



THE SHAPE OF SOUND

By Joe Sleney

Introduction

I want to consider the physical structure of sound. We all understand sound and define it by the instruments we hear and those created naturally from our environment or vocal chords. One thing that isn't well known is what would those sounds look like as a physical structure.

I believe that everyone has common ground when it comes to music, some stick to a certain genre, some have a more expanded outlook on the variations they like. What we all have is that love of sound whether it's sat listening to a piece of produced music, or something created naturally from the environment around us.

We collect the things we love. We build up an array of materials that give us nostalgic feelings, things that aren't essential to daily life but items that make us who we are. When it comes to music it is so easy to get wrapped up in the artists you love, that you sought every possible thing created by them or linked to them in merchandise.

This research will be to identify areas of cymatics people have already studied and to consider how I could propose a way for people to see sound. When I talk of merchandise I want to consider how music could be given to someone in a structured form. Many philosophers have gone through the process of seeing how sound looks and created shapes through cymatic experiments, but generally for research into how it is visualised.

I want to go that step further and put sound into a potential piece of merchandise that could come in the format of a new kind of business. One which sells these items to anyone who wants a unique gift and a new way of being able to see the sounds they love.

Overall this study will consider the way people have used cymatics to visualise sound and how those various processes could come together to create a piece of jewellery, made from a musical cymatic structure.

1) Visualising sound origins

Being able to see sound was given the name 'cymatics' by the physician Hans Jenny. The term dates to a Greek word known as 'kupa' meaning wave. Jenny published his first version of cymatics: *The Study of Wave Phenomena* in 1972, the year that he died. He had dedicated several years to the subject and in all concluded that *"This is not an unregulated chaos; it is a dynamic but ordered pattern."* (1.1)

Jenny picked up on the work of an 18th century philosopher and musician Ernst Chladni, who experimented with a technique to show the various modes of vibration on a rigid surface. One man before, 17th century philosopher Robert Hooke had been the first to research into nodal patterns, creating vibrations from running a violin bow across a glass plate. The areas with the strongest vibrations would be empty and where the vibrations were at their weakest the sand would collect. So depending on the frequency put through, the shapes would vary.

One thing to note is that the higher the frequency, the more complex the shapes would be. If it comes to be that I create a structure from a piece of music, I will have to consider 3D printing methods and whether a less complex shape may be easier to construct.

Jenny's understanding was an orderly form of sound waves, patterns dependant on the vibrations created through experiments. He

made use of crystal oscillators and used what he called a 'tonoscope' to set plates and membranes vibrating. (1.2)

Researching the early films created by Hans Jenny, his understanding of the topic related sound to being almost the creator of the Universe. Through extensive experiments he found that particles formed into patterns by sound and found it to be sound that would turn matter and energy into form. He said "sound takes particles and turns it into form and that is how the Universe was created, In the beginning was the word and the word was sound" (1.3)

Hans Jenny even took it as to thinking; *"every organ in our body resonates to a certain frequency and when our thoughts, emotions and stress de- harmonise the vibrational state of our body, we become ill, we think ourselves into illness because were affecting the vibrational state of our body. Every time you think and feel you are resonating a frequency which is making the energy around you resonate to the same frequency, stating what you give out is what you create."* (1.3)

Sound is a key part of our makeup and according to Jenny was what made the world go around. What cymatics does is let us visualise the structures behind certain vibrational movement, creating visible shapes that strangely enough seem to be symmetrical in the way they form. It personally fascinates me to see these certain musical patterns, beautiful in their design and structure, almost like that of a kaleidoscope.

