SEEING SOUND: HANS JENNY AND THE CYMATIC ATLAS

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I argue that cymatic imaging processes are methods of artifactual data production rather than data collection and that the production of sonorous figures can be shown to be scientifically valuable when compared to other artifactual data production methods used in the past, particularly Alphonse Bertillon's use of anthropometrics to organize police catalogues in the 19th century. By artifactual, I mean that the data produced through a cymatic regime are the result of the imaging practice, and do not exist in the world before they are manufactured through a contrived process. Cymatics, a mediating imaging practice, permits an enhanced visual access to acoustical phenomena that are typically only experienced through our senses of hearing and touch. Furthermore, the production of cymatic images allows both hobbyists and scientists to create atlases, visual data repositories, of sound, wave displacements, and other modal phenomena. Without the artifactual visual data produced by a process like cymatics, it is impossible to create image-based atlases of invisible phenomena like sound that show more than idealized graphics of a particular wave.

In order for scientific cymatic atlases to be created, the methods of production of a cymatic image, especially the frequency of the wave displacement and the media through which that wave displacement is being propagated, must be faithfully recorded and measured in order for viewers of the atlas to know what particular phenomenon they are observing.. Though cymatics has been studied in detail since the Enlightenment, Dr. Hans Jenny was the first person to accurately record this auxiliary data, which allowed him to create the first cymatic atlas that was useful to scientists.

TABLE OF CONTENTS

I: Introduction

What makes a photograph of a two-headed snake a worthwhile photograph? Why, for instance, would a scientist find it useful? One answer to this question is that a photograph of a two-headed snake has a sensory or perceptual antecedent in the world. It looks like a specific two-headed snake that already exists. Images like this gain their value by matching or resembling data that we can already see with our eyes, though we would like to have the image captured on film so that we can share this visible data with others or refer back to it later.

But what about pictures that do not resemble anything, or pictures that show us something that we could not normally see with our eyes? These kinds of visualizations, unlike photographs of two-headed snakes, cannot gain their value by referring to a visible antecedent in the world because what they are showing is not visible in the first place. How can we account for the value of the data shown by these images?

We can begin to think through this question by exploring cymatics. Cymatics is a practice or method of making sound visible. Through a variety of contrived processes in which sound is propagated through a medium that changes in a visible way to register the passing of the sound, it is possible to create a visual data set about a natural phenomenon that we cannot usually see. This innovative imaging process does not capture something that we could already see. Instead, it creates something that we can see. It makes a visual form for events that would not otherwise possess such a form. Once this visual data can be collected with the means of its production recorded, it becomes possible to create a scientific atlas of sound, or a book containing pictures and photographs, visual data that had no sensory existence before we found a way to create it through an artifactual process.

In this paper, I will argue that cymatics is useful because it allows us to see things that we could not see before. In the absence of the mediating technique, cymatics, used to create the images, there is no possibility of atlas-like organization of non-visible phenomena like sound, because cymatics creates the images that can be used to make the atlas in the first place. Even though our understanding of sound is already to sufficient to explain and predict what we end up seeing in a cymatic image, this atlas-like organization may still help set up the pre-conditions for the production of new knowledge. Cymatics fits into some of the broader narratives in the history of photography, and in order to clarify my argument and ground it historically, I will draw parallels between cymatic imaging practices and the anthropometric regime of artifactual data organization used by Alphonse Bertillon to create the first modern police database in late 19th century Paris.

II: Cymatics

Well, for me, cymatics is an almost magical tool. It's like a looking glass into a hidden world. –Evan Grant speaking about cymatics at TED.[1]

Figure 1. A static sonorous figure on a circular steel plate. Diameter 50 cm, frequency 6520 Hz. Jenny notes, "In pictures like these the patterns resulting from radial and concentric nodal lines can be studied."[2]

Cymatics is a process through which sound can be visualized by clothing it in a medium that we can see and photograph. A typical cymatic image can be made by taking a metal plate, covering it evenly with sand, and then running a particular

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[1] Grant, Evan. "Making Sound Visible through Cymatics." Recorded at a TED conference in Oxford, July 2009. Video available at http://blog.ted.com/2009/09/making_sound_vi.php video duration 4:40.

[2] Jenny, Hans. Cymatics: A Study of Wave Phenomena and Vibration. 1967. Macromedia Press; 3rd edition (July 2001). Page 44, plate 41.

wave displacement, or frequency that can be expressed in Hertz, through the plate. This sound can be produced from a variety of different sources including a speaker, a specifically designed vibrating plate, or even just by running a violin bow across the edge of the plate. As the sound propagates through the medium, it causes the sand covering the plate to move. The fact that the sand moves is not particularly interesting, but the way in which it moves is very peculiar. As the sand moves from spots that are vibrating on the plate to the places where there is no vibration, called nodal points or lines, the sand will form vivid and often symmetrical shapes across plate's surface. These figures include all varieties of lines, circles, waves, ellipses, and straight edged shapes. In some cases, depending on the frequency and medium, the sand will be static and unchanging after the sand has moved to fit the cymatic signature of the wave. In other cases, however, the sand will form a dynamic image and will move in periodic and repeating patterns of shifting shapes and figures.

Figure 2. A dynamic cymatic figure. The particles are in a constant state of periodic flow. This can be better seen in a video than in a photograph. Jenny did create a considerable number of video recordings of cymatic images that are still available online and in libraries today. Steel plate 25x33cm, thickness .5mm, frequency 10,700 Hz produced by crystal oscillators.[3]

Cymatics is a mediating imaging practice that produces visible artifacts called cymatic images which enable us to experience sound through vision. The visual data provided by cymatics comes into being courtesy of the interposition of the mediating regime, the specific process of spreading sand on a plate and vibrating it in a certain way, and this is the major difference between cymatic images and other scientifically relevant photographs, like the photograph of the two-headed snake. The visible data in the snake photograph was accessible to humans without the photograph, the photograph was just a means of catching and recording what we could already see. Cymatics, however, is a way to actually manufacture data that we can use to organize and understand sound visually, even though the visual data is created, not reproduced, during the imaging process.

[3] Jenny 31, plate 24.

I am aware that the word artifact can be used in different ways than the way I use it in this paper. Sometimes, scholars use the word artifact in this context to refer to spurious marks of registration in imaging practices that do not refer to the object of study. For instance, smears, smudges, and distortions found in some photographs do not come from the object being photographed, but are created through the process of registration, the process of photography, itself. I, however, refer to cymatic images as artifacts that are not spurious but are instead a telling species of artifactual data, or data that has been produced as an effect of the imaging process. These kinds of artifacts refer to something more than the registration technique itself. To put it another way, in the photograph of the snake, all of the data that is reproduced in the picture exists independently of the recorded image, but the data provided by a cymatic image are not independent, are not available to us, before we contrived a process to create and study it as an artifact of an imaging technique.

