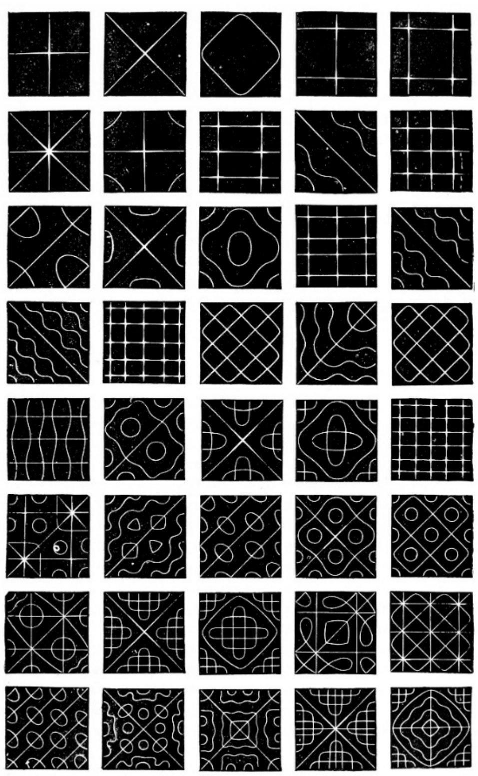
Extract from the book "The science of the future", chapter on Cymatics

By Mirko Kulig

"The more one studies these things, the more one realises that sound is the creative principle. It must be considered primordial. No single category of phenomena can be considered as the original principle. We cannot say that in the beginning was number, or in the beginning was symmetry, etc. By using these elements in the description of our surroundings we approach the heart of matter. They are not, however, its creative force. This force resides in sound'.

(translated from the book 'Kymatik, vol.2' by Hans Jenny).

The subject of sound and music has always fascinated human beings. All peoples have developed musical instruments, made music and sung. The inherent power of sound and music is today evident from the development of a billion-dollar record industry. Quite simply, people love music. It is able to cause very strong emotions and drive them to movement (dance). Moreover, sound is the most direct channel of communication between men.



Chladni figures

Music is generally relegated to the sphere of the arts. Science has mainly been concerned with defining the parameters and characteristics of sound and how it propagates.

However, there have been a number of scientists who have studied sound from a perspective that seeks to create a bridge between artistic aspects and rigorous scientific research. These scientists have tried to make sound visible to the naked eye in order to better study it.

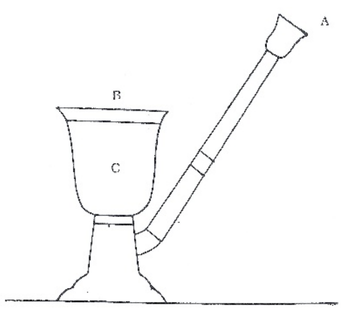
In the 18th century, Ernst Chladni, in the course of his investigations into the nature of sound, performed the following experiment: he applied a thin sheet of metal covered with fine sand to a violin sound box. By then running the bow over the strings, he observed that the sand, vibrating from the sound produced, arranged itself in geometric shapes that changed when the frequency of the note was changed. He began to study the subject in depth, laying the foundations for a new science that would later be called cymatics.

Chladni figures, as they are still called nowadays, are obtained by running a violin bow along the edge of a metal plate on which a powdery material (sand, salt, lycopodium, etc.) has been placed. They develop as regular geometric patterns with areas of dispersion and areas of accumulation (nodal lines) of the material, and change pattern depending on the note heard when sliding the bow. Chladni amazed an audience of scientists at a demonstration in Paris in 1809, and his experiments aroused such interest that Napoleon himself requested a private demonstration.

About 100 years later, a woman named Margaret Watts-Hughes took up Chladni's studies and tried to develop an instrument that would allow her to create figures through singing. Her aim was to be able to visualise the different properties that the sound of the voice takes on depending on how it is modulated in relation to the intensity and quality of the harmonics created. The instrument she invented, which she called the eidophone, consists of an oblique tube connected to an upward-facing sound box on which is a vibrating membrane. She experimented with an incredible variety of materials, from sand to lycopodium, from liquid substances (water and milk) to semi-liquid substances.