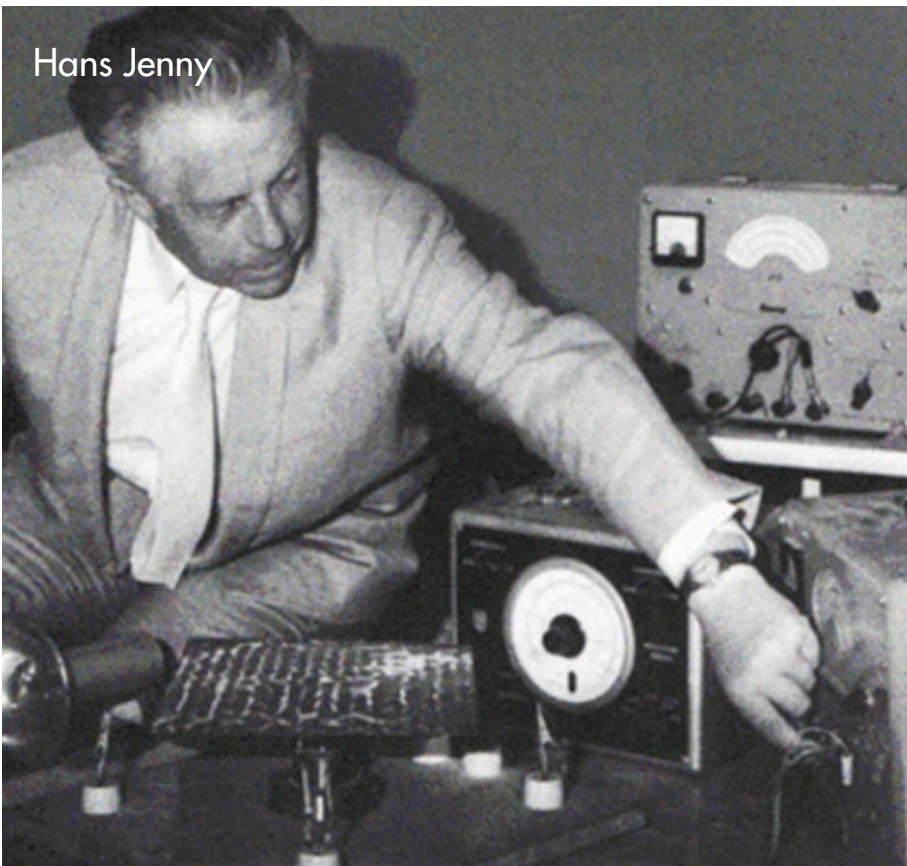
Robert Hooke



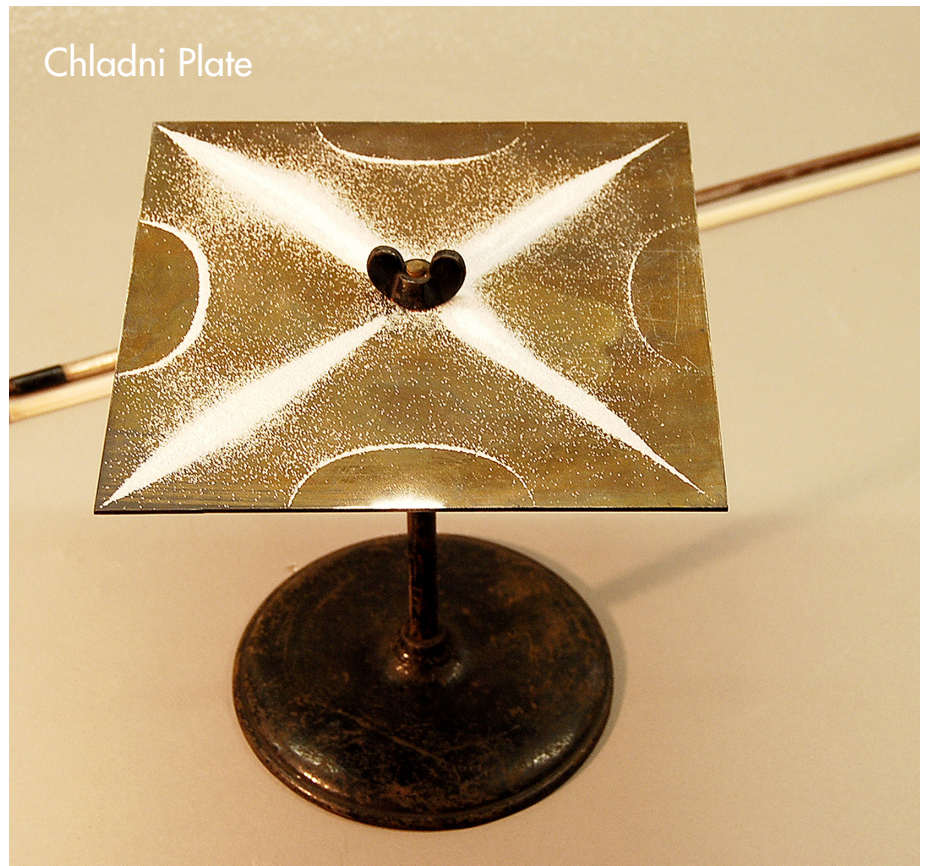
Ernst Chladni

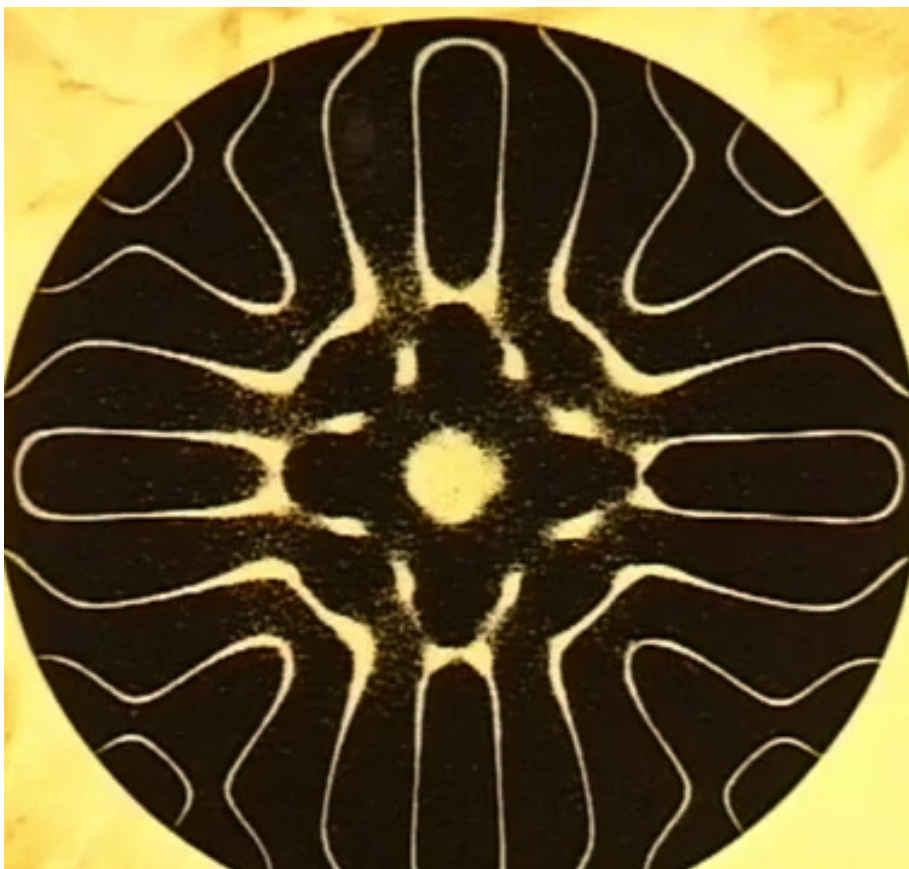
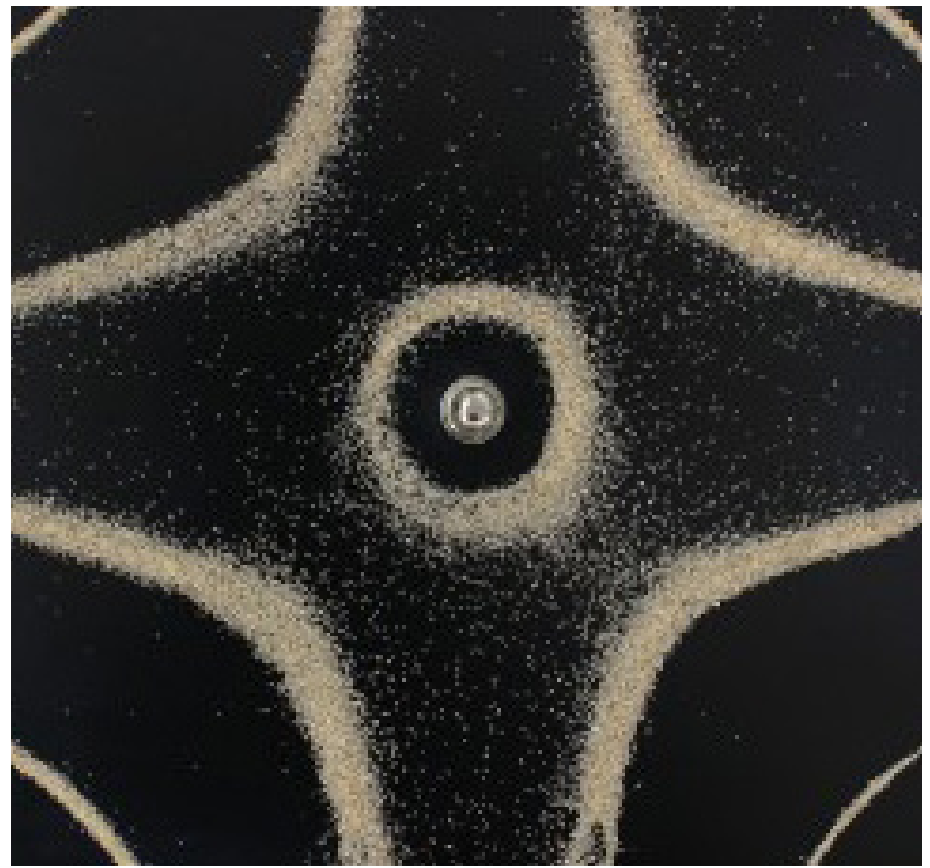


Hans Jenny



Chladni Plate





2) *Ways people have created visuals from sound*

Cymatic experiments have come a long way from Chladni and Hook's time. The technological advancements have led to numerous studies into the subject.