There are accounts of cymatic images dating back several centuries**.** Indeed, one could argue that the first caveman to throw a rock in water and remark to his friend that the propagation of the wave through the water can be observed and is interesting was truly the first cymaticist. However, the practice has not received a tremendous amount of popular exposure, and in the rare cases that it has been studied scientifically it has been studied by scientists or craftsmen as a peripheral aid to a different craft, like making violins or studying the acoustical qualities of a particular material. The vast majority of cymatic images available today, especially on the internet, are produced by amateurs without much regard for scientific precision when recording the results of their cymatic experiment. Instead, it is usually done as a do-it-yourself hobby for the sake of producing the cymatic patterns, which are frequently described as beautiful, fascinating, and artistically meaningful. I think this speaks to the inherent aesthetic value of a cymatic image even if it is stripped of its use as a piece of scientific data, and I will address this point in greater detail at the end of this paper.

It is important to this discussion that I clarify the way that I use the words sound and wave interchangeably throughout this paper. Cymatics is the practice of making waves visible by putting those waves through a medium. Humans are equipped with a sense of hearing that allows us to analyze the information given to us through waves or moving pressure differentials in the air around us. While cymatics can be used to image any frequency, or sound, that humans can hear, we can also use cymatics to image frequencies that humans are unable to register due to the limitations of our sense organs. Though some might object to my use of the word "sound" to describe waves that are outside of the typical 20-16,000Hz range of human hearing, I do this for the sake of brevity. It should be noted, however, that the value of cymatic imaging is substantially increased in the case of non-audible waves, because it is a process of collecting data on a phenomenon that had virtually no way of being received through our natural sensory pathways. Of course, even when we consider a wave of which we can have no auditory experience, the cymatic image of the wave is not reducible to what we hear, and has a separate autonomous value.

One might be tempted to ask why it is necessary to collect images of vibrations and waves in nature, especially if they can be expressed and studied mathematically in the form of formulae and graphical representations. I believe that a quote from Hans Jenny, an important cymaticist who will be investigated in greater detail later in this paper, helps us to express why it is important and informative to capture images of waves in nature and not just idealized into a formula:

"All the same, the phenomenon must be made to yield as much specific knowledge as possible. There is no point in merely reading from the phenomenon what is immediately apparent. Time and again one is reminded of Goethe's words: 'All have a similar form yet none is the same as the other, and thus the choir shows a secret law, a sacred mystery.' Of course, many processes can be analyzed, measured, and expressed in formulae. Of course, formulae, graphs, and probability relations are also derived from reality. These are images of reality and as such are also real. With their aid one can influence this reality, and indeed create new realities (e.g. in technology). But they are derived from reality; they are outside that which really exists; and the latter is more, much more, than the formula, than the quantitative determination can indicate. Only certain aspects of the phenomenon are grasped. But how is it possible to grasp the complete phenomenon, the really real, at all? The creation of purely philosophical ideas, which paints Nature in mental images, is likewise incapable of grasping existence in its vital plenitude. It is "above" the really real."[4]

Here, Jenny engages in a rather reckless discussion of archetypes in nature and the philosophical relationship between theoretical formulae and the evidence in

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[4] Jenny. Hans. Cymatics: A Study of Wave Phenomena and Vibration. 1967. Macromedia Press; 3rd edition (July 2001). Page 69.

the world from which those formulae are derived. His ideas are heavily influenced by one of his favorite naturalists, Johann Wolfgang von Goethe, the famous German writer and polymath who, during his time studying botany, had written at some length about the peculiar way that all members of a given species always share certain characteristics, but no two examples are ever identical.[5] Though Goethe applied this idea to plants, here Jenny expands the domain of this idea and applies it to modal phenomena and waves, or sound. He believes that the "really real" information about sound cannot be grasped with just formulae, and that cymatic visualizations can reveal something about the uniqueness of each species of a particular wave that cannot be expressed in formulae. Whether Jenny is strictly right or wrong here is debatable, but it is true that cymatic images increase the amount of empirical data we have on vibration and sound, even though that visual data come into existence, as data, courtesy of the process designed to produce it. These visual data can then be used to sort, categorize, and analyze the characteristics and fundamental architecture of particular sound waves or the media that the sound wave is moving through.

Regardless of Jenny's claim about the "really real," it is also clear that cymatic images refer to more than the individual sonorous figures that have been manufactured, but also refer to a category or type of thing, a super-individual species of wave displacement or sound that can be understood formulaically. The individual sonorous figures are all unique in their own way, but each is derived from a particular combination of wave and medium, and their artifactual geometrical characteristics are dependent on the archetypal species of wave/media interaction used to create them. This speaks to the ultimate scientific goal of a cymatic atlas: the categorization of sounds and waves by manufacturing visual data in the form of individual sonorous figures through contrived processes.

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[5] Gábor, Zemplén. *Form as Movement in Goethe's „The Metamorphosis of Plants"* http://hps.elte.hu/~zemplen/goethemorph.html. Retrieved 4/3/2010. Gabor is a PhD student in the history and philosophy of science at the Technical University of Budapest.

The word cymatics, coined by Dr. Hans Jenny, derives from the Greek κῦμα[6], or "wave." Though this term was not coined until the middle of the 20th century, cymatic images have been produced and described for centuries, though sometimes inadvertently. Perhaps the oldest example of cymatic imaging devices are singing bowls. Most popular in the Himalayan region and the far Eastern countries of Korean, Japan, and China, singing bowls are a kind of ceremonial upside-down bell made of metal. Singing bowls have been produced and used since at least the 12th century and possibly earlier. When the edge or rim of the bell is rubbed, usually with an ornamented wooden baton, the bell vibrates and produces a harmonious sound. The physical characteristics of each bell – its dimensions and composition particularly – determine the range of sounds the bell can produce, and are unique to each bell. A singing bowl is very similar to a crystal glass that will "sing" a particular note if you run your finger around its rim.