Figures obtained by the author

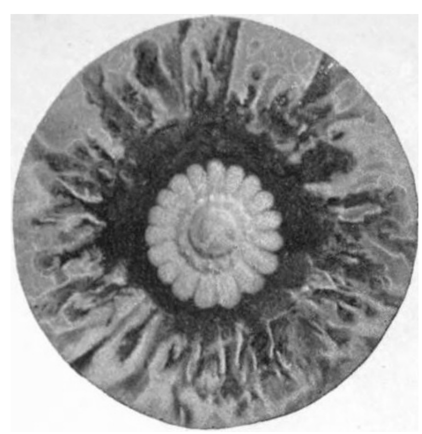
The results she obtained varied greatly depending on the type of material (both the membrane and the vibrating substance). She observed, for example, that for a given size and material of the vibrating membrane, not all notes have a well-defined shape: while with some there is an immediate repositioning of the vibrating substance according to a well-defined pattern, with others this does not happen immediately and sometimes not at all.



The eidophone

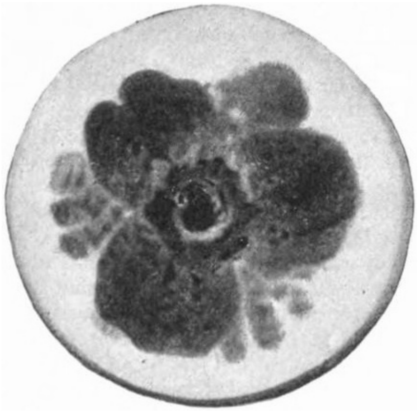
She also observed that the higher the sung note, the more complex the figure becomes. Another peculiarity is that the type of figure depends not only on the frequency, but also consistently on the intensity of the note. This fact is easily explained if one thinks that the human voice depends on the resonance of the entire ribcage, so altering the intensity of the note creates a different harmonic spectrum.

The most interesting results, however, were obtained with semi-liquid materials, created by adding watercolour powder to water. These materials proved to be the most sensitive to any variation in the voice, to the point that many figures could only be obtained by keeping the intensity of the note constant long enough for the material to settle on the membrane. The type of figures obtained in this way were very varied, ranging from purely geometric figures to very complex figures that recalled forms found in nature, particularly plant forms. These types of figures sometimes appeared in rapid succession while a single high tone was held,



The Daisy

moving from one to the other like a kaleidoscope. Mrs. Watts-Hughes herself was unable to explain this phenomenon, which evidently does not depend on frequency.



The Pansy

One particular experiment deserves a more accurate description: she placed semi-liquid material with a larger amount of watercolour on the membrane and then sang a note. The material began to arrange itself in the shape of the petals of a daisy but then remained in a still semi-amorphous state. She then made a diminuendo and the material clustered a little towards the centre, but retained some of the shape it had previously acquired. By increasing the intensity of the note again, the shape of the petals became sharper. After repeating this process several times, the flower eventually appeared very sharp and precise. The most perfect figures she managed to obtain also showed veins in the petals and dots in the centre. Some shapes showed layers of overlapping petals.

She also noticed that the sensation when singing a note in a semi-liquid material differed somewhat from that of singing the same note in lycopodium. In the creation of the flower as shown above, Watts-Hughes had the feeling at the beginning of the process that she would never be able to move the mass of material, as if it were resisting her. After the alternation of crescendi and diminuendi, as the flower was formed, the feeling also changed. This is described by her as follows: “The sensation is now as if all of a sudden the air in the pipe, in the sound box, on the disc and all around are acting together for the singer's purposes”. When she reached this condition, it was as if the semi-liquid material no longer offered any resistance.