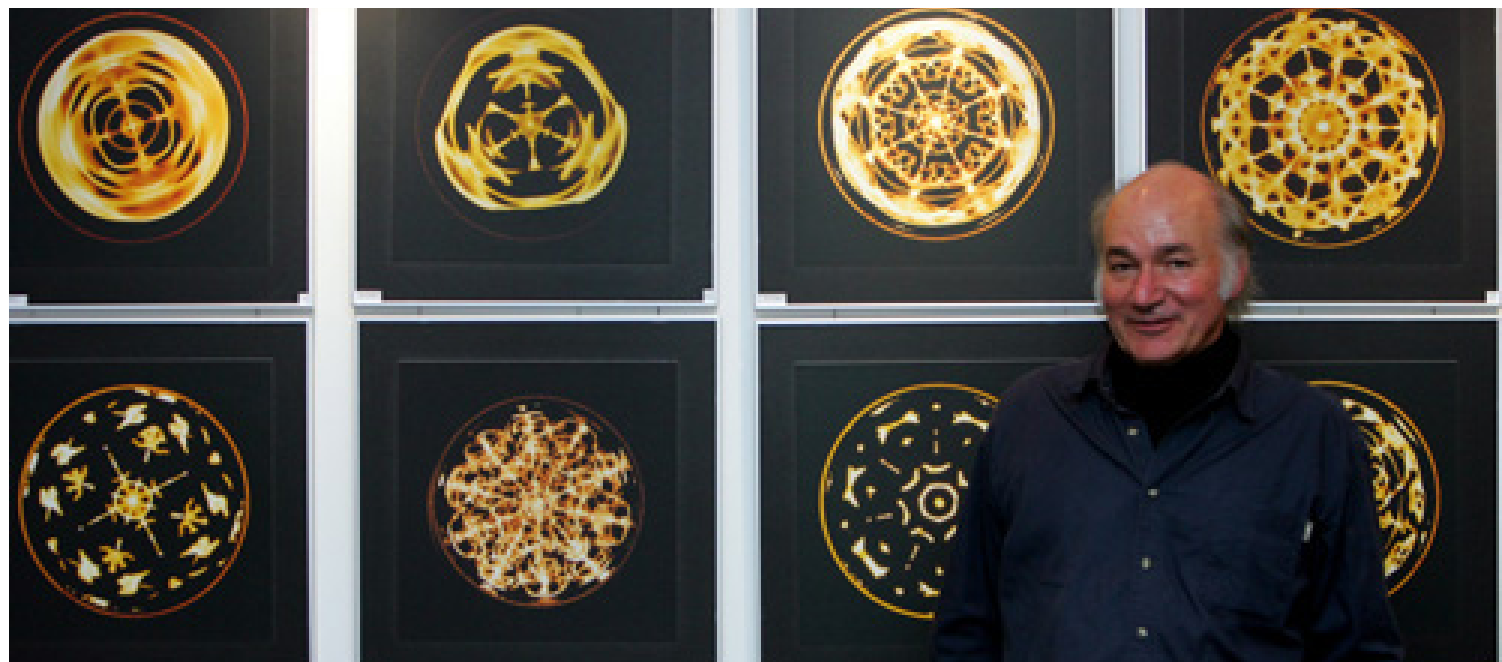
The early experiments give us an insight into nodal patterns and various forms of frequency and vibration. From people like Ernst Chladni through to even more recent Hans Jenny, the technological advancements have since surpassed them. Researchers now have access to innovative ways of capturing cymatics that only the early researchers could have dreamed of.

One man to consider is the work of Alexander Lauterwasser who has carried on the work of Chladni and Jenny and dedicated his time to the subject of cymatics. He has gone through some of the same processes as the earlier

philosophers, but having access to newer technology enables him to experiment with new innovative processes.

One point to make is that Lauterwasser was a pioneer of using water experiments, done in a comparable way to the Chladni plate, but with water in a petri dish and a speaker attached underneath. This causes the nodal patterns you get with the sand on a plate, but to me seem a lot more defined due to sand being fine and the frequencies it takes to make it fully stand out.

A video showing some of the techniques Lauterwasser used, talks about one story about the patterns on a tortoise back. He raised tortoises growing up in Germany and by the time of his studies he came across the images or Ernst Chladni's sound figures, which had a striking resemblance to that of a tortoise's shell. *"Most surprisingly to me they bore a close resemblance to the structures found in nature, especially that found in a tortoise's shell"* (1.4)