Singing bowls were used as an accompanying instrument for chanting and prayer and were also used as a meditation aid. Sometimes they would be filled, usually with water, to alter the sound they made. When a singing bowl filled with water was played, waves corresponding to the frequency of the bell would propagate across the surface of the water. These waves are visible to the human eye and are an example of a dynamic cymatic image. It is a visualization of the frequency of the bell moving through the bell and the water, and because of water is a fluid medium, the image is dynamic and changes over time as the waves move through the water.[7]

Figure 3. A man holding a singing bowl and baton.[8]

The use of singing bowls is an example of an artistic and ceremonial custom that could be used to produce cymatic images. But cymatic images have also piqued the interest of scientists and natural philosophers since the Enlightenment. One of

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[6] Pronounced 'kuma.'

[7] For more information on the history and use of singing bowls, see Jansen, Eva Rudy *Singing bowls: a practical handbook of instruction and use*. Holland: Binkey Kok Publications. (1992).

[8] Gray, Rain. "An Interview with Lama Lobsand Leshe." http://bodhisattva.com/singing_bowl_history.htm. Copyright 1989. Previously published as *Tibetan Singing Bowls: an Historical Perspective.*

the earliest western accounts of a cymatic image was provided by Galileo Galilei in his *Dialogue Concerning the Two Chief World Systems* of 1632.

> As I was scraping a brass plate with a sharp iron chisel in order to remove some spots from it and was running the chisel rather rapidly over it, I once or twice, during many strokes, heard the plate emit a rather strong and clear whistling sound: on looking at the plate more carefully, I noticed a long row of fine streaks parallel and equidistant from one another. Scraping with the chisel over and over again, I noticed that it was only when the plate emitted this hissing noise that any marks were left upon it; when the scraping was not accompanied by this sibilant note there was not the least trace of such marks.[9]

Though the *Dialogue* was primarily a comparison of the heliocentric Copernican and geocentric Ptolemaic astronomical systems, it is clear that the phenomena that Galileo was seeing when he scraped his chisel across the brass plate was a cymatic image, a visual fingerprint created by propagating a frequency through a medium that makes it easily visible. In this case, Galileo was creating a dynamic cymatic image, or one that changes over time and disappears when the wave stops running through the medium, just like the dynamic cymatic images produced in singing bowls filled with water. When the wave stops, the medium returns to its original unmoving state.

A major innovation in cymatic imaging practices was the discovery that cymatic images could be fixed into an unmoving state so that they could be more easily observed and recorded. This is analogous to the rise of photography in the 19th century: the camera obscura and camera lucida had been employed for centuries as a method of using light to create corresponding outlines and images on a surface, but fixing any single image created by the light was not accomplished until Joseph Nicephore Niepce (1765-1833) used a chemical called Bitumen of Judea to fix the first photographic, or heliographic as they were sometimes known, images onto a permanent surface. This process meant that even when the image in front of the camera was taken away or no longer existed, the light from that image had

[9] Galilei, Galileo. 1939. Dialogues Concerning Two New Sciences. (English translation.) Chicago: The MacMillan Company. Also, see *Good Vibrations*, Joyce McLaughlin, American Scientist, July-August 1998, Volume: 86. Number: 4. Page 342.

created a permanent chemical etching onto a surface that could be used to study the original image after the fact.[10]

In the case of cymatics, it did not take centuries of advancements in chemistry to provide the necessary ingredients for a revolution in image capturing. All it took was a little bit of innovative thinking on the part of Robert Hooke (1635-1703), the English polymath that the historian of science Allan Chapman has warmly labeled "England's Leonardo." Though he contributed to many fields ranging from astronomy to biology to architecture and is perhaps best known for his law of elasticity $F=-kx$[11], his contribution to cymatics is valuable to this paper.

Hooke took glass plates and covered their top surface in flour and then ran a rosined violin bow across the edge of the glass. This created a frequency propagating through the medium of the glass which caused the flour on the surface to move to fit the cymatic fingerprint created from the interaction between the frequency and the medium. Due to its physical properties, flour does not require continuous propagation of a wave to maintain a cymatic image, unlike the water in singing bowls or Galileo's brass plate sans flour. In effect, Hooke had learned to capture a cymatic image so that it could be recorded and studied in greater detail. To do this, he slightly altered Galileo's experiment with the brass and the chisel by modifying the medium and adding a little bit of flour so that a permanent trace of the wave displacement would be left behind and could be recorded even after the wave had disappeared. Hooke created the first static cymatic artifact, a major step towards creating an atlas of images made from sound.[12]

Hooke's process of creating static cymatic images was revisited in greater detail in the 1780s by the physicist and so-called Father of Acoustics Ernst Florens Friedrich Chladni (1756-1827). Chladni meticulously produced and recorded

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[10] Johnson, William, Mark Rice, and Carla Williams. Photography from 1839 to today: George Eastman House, Rochester, NY. Taschen. 1999. 38-40.

[11] Hooke's law states that as long as a force applied to a spring does not exceed the elastic limit of that spring, then the extension of the spring will be in direct proportion with the force being applied to it. *Ut tension, sic vis* "As the extension, so the force."

[12] McVeigh, Daniel. An Early History of the Telephone 1664-1865. 2000. See the chapter entitled "Robert Hooke (1635-1702): Experimental Philosopher. Available online from Columbia University at http://www.ilt.columbia.edu/projects/bluetelephone/html/hooke.html. Retrieved 4/3/10.

cymatic images by bowing the edges of different plates covered in fine sand and drawing diagrams of the resultant images. The resultant patterns, often vivid and precisely symmetrical, were sometimes referred to as Chladni patterns or sonorous images. These patterns helped to reveal the acoustical properties of certain media, including the bodies of instruments like guitars or violins. [13] A diagram of some of these images from Chladni's book *Die Akustic* (1802) is reproduced below.

Figure 4. A demonstration of the production of a sonorous image using a Chladni plate and bow.[14]

Figure 5. Illustration of Chladni patterns from Chladni's *Die Akustic* (1802)[15]

The next significant advance in cymatics that I would like to address did not occur until more than a century later when Hans Jenny (1904-1972), a doctor and amateur physicist, employed modern photographic and electronic equipment to produce cymatic images and record the parameters for the production of those images. Jenny is the father of the cymatic atlas, the creator of a scientifically useful collection of images derived from sound. There were other scientists interested in cymatics between Chladni and Jenny, including Michael Farraday and Lord Rayleigh, and although I do not address them in this paper, their contributions to cymatics and their respective fields are significant.

Dr. Jenny emphasized that humans can have access to vibration through three sensory pathways: we can hear a vibration as sound in the air, feel vibration with our bodies, and we can see vibration and the effects of vibration with our eyes. He also believed that our ability to see vibration was the most limited, and his goal was to facilitate the visualization and imaging of cymatic effects because he believed that our sense of sight is the most discriminating. While many scientists will object

[13] See the University of Cambridge's Whipple Collections. "Whipple Collections: Ernst Chladni". University of Cambridge. http://www.hps.cam.ac.uk/whipple/explore/acoustics/ernstchladni/. Retrieved 4/2/2010.