Plant figures

As a consequence of practising with the eidophone, Watts-Hughes was able to expand the frequency range she was able to sing, and on each semitone she was able to obtain figures.

To obtain the figure of a pansy, she put a small amount of watercolour mixed with a little water in the centre of the disc and added water all around. Singing the appropriate note, the watercolour expanded to create a few large petals, always multiples of 3.

This figure was particularly difficult to achieve, requiring much practice to achieve perfect control of the crescendo duration and to hold the note.

Working on slight voice modulations and the amount of watercolour and water, she also succeeded in obtaining figures of primroses, buttercups, chrysanthemums, roses and geraniums.

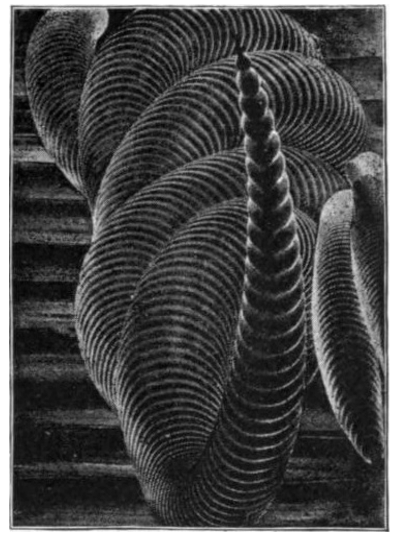


Figure obtained by moving the eidophone

Another technique she experimented with, in search of a way to preserve the history of the sound image, was to move a specially developed eidophone over a glass plate covered with semi-liquid material. In this way, the effects of the sung notes left a trace that reproduced their development over time.

With this technique, she succeeded in producing images resembling various types of plants and trees.

From Mrs. Watts-Hughes' writings, it is clear that the more complex figures require a great deal of training and refinement of the voice to achieve. The tree figure, for example, required many hours of practice before the photographed image was achieved.

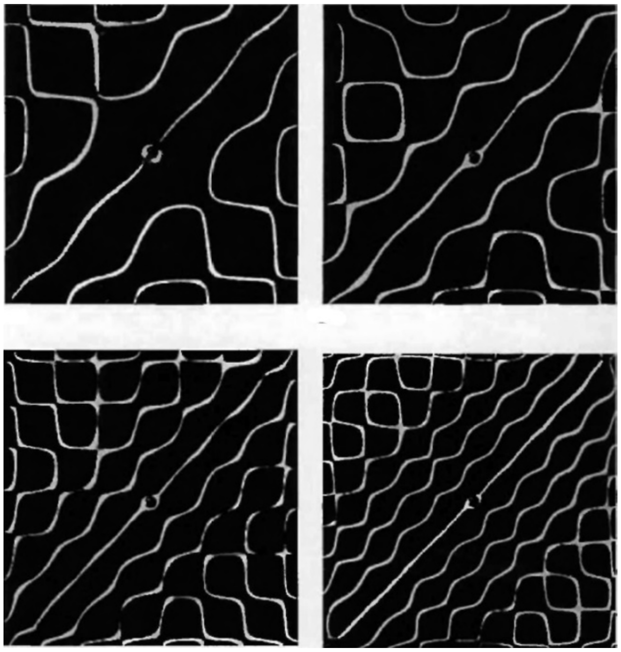
The most modern research on what was previously discovered by Chladni and later developed by Mrs Watts-Hughes can be attributed to the Swiss doctor Hans Jenny (1904-1972).

From an early age, Jenny had an affinity for music and a great interest in nature and art. He went on ornithological expeditions and made drawings and paintings. These interests accompanied him throughout his life. He first came into contact with Rudolf Steiner when he was young, and this prompted him to study anthroposophy. After completing his doctorate, he became a teacher for four years at the Rudolf Steiner School in Zurich before opening his own practice near Dornach in the Basel region.


Hans Jenny in his laboratory

Throughout his life, he investigated natural and vital phenomena using the approach originally proposed by Goethe and later taken up by Rudolf Steiner, which today is called Goetheanism or Phenomenology.