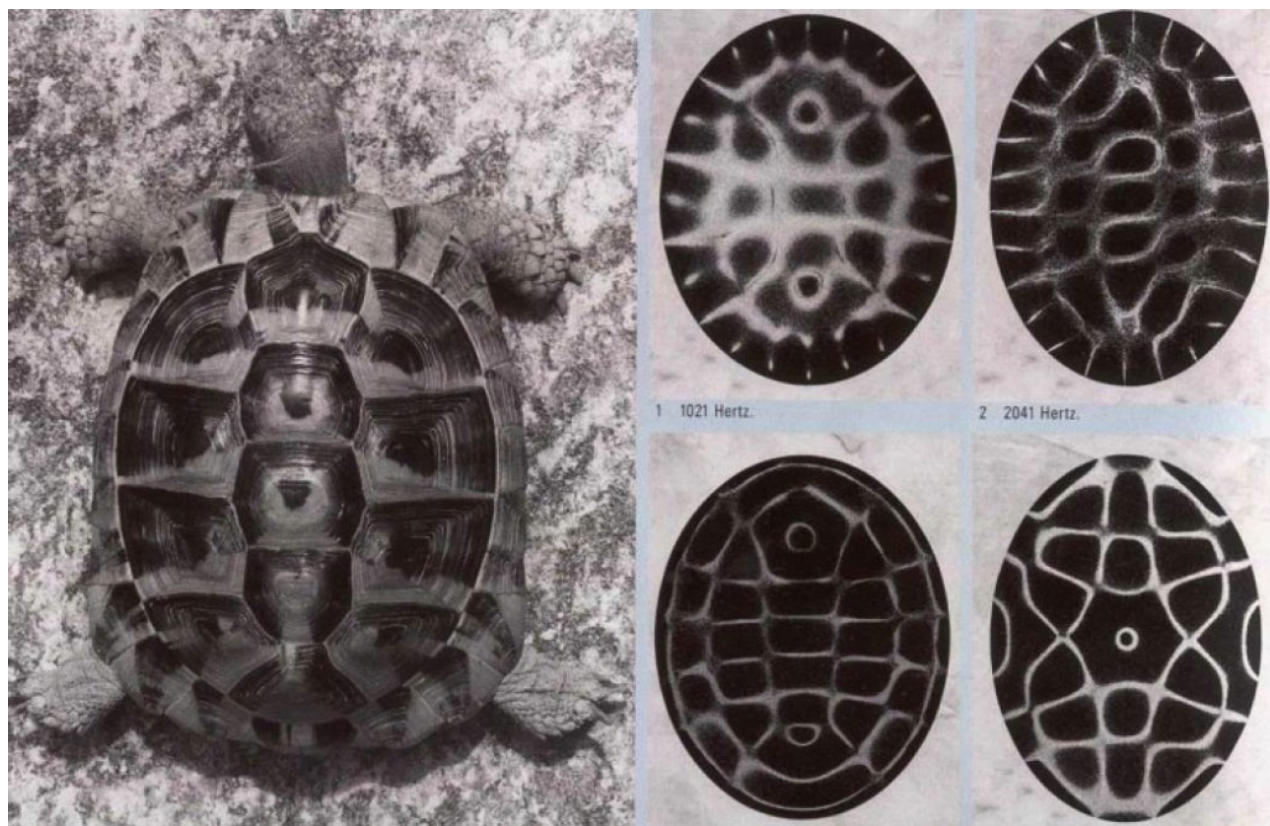
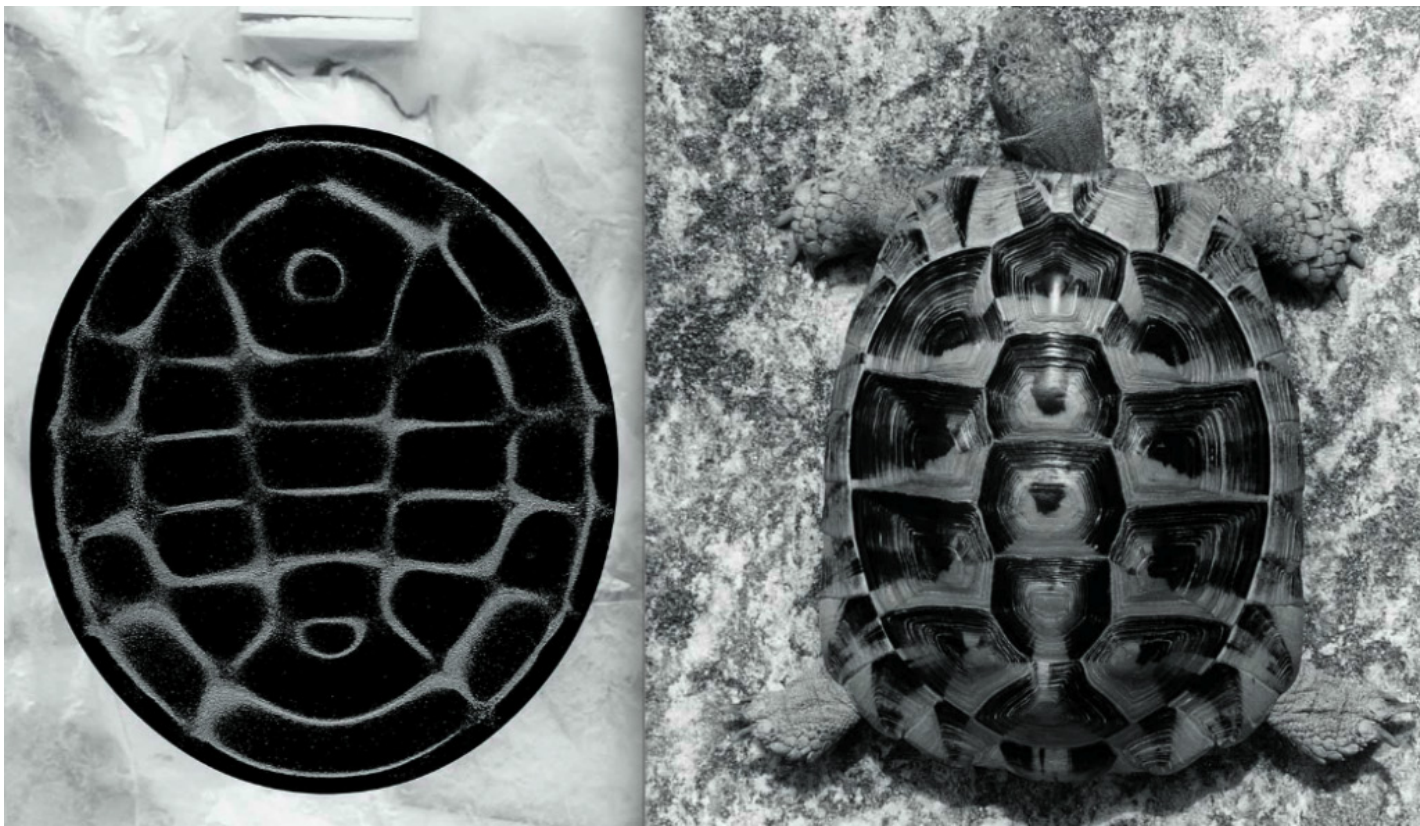