[14] Whipple Collections. http://www.hps.cam.ac.uk/whipple/explore/acoustics/ernstchladni/. Retrieved 4/3/10

[15] Image retrieved from the University of Cambridge's Whipple Collection. http://www.hps.cam.ac.uk/whipple/explore/acoustics/ernstchladni/chladniplates/ . For a more detailed account of Chladni patterns and the methods used to create them, see Chladni's book *Entdeckungen über die Theorie des Klanges* (Discoveries in the Theory of Sound).

to the claim that our sense of sight if the most acute or most discriminating, this much is true: Dr Jenny wanted to expand the kinds of data that we could receive from vibration, and by creating and cataloguing cymatic images, he provided visual access to a phenomena that is normally not seen, one that is usually perceived through our senses of hearing and touch. By doing this he created a way of making a scientific atlas, a tome of visual data about a particular phenomenon or subject, on sound.[16]

I find it useful to explain cymatics as a form of mechanically induced synesthesia. Synesthesia is a medical condition that causes people to experience sensations from multiple sensory pathways when a single sensory organ is stimulated. One example is sound/color synesthesia, where a certain harmony or sound will cause a person to experience and perceive color. Each sound has a particular signature color for a sound/color synesthete. In cymatics, a static fingerprint of a wave is made out of sand on a metal plate and is used to make a particular geometrical signature that is visually perceptible, allowing us to perceive and study the wave through a sensory pathway that it is not usually vividly experienced through. Even more, this sort of mechanical synesthesia is shared: anyone can see the same cymatic pattern with their eyes, just like anyone can hear the same frequency with their ears. I think Hans Jenny would appreciate this analogy of cymatics to a form of induced synesthesia because his primary interest was in documenting waves photographically for the sake of making them more visible than they had ever been in the past, and luckily for the sake of history he also took the time to carefully record his techniques and the details of production behind each cymatic image [17]

Because of his accomplishments, Dr. Jenny can be reasonably entitled the most important cymaticist in history. He examined thousands of combinations of

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[16] Jenny. Hans. Cymatics: A Study of Wave Phenomena and Vibration. 1967. Macromedia Press; 3rd edition (July 2001). Page 11. This may be the most complete published account of cymatics, and contains dozens of well documented cymatic images. It is a must-read for those interested in the history of cymatics.

[17] Hubbard, Edward, and Vilayanur Ramachandran. Hearing Colors, Tasting Shapes. Scientific American Magazine, May 2003. Synesthesia was first documented in the 1880s by Francis Galton, Charles Darwin's cousin, when he published a paper on the topic in the periodical Nature.

frequencies and mediums and recorded the details behind each of the photographs and videos of the resultant cymatic images with a precision that his predecessors were not able to achieve, if they had even tried at all.

Refer back to Figure 1. While Chladni has done an admirable job of recording the shapes that the sand on the plates formed, he is unable to tell us what frequency made that image. Chladni may have been able to describe with some degree of precision the medium through which the frequency was being propagated[18], but he would not have been able to accurately measure the frequency that was being imaged through that medium. Because Chladni was producing the cymatic images by running a bow across the edge of the plate, he did not have the ability to determine or accurately measure the frequency of the wave displacement in a scientific unit like Hz. Jenny's contribution to cymatics was that he was able to produce, reproduce, and record the frequencies that he was using to make cymatic images with a degree of accuracy that was afforded to him by his more modern equipment. Instead of using a bowstring on a metal plate, which can be used to make many different cymatic images depending on where the bowstring is used on the edge of the plate, Jenny was able to propagate frequencies that could be measured in Hz and reproduced more accurately than an image made from a bowstring. Jenny also used a much more advanced form of wave generation: instead of using a bow string, he was able to create cymatoscopes using piezoelectric generators that could be regulated electronically and could produce steadier wave displacements than any of Jenny's predecessors.

Dr. Jenny also conducted the first cymatic experiments involving fluctuations in frequency and amplitude. With the help of his modern equipment, he was able to produce a specific cymatic image from a particular frequency and then record the way that image would change when he changed the frequency. He writes, "Hence it is possible not only to produce vibration patterns and investigate the laws to which

[18] For example, it would have been within Chladni's ability to measure and record the dimensions of the plate upon which he was creating a cymatic image. He would be able to measure and tell us that he was using a steel plate weighing one kilogram and with dimensions of 15x15x1 centimeters, but he would not be able to tell us how to reproduce the same wave displacement through that medium because he could not tell us what that frequency was, only that he produced it by using a specific bow.

they continuously conform, but also, and more especially, to make a close study of the transitions as one figure gives rise to another."[19]

Figure 6[20]

Because Jenny was able to collect so much additional data, he could explain what, exactly, is being represented in a photograph of a sonorous image. He measured the wave and the medium that come together to create a cymatic effect, and by doing this, he was able to identify the phenomenon in a photograph. He was able to give the elusive waves in nature names, identities, by combining a photograph of the sonorous image and sorting data in the form of a detailed account of what materials and conditions were used to produce that sonorous image. Jenny's predecessors had learned to make cymatic images but had never been able to give the figures in those pictures a meaningful identity, which prevented them from being organized coherently into an effective scientific atlas.

It is clear that cymatics has had a long history of being flirted with by serious scientists, but its historical scientific value has been and continues to be somewhat obscure and undervalued. Cymatic images have been made and observed by humans for centuries, but they did not begin to receive serious scientific attention until the Enlightenment, when Galileo first recorded his observations of dynamic cymatic images and Hooke found a way to fix these images in a way that allowed them to be more easily recorded. Chladni created the first serious archive of cymatic images, and Jenny used modern equipment to record the exact circumstances achieved in his lab to produce each cymatic image, and was also able to record these images with high-speed and high-definition photography. Though there are some scientists and hobbyists using and studying cymatics today that are creating new techniques by using new mediums or wave production equipment, Jenny's work was the last great advancement in cymatic imaging. Cymatics exists today primarily as a popular do-it-yourself activity among amateurs and a significant amount of

[19] Jenny, 22
[20] Jenny, Foreword. Here, Jenny is pictured with some of his cymatic imaging equipment.

cymatic images, including both photographs and videos, are available in archives and on the internet today.