Jenny had observed that in nature, both animate and inanimate, the presence of periodic systems can be recognised everywhere. These are found in respiration, in the heartbeat, in the tension of a muscle, in the production of sound, in the electromagnetic spectrum, in the structure of crystal lattices, in the motion of planets, in the motion of the oceans, in minute atomic motions, in Liesegang rings in chemistry, etc. All these phenomena make explicit the existence of vibratory, oscillatory, wave and pulsating motions. Jenny noted the fact that a tense muscle, although apparently immobile, is actually in an oscillatory state, which can be demonstrated mechanically, optically and acoustically. All the internal processes of the muscle (bioelectric, chemical mechanical, etc.) take place in this vibratory field. He therefore wondered about the effects of the vibratory field on liquid systems.

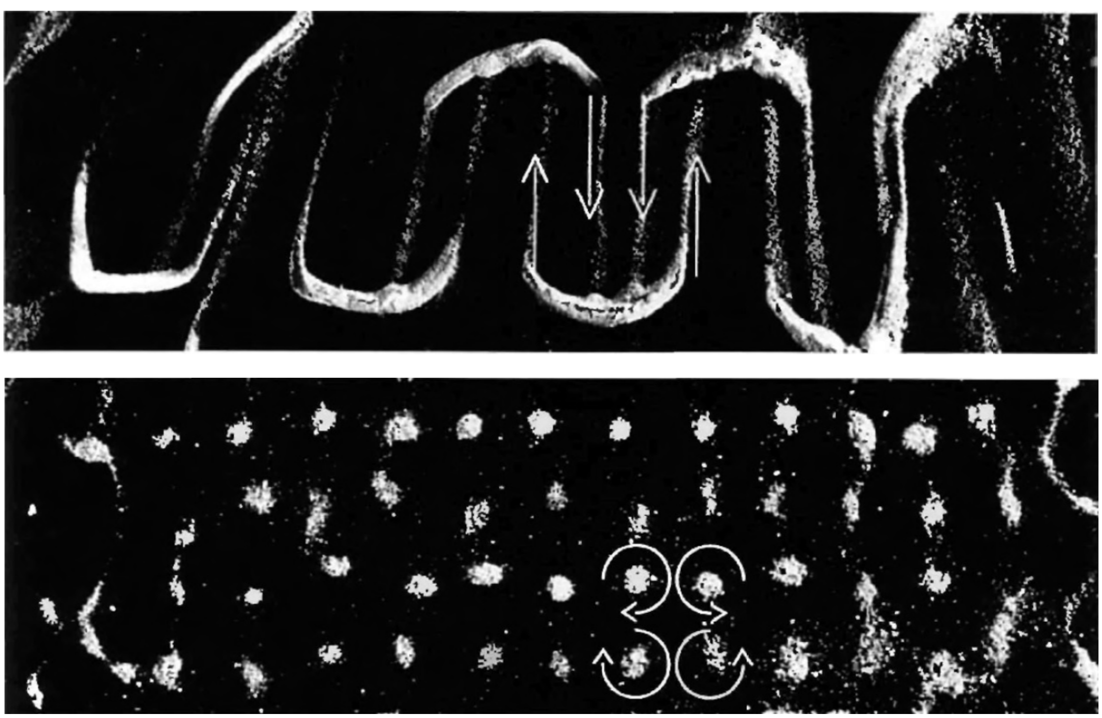


Increased complexity. The images were created with the following frequencies in order: 1690, 2500, 4820, 7800 Hz.

It was he who coined the term cymatics (from the Greek kyma - wave) to describe all the phenomena he studied that were oriented not to waves per se, but to the effects of vibration. His research on cymatics was published in 2 books 'Kymatik: Wellenphänomene und Schwingungen' (Cymatics: Wave Phenomena and Oscillations) Volume 1 and 2, and original footage taken by him showing the many experiments he performed is available on Youtube. The images presented here are all derived from Jenny's books.

