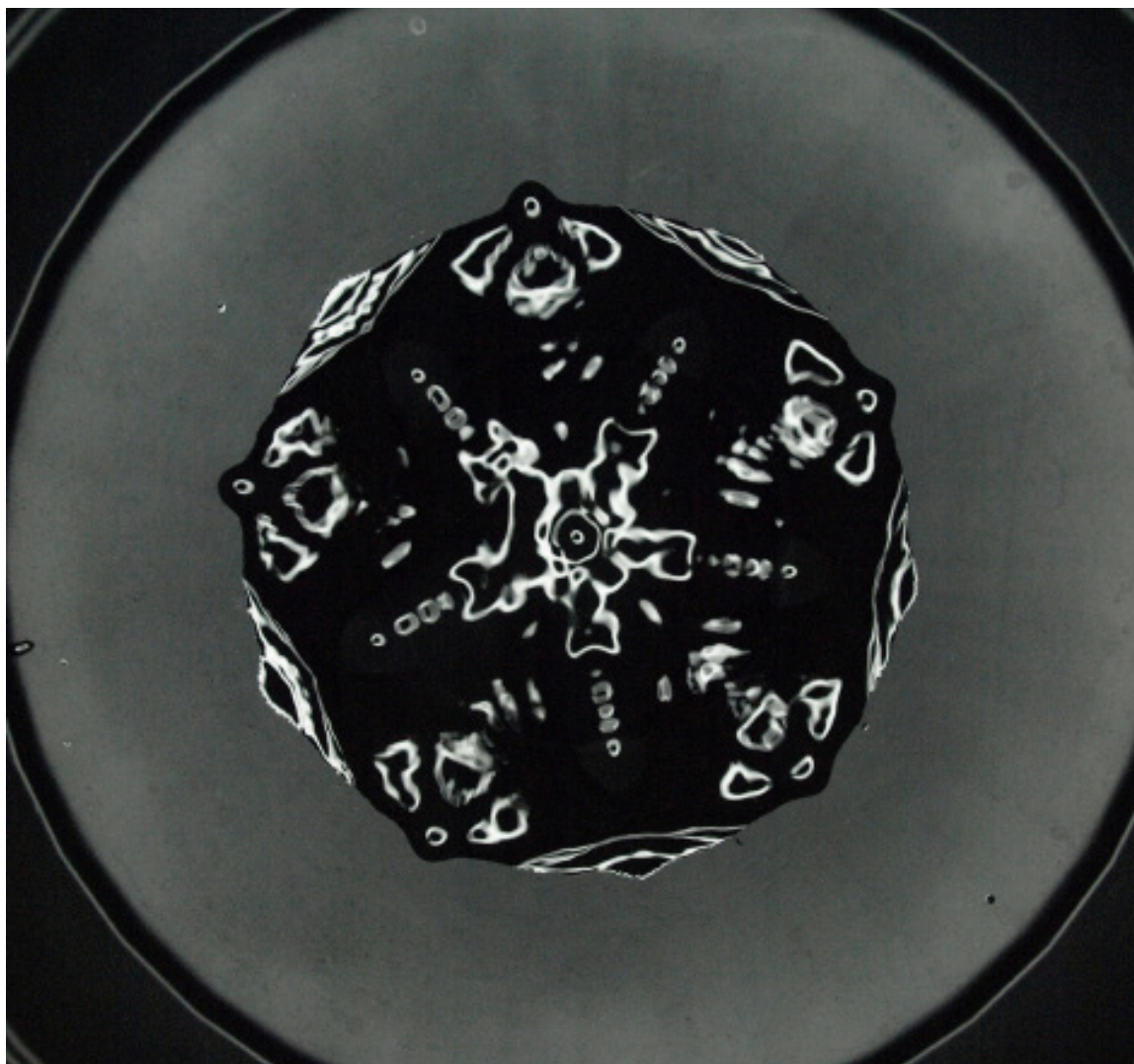


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fig. 13

ration for today's creators. My transdisciplinary approach to this project brings together different disciplines such as maths, science, technology, quantum physics and art. This project speaks of interconnectivity and offers a holistic perspective of sound. Hans Jenny founded cymatics in the 1970's. It remains a phenomenon today and is still such an unexplored field of natural science. I endorse Hans' Jennys theory that suggests that sound is a primordial force that generates the geometric essence within form (JENNY, 2001). 'In the beginning was the word and the word was god.' The Old Testament tells us this is how creation took place; into the voids of space came a sound and matter took form.