III: Cymatic Atlases and Applications

By recording dolphins as they echolocate on various objects, and also as they communicate with other dolphins about those objects, we will build a library of dolphin sounds, verifying that the same sound is always repeated for the same object. The CymaScope will be used to image the sounds so that each CymaGlyph will represent a dolphin word. Our ultimate aim is to speak to dolphins with a basic vocabulary of dolphin sounds and to understand their responses. This is uncharted territory but it looks very promising. –John Reid on using cymatics to decipher dolphin song

Above, I have explained how cymatics is a process that allows us to invent visible data that corresponds to particular sounds. I would now like to show how this kind of data collection can be used to create atlases, or scientific artifacts that allow visible data to be shared between researchers and laypeople alike.

I borrow the idea of the atlas from Lorraine Daston's and Peter Galison's Objectivity, and this idea can be used to help to show what the real value of a cymatic image can be if they are created and recorded carefully. An atlas is a compilation of "working objects" of science. These can be drawings, graphs, photographs, lab procedures, specimens, or more. This is one kind of tool or communal data repository used by scientists to preserve and share their data within a scientific community. Atlases are useful to scientists because they allow them to see specimens of a particular class and to train their eye to identify visual distinctions within and between certain classes of things, like animals, astronomical phenomena, or insect wings. Daston and Galison argue that atlases were and are created for longevity, to preserve scientific data, and to provide a body of data that can be and is publicly accessible and will facilitate collaboration. There are atlases for every field of science, including zoology, astronomy, biology, chemistry, medicine, and Dr. Jenny created the first comprehensive atlas of cymatic phenomena, of sound being caught on camera by clothing them in visible media.[21]

It can be argued that Ernst Chladni actually created the first atlas of cymatic atlas by collecting and printing sketches of the sonorous figures produced by a

[21] Daston, Lorraine, and Peter Galison. Objectivity. Zone Books: New York. 2007. Pages 22-27. In this book, Daston and Galison "trace the emergence of epistemic virtues through atlas images," especially the rise and fall of mechanical objectivity in the 19th and 20th centuries.

violin bow in his lab. This may be true, but I prefer to think of Chladni's work and cymatic images as a kind of proto-atlas, and the reason that why I believe this is also the reason why I believe Dr. Jenny was so important to the history of cymatics.

Dr. Jenny was one of the few scientists to make an effort to not only create cymatic images but also to record what wave and medium were being pictured and to describe the contrivance he used to bring about this new kind of visual data. He did this by recording certain auxiliary information about each cymatic image. This information included the frequency of the sound or wave being produced, how it was produced, and the characteristics of the medium through which the wave was being propagated, including dimensions, shape, density, and the material the plate was made of. He also recorded detailed information about the kind of secondary media he used to create the images, or the media that actually moves to form the cymatic image, such as sand, lycopodium powder, oil, iron shavings, or non-Newtonian liquids.

Jenny was the first and remains one of the only cymaticists in the history of the practice to have the ability to collect this data and include it with photographs of his cymatic image and to actually collect it in practice. For Jenny, this is largely due to luck; he was active during a time period when the available technology allowed him to produce and record waves precisely and accurately, something that his 19th century counterparts would have only been able to approximate with their more limited equipment.

Imagine an ornithological atlas that contained nothing but extremely high-quality images of hundreds of species of birds, but contains no additional information about those birds. In the case of ornithology, this additional information would usually be the genus and species of the bird. How could these birds be usefully catalogued? How would you efficiently use this atlas to find a picture of a bird that you have not seen before, or a bird that you have seen but want to know more about or cannot identify? You could, for example, try to categorize the photographs by the color of the bird. But then what do you do for those cases where a bird is many different colors or distinguished from similar species by factors other than color? Without an effective and universal way to organize these extremely valuable images, they lose their value as working objects for science because they cannot be retrieved when they are needed due to a lack of organization.

Chladni's cymatic atlas is analogous to this photograph-only ornithological atlas. It contains accurate representations of cymatic phenomena, but does not tell the person viewing these images the identity of those phenomena in terms of the wave and medium used to create it with sufficient accuracy or precision. Jenny's atlas, on the other hand, identifies the species of the things in his photographs, but instead of using the binomial nomenclature used by ornithologists to identify species of birds (like *Ramphastos R. sulfuratus* – the Keel-billed Toucan), Jenny provides the data about what frequencies he used, how he used them, and what media these frequencies were propagated through (800Mhz propagated from the bottom left corner of a glass square with mass x, density y, and shape z). This means that his atlas includes a visualization of sound that was created using a particular process of spreading sand on a vibrating plate, and also exact information about the process itself. By doing this, he lets observers know what they are looking at and also tells observers how to reproduce these visualizations should they want to.

Figure 7. These four figures have similar patterns but range in complexity. This relationship between these frequencies could be meaningfully assessed and described by scientists, but only if they also had additional information about the process used to make these images, which would identify each species of cymatic image and let viewers know what they were looking at. Clockwise from top left: 1690 Hz, 2500 Hz, 4820 Hz, 7800 Hz. All patterns imaged on a steel plate with dimensions 23x23cm and thickness 1mm.[22]

But what is the value of a cymatic atlas, and who has used an atlas of cymatic images for scientific purposes in the past? It would be tempting to say that Dr. Jenny was the first person to use his collected photographic data to create hypotheses and theories, but this does not seem to be the case. Dr. Jenny was primarily concerned with collecting the data reliably and efficiently and describing the characteristics of the cymatic image in great detail, and by doing so established the method through which an effective visual atlas of sound could be created. His project was to create a process of archiving scientific cymatic images so that they could be used as new and

[22] Jenny 34. Plates 27-30.

reliable data about sound by other scientists. He wanted to establish the practices necessary to bring scientific value to the cymatic images by documenting the circumstances of their creation. Of course, the visualization technique – using a particular sand on a particular plate vibrating at a particular frequency – is an arbitrary collection of equipment and media relative to the wave displacement on which this equipment is used to report. Any number of cymatic contrivances could be used to report on any wave displacement, often with highly different results.

However, Jenny did not make significant contributions to cymatics or acoustics by creating detailed theories of how and why the cymatic images formed the way they did, or by making predictions about what a cymatic image that had not been created yet would look like based off of past data. He took the step that is necessary before theory formation and hypothesizing is possible: he manufactured the data, and that data can be easily used by anyone else with access to it in the future because it contains the necessary information about the process used to create the image shown in the photograph, allowing a comprehensive visual atlas of sound to be created.[23]

It is clear that Jenny was a tremendous contributor to cymatics, but his contribution was that he learned to assemble the valuable working objects, photographs with information about the species of the sound wave being imaged, into an expanding atlas of cymatic images. But there are a few notable and fascinating examples of scientists using atlases of scientific cymatic images for practical purposes, prediction, and theory production.