It fascinates me to see this research and it makes you think, does the pattern on the tortoise's back come from a frequency associated to the foetal stages? Are there sounds out there that make these patterns form in the way they do? There are so many questions I want to be able to ask of the science behind Cymatics and I think the shapes of the vibrations give it more of a deeper meaning to me as a graphic designer. We deal with how things should be structured daily and having a grid means things can be lined up in orderly form that's pleasing to the eye.

The shape of sound is clearly defined by frequencies, but why so symmetrical in the way it forms? It's interesting to see these patterns and it is one of the reasons I want to propose a way to be able to capture part of a song in physical form. If these shapes appear so symmetrical, will capturing part of a song work in the same way as an individual note. Could I create something that has an order to it and looks as good in its form as the experiments undertaken by people like Hans Jenny and Ernst Chladni. That would be the main outcome of this study, to have an

object that has all the characteristics of these early experiments, but in a novelty form as a personal gift that you could give to a friend or loved one.

What I will have to do is weigh up the best ways to visualise part of a song and whether I capture its form from waves or cymatic patterns. I also need to know if it's possible with a piece of music in comparison to that of an individual note on a piano or oscillator. From those early experiments, it seems to be that people are hitting a frequency of so many hertz and that is what causes the pattern to form in the way they do, just like the tortoise shell patterns. They have an individual note to abide to in a way and the stronger the signal, the stronger the nodal patterns appear. In my opinion to get one solid looking structure, the frequency that is applied, must hold the same note to get the best form. This makes me wonder that a song with all its different contributing instruments and vocals, would that mean it will be harder to capture a more rounded, symmetrical looking shape.



I came across a video of Pink Floyd called 'Welcome to the machine' which used a cymatic device called a cymascope. This device is a way for us to be able to see a full audio track in all its form. The technique was exactly like that pioneered by Alexander Lauterwasser, which involved applying vibrational frequencies to some form of petri dish filled with water.

(The video can be watched at this link: (1.5)

The video was made by Sonic Age America LLC in 2009 so didn't come from the time Pink Floyd put out the song in 1975. There are no enhancements made to the video, just high end cameras, a vibrational plate and certain lighting to give the shapes that blue hue.

They have also experimented with several other different songs including Beethoven's Sonata no 14.

I think there is something about the shapes that form, they flow with the song and they

don't look out of place. It's as if that is what the eye would imagine those vibrations to be and feels part of the song.

Another video I came across by Lauterwasser, was a cymatic experiment created from the sound of a gong. The way he creates the scene with colour, reflecting that of a golden looking cymbal makes it feel and look as you would imagine. The outcome looks just like a cymbal being hit and the displacement looks like it resonates from a centre point.

What I can take from this video is that the louder the gong is being hit, the more you can see vibrational frequencies move. This visual indicates the same as the tortoise shell. It shows there are more nodal patterns due to a higher amount of frequency being applied. Unlike the shell patterns on a Chladni plate, Lauterwasser used water for this. This therefore indicates that although the shapes in these sound patterns are different, there are similarities in their structure.

(The video can be watched at this link: (1.6)





Pink Floyd's Welcome to the Machine



Beethoven's Sonata no 14

For the outcome of the research, I'm trying to see what techniques in cymatics could bring together some form of shape from a song. A cymascope moves at a rapid pace when a full song is implemented, due to the contrast in sounds. There isn't any kind of fixed note like the early experiments from Hans Jenny, so the patterns move with the music.