For Jenny it was essential to make vibratory phenomena visible, precisely because of the qualities of clarity and consciousness that visual perception conveys, unlike auditory perception, which certainly conveys a great deal of emotion, but which does not possesses these qualities to the same degree.

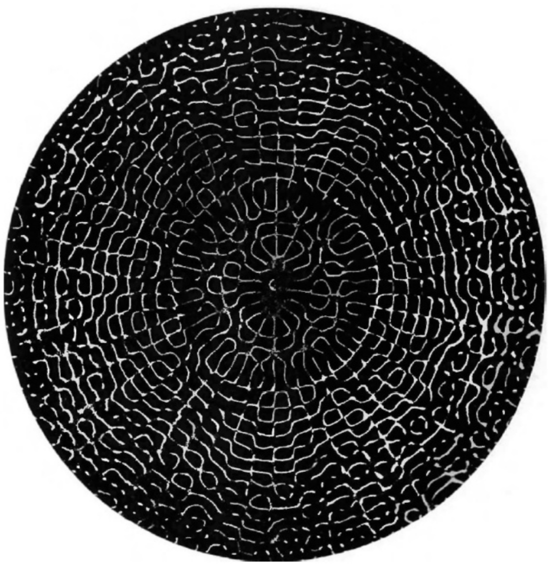
The system he developed is similar to those used by his predecessors, the only difference being that he used a frequency generator and crystal oscillators. In this way he could study the figures created by a large number of different pure (sine) waves, knowing at all times the frequency and amplitude of the oscillation and also being able to observe the effects of the transition from one frequency to another. This method also made it possible to observe the figures created by using several frequencies simultaneously.



Currents and circular motions indicated by arrows

Jenny observed that when beats were created due to the use of 2 similar frequencies, the sand figures on the slab had pulsating motions. Even the apparently stable image due to a single frequency, when observed closely revealed currents of particles along the lines of the figure. Where the sand accumulated in small circular areas, it could be observed that it actually rotated. Adjacent accumulation points had rotation in the opposite direction. In other figures, the two motions combined to create movements that resembled those of galaxies, with currents of sand flowing towards centres of rotation. Jenny also experimented with surfaces of widely varying shapes and found that the shape of the vibrating surface also had an influence on the type of figures that appeared. Using viscous materials, he verified that, once the vibration was applied, the vibrating surface could be tilted but the material retained its position. By placing liquids on the vibrating membrane, Jenny found that vibratory zones were created where, using sand, there were no particles. By heating the vibrating surface, the figure changed to return to its original pattern after it had cooled.

In general, the higher the frequency, the more complex the figure became. Standing waves could be observed as well as moving waves.



Complex pattern

By energising liquids with certain frequencies into which a dye had been placed, the formation of vortices could be observed.

Jenny also experimented with a variant of the Watts-Hughes eidophone, which he called the tonoscope, confirming her observations of figures created by the human voice (I don't know if he was familiar with her work) and also experimenting with symphonies of classical music transmitted in liquids.

In studying the three-dimensional effect of vibration, he subjected heated semi-solid substances to sound and observed what happened as they cooled and became completely solid. The figures that were created had dendritic and sculptural forms. Periodicity, however, remained ever-present.

In addition to reconfirming what Chladni and Hughes had experimented with, Jenny developed his work according to rational criteria and with repeatable experiments.

The images he filmed and photographed show patterns that change depending on how the frequency is modulated. One frequency always corresponds to the same figure (obviously using the same vibrating material). Furthermore, when observing the details of a sound figure magnified sufficiently, one notices that what from a distance and as a whole appears to be a static, stationary line, is in reality a continuous flow of particles (depending on the case, of sand or other) that move, flowing in the same pattern always corresponding to a certain frequency. These flows sometimes take the form of vortices, sometimes look like small explosions, in general they call to mind the images we have of meteorological flows, the appearance of astronomical objects (nebulae, galaxies, stars), as well as elements present in living beings. The most surprising thing one notices when watching his films is that, as soon as the frequency is changed, the entire image changes almost instantaneously and another pattern with other flows is formed.