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[23] A reviewer named Peter Baum sums this up well in his comment on Jenny's Cymatics on www.amazon.com, dated June 22, 2004: "On the positive side, this set shows many examples of patterns generated by sound in various media and using various techniques. As such, it represents a nice compendium of examples, and the photographs are visually appealing. However, the work does not represent scientific research into this phenomenon in the modern sense but is more like the exploratory research and categorizing done by the ancient Greeks. No theory is presented that explains the phenomena in terms of mechanics or dynamics and no predictions are made based on theory or observation." My argument is that Mr. Baum's review is accurate, but that he cannot claim that Dr. Jenny's work is not scientific because Dr. Jenny was collecting valuable scientific data by using a combination of innovative imaging practices and modern electronic equipment. He did not use that data to make theories himself, but this data could be used by scientists in the future to make and test theories. http://www.amazon.com/Cymatics-Study-Wave-Phenomena-Vibration/dp/1888138076 . Accessed 3-24-10.

One of the most intriguing examples is the use of cymatics to create a visible dictionary or lexicon of dolphin song. Dolphins emit a wide variety of dynamic noises to communicate and to navigate, much in the way that bats use echolocation to "see" where they are going and hone in on their insect prey. English acoustics engingeer John Stuart Reid, and American dolphin researcher Jack Kassewitz are spearheading an effort to photograph and record the cymatic impressions left by particular dolphin songs in water. These images can then be organized according to their species – the series of waves and frequencies that made them visible in the water – and these images can then be catalogued and compared to reveal similarities or differences in particular songs that are not readily apparent through a sound recording or graphical representation of that song. This is a perfect example of how cymatics allows us to have new sensory access to a familiar phenomenon – we can see the footprints of sound, and these visualizations can allow us to compare and contrast sounds in a whole new way. Furthermore, many of the noises used by dolphins to communicate and echolocate are at frequencies above the range of human hearing, so cymatic imprints of these noises are giving us access to a phenomenon that was difficult or impossible to perceive through any natural sensory pathway in the first place. We already knew that dolphins made sounds, and we already knew what frequency those sounds were, but the cymatic atlas or lexicon of these sounds provides a whole new way to sort, compare, and understand these sounds and how they are used by dolphins to interact with the world.[24]

Figure 8. A dolphin sound moves through the water in the shape of a cone, and "slices" of this cone may be imaged and show cymatic figures called CymaGlyphs by John Reid. These cymatic imprints can be recorded and used by scientists to catalogue and study the nature of dolphin communication and echolocation.[25]

[24] Retrieved from the online archive at Cymascope.com. http://www.cymascope.com/cyma_research/oceanography.html. Accessed 4/1/2010. Also, see John Reid's paper "Songs from the Sea: Deciphering Dolphin Language with Picture Words." 09 June 2009. http://cms.soundhealingnetwork.org/index2.php?option=com_content&do_pdf=1&id=181

[25] Cymascope: Sound Made Visible. 2010. http://www.cymascope.com/cyma_research/oceanography.html

Figure 9. A dolphin CymaGlyph from John Reid.[26]

Cymatic images are artifactual and their artifactuality[27], the process used to create the image, is the precondition for their rational storage and organization. For instance, a cymatic atlas can be organized effectively by splitting the various images into groups according to the medium or frequency used to image them. At this point, it should be mentioned that the additional data about the creation process that makes a cymatic image atlas-worthy may require expansion in the future, especially as we discover that certain factors like temperature and pressure can have dramatic effects on the way that a wave moving through a medium will leave a cymatic fingerprint in its wake.

Dr. Jenny may have been the first person to experiment with changing the temperature of the media by heating the edge of the plate with a flame. He noted that this temperature change in the media caused changes in the geometry of the zero-vibration nodal points, and thus changed the resultant cymatic image. These changes are caused by the effects that temperature fluctuation can have on density and molecular structure in a medium, especially if that fluctuation is uneven across the medium. Temperature and other additional measurements must also be included in the additional information used to identify the various species of cymatic images. Dr. Jenny did not include precise information about the nature of the temperature change on his cymatic figures, only that he used a flame to heat a corner of a plate. This decreases the ability of viewers of these atlas images to identify what they are looking at, or to know the exact parameters of the creation of this visible data from a non-visible phenomenon. The project of collecting important additional data about a particular cymatic image was advanced and promoted by Jenny, but these techniques must continue to be refined in order for the scientific potential of cymatics and cymatic atlases to be maximized.[28]

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[26] Ibidem

[27] Artifactual data is a product of the resitration, and in the case of cymatics, the sonorous image is a telling and informative artifact, not irrelevant static or noise that is only informative about the registration process and not the object being imaged.

[28] Jenny, page 30. Plates 22 and 23 show sonorous figures before and after the temperature across the plate was changed.

Figure 10. The picture on the left is a sonorous figure produced on a steel surface measuring 24.5x32.5 cm with a frequency of 1580 Hz. The right picture is the same experiment after a corner of the plate has been heated with a flame. Jenny notes that sonorous figure from the left reforms after the plate cools off.[29]

There are many other practical research purposes that can be served by employing cymatic data. One practical application would be to use cymatics as a way to study the acoustical properties and molecular structure of certain solids under different circumstances. Because cymatic images are very sensitive to variations in density and temperature across a single surface, cymatics could also be employed to test materials to see if they are warped or deformed and if the material is of uniform density. You could use before and after cymatic images to compare and study differences in a material over time by analyzing its acoustical fingerprint. This could be useful for tasks like inspecting structural integrity of building materials as they age or are affected by fire, earthquake, or other disasters. Cymatics can also be used to study the formal architecture of waves by comparing the acoustic structures of different waves as they travel through the same media. Comparing cymatic images in this way may reveal hidden differences or similarities between sound waves that could not have been easily revealed by experiencing these phenomena through tactile or auditory sensory pathways. This is only a short list of the practical applications of creating and employing cymatic atlases to reveal information from the world around us that may have been difficult or impossible to uncover before.

IV: Bertillonage

Bertillon's work also offers an opportunity to establish a wholly different theorization of the concerns, imperatives, and imaging strategies that, in the late nineteenth century, informed the deployment of photography in some of its most significant scientific uses. –Josh Ellenbogen, Criminality, Identity, and the "Unreasoned Image."