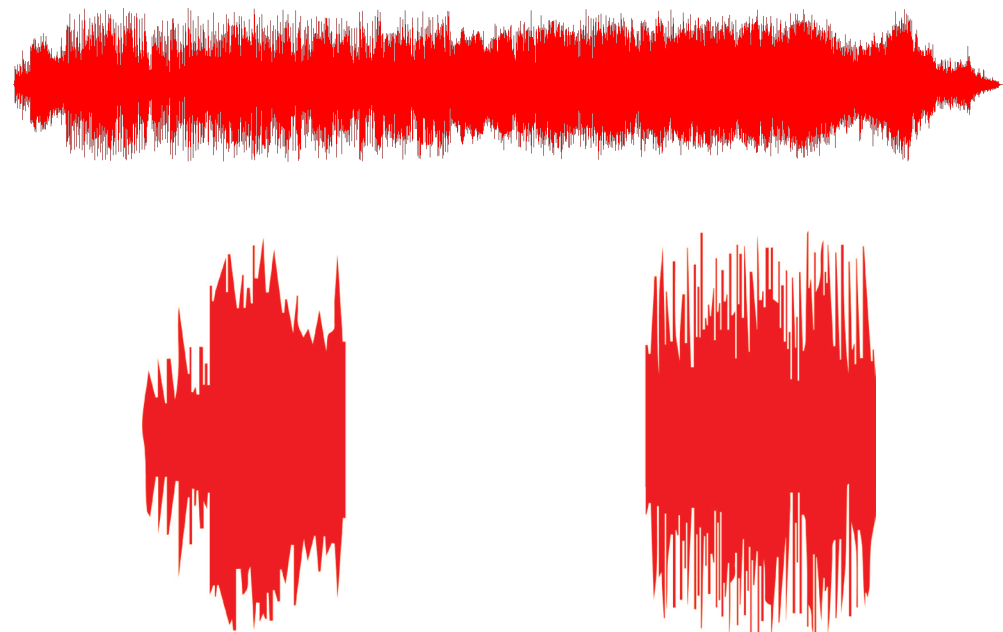
The only viable way I see using a cymascope, is if there is a way to take a photograph at a point in a song. The proposal is to make jewellery so am going to need a fixed shape that could work as a 3D object. I will need to determine how I can implement the shapes with 3D software, with an eventual outcome as cast metal jewellery.

I have considered the extensive side of cymatic patterns, but the other option in seeing sound is in simple wave form. We all know the shape of a sound wave and it's something that is more known to us than the structure of

cymatics. There are options where you can create a wave pattern online by uploading an mp3. (1.7)

Using an online wave generator, I copied across the image of a song (I am the walrus) and turned it into a vector.

There are ways of turning a flat image such as the waves above into a 3d shape in Illustrator. You can use the rotate option to get 3D shape from any flat vectorised image. An option would be to break up the image like above and use part of a song due to the size of a full one. From Illustrator, the next option would be a 3D compatible programme that could work with a 3D printer. If I undertake the project I will consider the software side and speak to tutors who can give me access to these various programmes. I could contact people from various Universities who could guide me to the right software and find out how to implement the shapes into a form of jewellery.



3) *Physical objects created from sound*

It is all well visualising sound but who is making something physical? Who out there is showing us something different than just a petri dish filled with water or a Chladni plate covered with sand?

My proposal is to create something physical from music that can be handed to someone as a gift, something you can hold and get a sense of the structure. To do this, I researched the ways people have created a physical object from sound. One project I came across was from De – Montfort University in Leicester called 'The Sound Sphere Frontrunners project'. They have been able to create a 3D printed model of a Pendulum song in layers, capturing all the various peaks in the vibrational make up.

"Sound sphere is a way of converting music or a sound file and modulating it into a 3D created model"

(Dr Eugin Pen) (1.8)

"The way the sphere works, arranged from the north pole to the south pole, is the sound divided into frequency bands, the bottom low frequency such as bass, the middle mid-range such as the human voice and the top would be high end frequency"

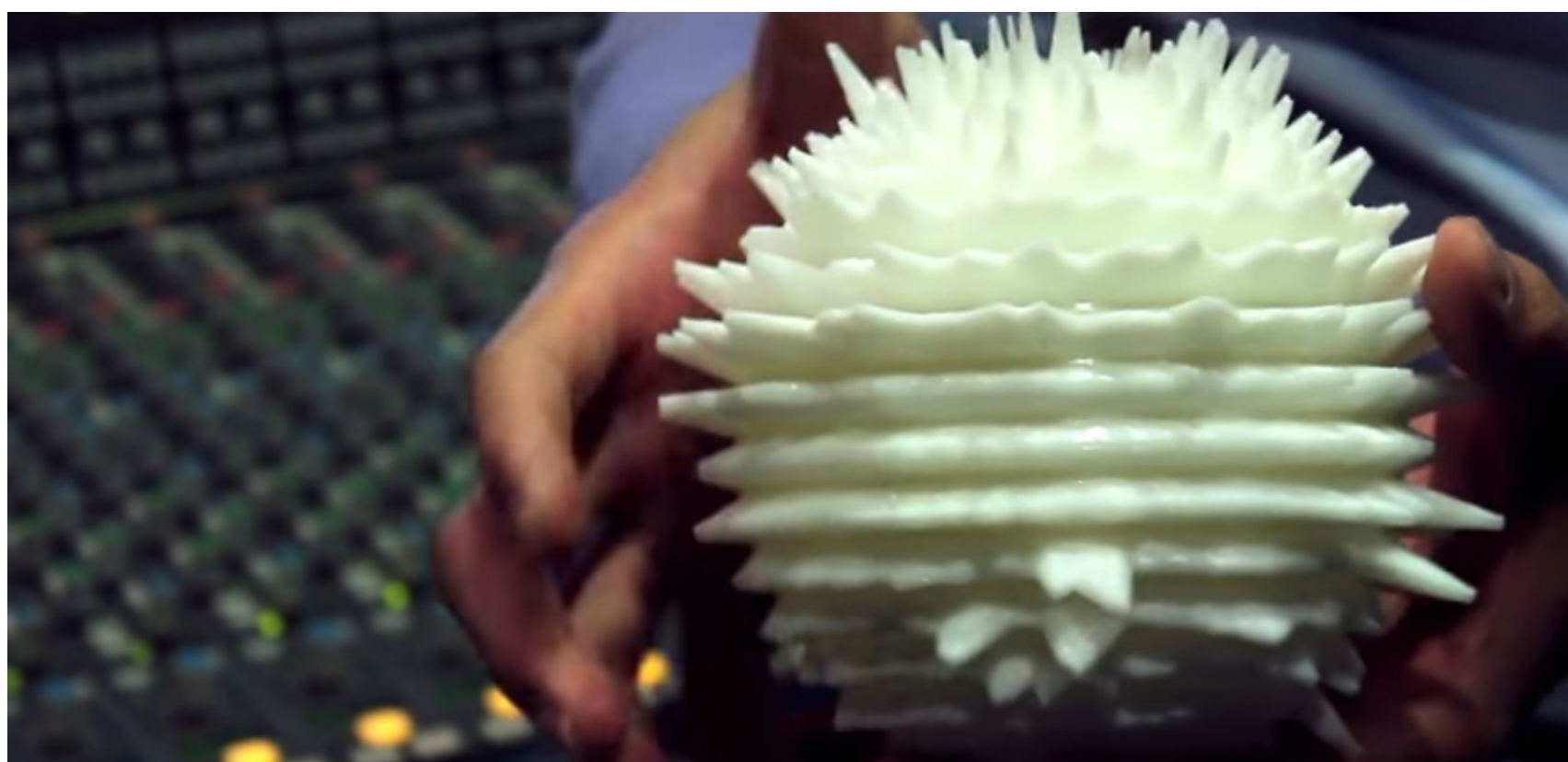
(Chris Feakes) (1.8)