Cymatics reveals a remarkable phenomenon; the inherent responsiveness of matter to sound. Sound affects matter because matter is held in form by vibration. The cymatic pattern from the resonant frequency of St. Anne's church shows fig. 14-15 a five pointed star inside a pentagon, which coincides with the golden section. Cymatic patterns suggests the same orderli- fig. 16 ness that underlies all action in nature. The stunning array of patterns are a physical phenomenon evolving before your very eyes as audible sound excites water into processes that mimic atomic, geologic, biological, solar and even galactic shapes and movements. Their visual beauty inspire a deep recognition that we are part of this complex and intricate vibrational matrix, suggesting that the vibrations of our every thoughts and feelings may have great effect on what will manifest in the physical world. I advocate Jenny's research and bring light to the relationship between sound, geometry and physical reality. This project aims to provoke new insights into the subtle vibrations through which all life manifests itself.



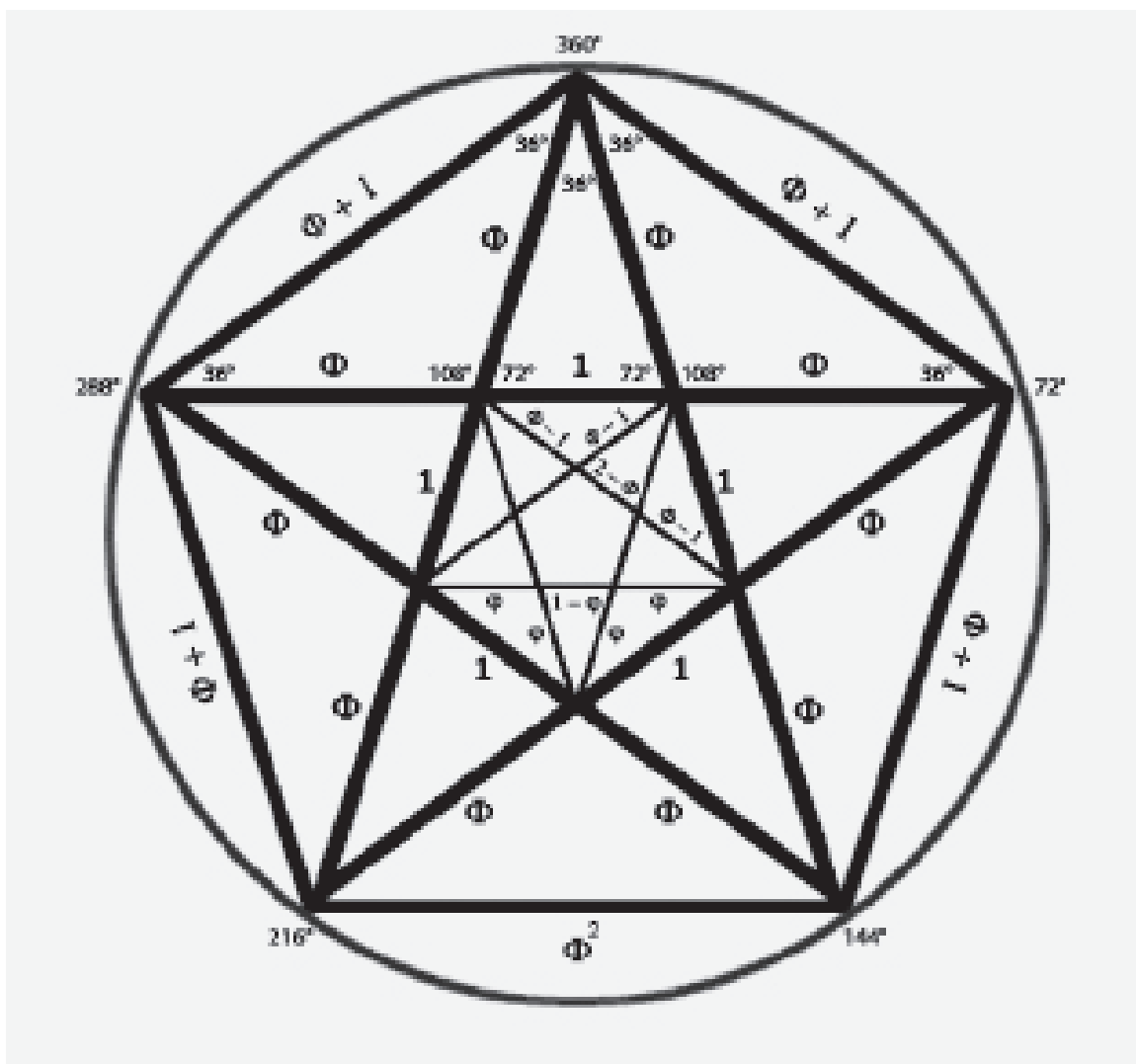


fig. 15