I would now like to embed this discussion in the history of scientific imaging practices by comparing cymatics to another set of historical data that did not derive its force or practical value by matching up with a sensory original or with data that could be perceived in the world with our five senses alone. This practice is called anthropometrics.

[29] Jenny 30, plates 22 and 23.

Anthropometrics literally means "human measurement." It is also known as Bertillonage, an homage to its most famous innovator, Alphonse Bertillon (1853-1914). Born to a prestigious and well-educated Parisian family, Bertillon was a mediocre student in his youth. He received his first menial appointment to the Paris Prefecture of police in 1879 with the help of his father, the statistician Louis-Adolphe Bertillon. He worked in the Identification Service, where the files of criminals and felons were maintained. At the time of his appointment, there was no meaningful system of organization for these criminal records. This lack of systematization made working with the data in this archive a tedious and difficult task.[30] Bertillon's major contribution to criminology was to fix this problem by employing artifactual anthropometric data as a means of organizing the archives.

Figure 11. Mug shot and anthropometric measurements of Alphonse Bertillon. It was nearly impossible for police to catalogue and access these photographs without a standardized method of identifying the criminal subject.[31]

The Identification Service had been including photographs in criminal files since 1872. These were usually pictures of the side and front of a person's face, called a mug shot, and these were a significant addition to the police files. By the time Bertillon began working for the prefecture in 1879, the archives already contained tens of thousands of files that included photographs of the documented arrestees.[32] [33]

One of the most important functions of a police record system is to identify repeat offenders. This was particularly important to the Paris Prefecture because their legal system enforced stricter punishments for repeat offenders than for first time offenders. Every time someone was arrested, he or she would have a file created to record his or her activities. The police department hoped that this would allow them to prove the identity and past of a person if he or she were arrested again.

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[30] Ellenbogen, Joshua. Reasoned and Unreasoned Images. Manuscript. 34-35.

[31] Retrieved from http://farm1.static.flickr.com/55/112271319_36374945e7.jpg .

[32] Ellenbogen 40, 41

The system before Bertillon's intervention did a good job of taking photographs of arrestees, and also documenting details of their crimes, their given name, their residence, and so on. But it was crippled by a serious flaw: there was no efficient way to organize the collected data. This meant that even if a particular file held important information, there was no easy way for the police clerks to know to look for that file in the first place.

This problem was exacerbated when re-arrestees lied about their identity. This caused two separate problems. First, it meant that the police would not be able to easily find the file that proves that the person has been arrested before, even if the police suspected that the person was lying. Second, it meant that two or more files could be created for the same person. This second problem created a significant amount of redundant data in the already massive archive of criminal histories, personal details, and mug shots, making it an even more difficult task to organize and catalogue the data effectively.

Bertillon summarizes this problem well:

> "It is one thing to pass a law against recidivists: it will next be necessary to apply it. In order to condemn a recidivist to exile, the first condition is to recognize his or her identity. If an individual already condemned under the name of Pierre claims that his name is Paul and that it is his first offense, how can one even suspect a lie? How can one prove it? There is the problem that occupies us… To the extent it receives no solution, make no mistake, the law against recidivists will have a difficult and limited application."[34]

Bertillon was absolutely right. Having comprehensive files on arrestees could only be useful if it was organized in such a way that a file could be accessed when it was needed. Today, these sorts of archives rely on computers to organize files, but in the 19th century this process was carried out by people. If the files were organized by name, an arrestee could easily thwart the police by giving a false name. If a police officer suspected someone of lying but did not know the suspects name, he would have to dig through hundreds of drawers filled with thousands of files to get the file that could easily prove that the suspect had a previous criminal record.

Bertillon decided that the best way to organize the files would be to collect data from arrestees that they would not be able to lie about in the future. He decided

[34] L'Identite des recidivists et la loi de relegation (Paris: Masson, 1883), 1-2.

that organizing the files into a hierarchy based off of measurements taken from the arrestees would be most effective. A criminal could not lie about their height, or the length of their left ring finger. Bertillon already had experience with this kind of data collection, and his family included statisticians, anthropologists, and doctors that understood how to take and record these kinds of precise anthropometric measurements. One could say that Bertillon took his family's trade and applied it in a new and useful way to the field of criminology.

Figure 12. This instructional diagram shows the strict procedures used to collect nine of the anthropometric measurements from arrestees.[35]

There are an enormous number of measurements that can be taken from the human body. Bertillon decided to use eleven measurements that he considered to be the most constant throughout a person's life. He chose eleven because he calculated that there was only a one in four million chance that two adults would share the same eleven bodily measurements. He then separated each measurement into seven categories into which the files and mug shots could be sorted. By using the binomial curve developed by the Belgian statistician Quetelet, Bertillon was able to ensure that each of the seven divisions in each measurement would have approximately the same number of cases. There were approximately a dozen files in each of the smallest subdivisions, a number that a police officer could easily look through to see if the current arrestee matches anyone else in their records, a task made particularly easy by the fact that photographs of arrestees were included in many or all of these files.[36]

The final result would have operated like an average card catalogue in a library. Identification cards were sorted into a series of drawers that were divided by the eleven anthropometric measurements. When a new arrestee arrived at the

[35] Alphonse Bertillon, Signaletic instructions including the theory and practice of anthropometrical identification . . . , Chicago, 1896. National Library of Medicine. Accessed online at http://www.nlm.nih.gov/visibleproofs/education/measure/ii_c_102.pdf . The measurements depicted are: height, reach, trunk, length of head, width of head, right ear, left foot, left middle finger, left forearm.

[36] Ellenbogen 43-44. These eleven measurements were height, length of body from left shoulder to right middle finger, bust, length of head, width of head, length of right ear, length of left foot, length of left middle finger, length of left elbow to end of middle finger, width of cheeks, length of left little finger.

jail, the police would not even have to ask them any questions to determine whether that person had been arrested before. They could simply take the eleven anthropometric measurements from the person and check the files that matched these measurements to see if that person had been processed before.

Figure 13. Mock record of Francis Galton, created when Francis Galton, a respected scientist and half-cousin of Charles Darwin, visited Bertillon's laboratory in 1893. These catalogue cards would allow police to easily identify recidivists by attaching a photograph of arrestees to their anthropometric data.[37]

This innovative application of anthropometrics to criminology turned out to be extremely effective. Bertillonage remained the dominant method of criminal archive organization until it was replaced by advanced fingerprinting techniques in the 20th century.[38] Bertillon became somewhat famous for his contribution, especially within law enforcement circles. He is even immortalized in literature; a character in Sir Arthur Conan Doyle's "The Hound of the Baskervilles" claims that Monsieur Bertillon is the greatest expert in Europe, the runner-up being Sherlock Holmes.[39]

Before Bertillon found a way to make the data in the archives accessible, the information there was largely useless. There were no doubt many cases in which a recidivist was processed as a first-time violator even though a damning photograph of him tying him to his criminal past sat in a dusty file that no one knew how to find, if they even knew it was there. The inclusion of the anthropometric data allowed the images of fugitives to be catalogued usefully by creating a reliable system of identification that allowed subjects to be identified and re-identified by processing them through Bertillon's methods of data creation. With this system, Bertillon turned a body of useless data into one that could be used to track and study fugitives with unprecedented precision.