His experiments also highlight the connection between the overall pattern and the individual processes that make it up.

The two are intrinsically related; the individual streams that are created are difficult to comprehend when removed from the vibrational matrix to which they belong. That is, the total represents more than the sum of the individual parts, and the latter only make sense when placed in the larger context in which they were formed.

Jenny believed that he had identified three components that together gave shape to the unitary overall phenomenon. On the one hand there was the general figure that a frequency determined, on the other there were the dynamic and kinetic motions within the figure, and the whole was generated and sustained by periodicity. The three elements were found in all observed phenomena with the prevalence of one or the other depending on the particular experiment performed, but they were not separable.

Spiral motion in liquids

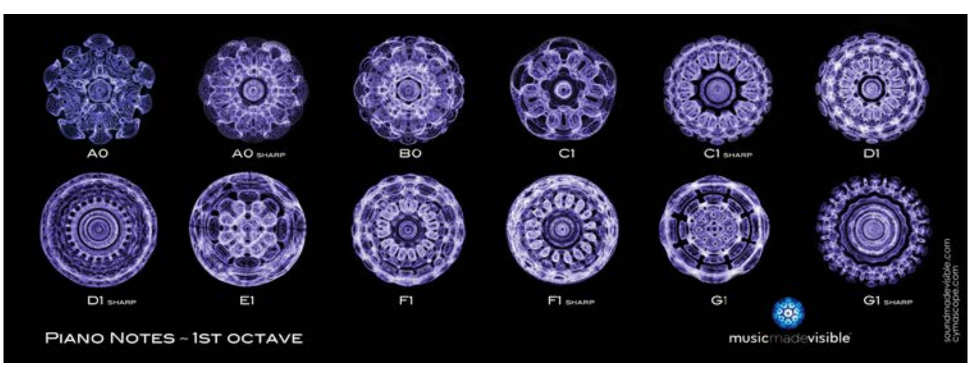
More recently, the English acoustic engineer John Stuart Reid developed a device he called the Cymascope. Reid and his associates work mainly with purified water set into vibration by a membrane. This choice stems from the fact that water reacts much faster to sound modulations, even if they have durations on the order of milliseconds. In addition, it allows patterns to be visualised in three dimensions. Reid's team is actively researching the visible effects of sound in many areas of nature, including biology, astrophysics, oceanography and ornithology.

Three dimensional figure in plastic material

I advise the interested researcher to do a search on Cymascope. The images are truly fascinating.

Chladni, Watts-Hughes, Jenny, Reid and others have dealt with a subject that has taken them into completely virgin territory and on which there is still much to investigate. It is likely that this new science will perhaps be able to make a contribution in the future, and after further study, to the understanding and unification of all the sciences developed by man.

I have personally tried to repeat some of the experiments described here with makeshift means, and have been very impressed by what is achieved. The most striking thing is precisely the fact that sounds experienced until then only as body vibration and auditory perception, all of a sudden become visible and manifest themselves in forms that are not amorphous, not meaningless, but as precise geometric figures.



Sound figures in water obtained by Reid with the Cymascope

In my opinion, these studies also provide a clue as to why music has always aroused the interest of human beings and has developed independently in populations that have never had contact with each other. Perhaps sound and vibrations in general conceal more secrets than we have been able to recognise to date.

Peter Guy Manners was a British doctor who became interested in Jenny's work and worked together with George De La Warr. In collaboration with other researchers, he developed a device similar to radionic devices but that sends sound frequencies to the body. In their research on sound, Dr. Manners' team discovered that five frequencies had to be used simultaneously to obtain three-dimensional figures. After much research, they built a sound frequency generator to transmit healing frequencies to the body and in which there are over 600 pre-programmed frequency combinations, each one of which helps the body to cure a specific health disorder.

Mirko Kulig, 2018