"What you see with each ridge is the change in loudness, effectively of each band of frequencies as the song plays"

(Chris Feakes) (1.8)

Dr Eugin Pen also mentions that 3D printing technology enables you to create objects at any size and it is very cost effective to that of something hand made. This will be crucial for the project to work as an effective business. Developing new songs and music would require printing a 3D model for each customer. Before casting in metal the object would have to be cheap, if I were to repeat the process on a large scale.





From that video, it is great to see something created from sound in its physical form. I have spoken about the aesthetics of the model and whether something as pleasing to the eye as Lauterwasser's water experiments, could be made into a piece of jewellery. These are the sort of people I could do with having on board, as they have been able to physically create an object made from sound. The programme they used works like a wave generator, hitting peaks of sound to show its structural make up. They have then been able to translate these structures into 3D form and create an object unlike anything you may have ever associated with sound.

Whether it is cymatics that features as the technology to capture sound, or using a wave generated programme, there are several ways that could bring this project together. It will need a team of people working together to enable sound to become a physical structure. There will be a need to experiment with firstly

making sound into a 3D printed object, then applying that to metal casting. The jewellery's expense will depend on which metals can be used. I would like to see tests done in Silver casting which I know from discussing with a lecturer at Hillsborough College, would be a viable metal to use. Silver is also a popular and sought after metal when it comes to jewellery.

An important part will be how the object fits into a piece of jewellery. The sound shape will have to be quite small to work as a ring or a bracelet. In this form, they will need to be cylindrical to fit around a finger or a wrist, so that will be a challenging part of the proposal. If I were to firstly start by creating a pendant, casting a 3D shape like the one created by 'The Sound Sphere Frontrunners project'. This will be an effective way to start, as it won't have the need to work based around a ring or wrist, it could work as a small fully cast object.

Conclusion

Finally, my research into 'The shape of sound' was to see what physical structures could be created from sound. Cymatics play a significant role throughout and seeing the way the shapes form from vibrational frequencies is a constantly evolving process. It is still in its initial stages from what can be achieved and is an interesting subject that I will follow, along with the development of this study.

Research is ever expanding into how sound is visualised and even certain scientists are using cymascope to differentiate between healthy cells and diseased cells.

" When cell sounds are made visible with the Digital cymaScope distinctive features can be

analysed that could lead to the development of a new diagnostic tool." (1.9)

Without thinking about just a piece of jewellery, the shapes of sound are becoming a necessity to help us make new discoveries. The subject surpasses seeing a form of music and could lead to a host of new advancements in science moving forward.

My proposal is to give people a way of seeing sound, visualising the songs they love in a new form of jewellery. It will take a lot of collaborations with people in various fields to achieve a product, but a worthwhile one that is innovative and can reach an expansive audience.

Bibliography

- 1.1 [https://en.wikipedia.org/wiki/Hans_Jenny_\(cymatics\)](https://en.wikipedia.org/wiki/Hans_Jenny_(cymatics))
- 1.2 <https://www.youtube.com/watch?v=W6PSA5bYTxs>
- 1.3 <https://www.youtube.com/watch?v=W6PSA5bYTxs>
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- 1.5 <https://www.youtube.com/watch?v=WRyCS746j2Q>
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