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[37] Karl Pearson. *The Life, Letters, and Labors of Francis Galton*. vol. 2, ch. 13, plate LII Pages 382-383. Retrieved from http://en.wikipedia.org/wiki/File:Galton_at_Bertillon%27s_(1893).jpg

[38]Dr. Ellenbogen references Simon Cole's account of the shift between Bertillonage and fingerprinting. See Cole, Simon. Suspect Identities: A History of Fingerprinting and Criminal Identification (Cambridge: Harvard University Press, 2001), Ch. 2.

[39] Ellenbogen, Joshua. Reasoned and Unreasoned Images. Manuscript. 38. See The Complete Sherlock Holmes (Garden City, New York: Garden City Publishing, 1927) 787.

The data produced by Bertillon's anthropometric prescriptions was arbitrary, artifactual, and abstract. A mother would not be able to identify her child using anthropometric data, despite being very familiar with what her child looks like. Bertillonage produces data by subjecting a person to an arbitrary and contrived process of measurement that produces a data set that corresponds to the subject. These anthropometric measurements are only valuable if they can be reacquired, or reproduced, using the same subject and prescribed measurement techniques in a different time or place. The data collection technique, as well as the data it produces, is largely irrelevant except for identification purposes. If Bertillonage produced a finger measurement of forty-five feet from an individual, an impossible measurement, it would still be useful for identification purposes as long as that number could be reacquired using the same measurement techniques at a later date, even though it tells us very little about the subject's finger, or what the subject actually looks like.

The similarity between Bertillonage and cymatics is this: both are artifactual processes used to create new data about a subject or phenomena in order to study and catalogue information about that subject in new or meaningful ways. In the case of Bertillonage, the subject is criminals. In the case of cymatics, the subject is sound. Bertillonage is a prescribed process of collecting data that cannot be acquired through our natural senses alone. Therefore the value of that data does not become valuable because it represents something that we can sense, but instead because it allows us to organize data about inmates meaningfully by providing a specific artifactual method of collecting unique sets of data from the subjects. Some may be tempted to argue that we can surely see an inmate's finger with our eyes, and this is true, but anthropometrics prescribes a particular way to take a measurement from that finger that requires tools, training, and procedures in addition to our natural senses in order to produce the anthropometric measurement, the new data about inmates that will allow us to study and identify them with greater ease.

IV: Cymatic Theory

Because Jenny's experiments were so thorough and exacting, and so well documented, this body of work, which he named Cymatics after the Greek ta kymatika, could easily be applied to other fields. In fact, the principle underlying Cymatics, that of periodicity, is so ubiquitous in nature that it is found in all manner of phenomena. –Jeff Volk, forward to the 2001 edition of Jenny's Cymatics

The primary analogy that I have drawn between cymatics and Bertillonage is to identify both practices as a process of manufacturing artifactual or created data that can be used as a mechanism of sorting and comparing phenomena in ways that cannot be done by observing that phenomena with our natural senses alone.

There is another important similarity that can be drawn between these two practices based off of this analogy. In both cases, if an artifactual system of data collection is established as the primary method that a set of data is organized, then any data that do not include this additional manufactured data cannot be integrated into the system of organization.

In the case of the police archive and anthropometrics, a mug shot of a criminal could not be organized according to the anthropometric measurements of the arrestee being photographed if those measurements were never taken. If you have a previous mug shot and file for the man John Smith but it is not catalogued in the archive according to the anthropometric measurements of Mr. Smith, then you will not be able to find that file later if Mr. Smith gets arrested again, even though it contains extremely valuable information. The photograph in that file is useful, but only if it is found, and when it is orphaned from the data that allows it to be catalogued, its potential value as evidence is lost because it cannot be integrated into the atlas of mug shots, the working object of police scientists, which is organized according to anthropometric data.

For cymatics, what this means is that an atlas of visible sounds cannot include or integrate created visual data of a particular sound if a cymatic image of that sound has never been produced in the first place. This limits the value of a cymatic atlas to only those wave/media combinations that have been used to produce cymatic images in the past. However, it is quite possible that researchers in the future will be able to extrapolate axiomatic data about the propagation of sound waves from previous cymatic visualizations in order to make predictions and hypotheses about what a particular sound that has not yet been imaged will look like if it is imaged according to a prescribed cymatic process. This is a notable difference between cymatics and Bertillonage, because it does not seem possible that a scientist would be able to hypothesize the anthropometric data of a criminal when no anthropometric data was collected when that criminal was sitting in the police station, but a clever cymaticist may very well be able to derive certain relationships between the cymatic image and the sound used to produce it by examining previous visual data included in the cymatic atlas, and by doing this may be able to predict with accuracy what a new cymatic image will look like. The possibility that theoretical relationships between sound and image could be derived from cymatic images and employed for predictive purposes speaks to the untapped scientific potential of the cymatic atlas today.

VII: Beyond the Atlas: Cymatics as Art

"Architecture is the frozen music ; music is the flowing architecture…" - Goethe

It is clear that cymatic images can be useful to scientists if they are collected in a way that allows them to be organized as visual data in a scientific atlas. But what are we to make of the majority of cymatic images, those thousands of pictures and photographs available on the internet that do not include the necessary information about the frequency and medium to inform the viewer of the identity or species of the cymatic phenomenon he or she is looking at?

Dr. Jenny was the first and one of the only scientists to collect the necessary data that allowed cymatic images of sound to be meaningfully identified and organized in an atlas, but many past and modern cymaticists did not record the details of the artifactual process used to manufacture the cymatic image, making it difficult to organize these images in an atlas. However, these kinds of cymatic images do serve a purpose, and that purpose can be revealed by comparing them to Bertillon's police archive once again. Those of Bertillon's photographs that were not sorted by anthropometric data lost what little scientific usefulness they had once the new anthropometric regime of cataloguing had been established because they could not be integrated into that system. These mug shots had lost their scientific value, and people had no other reason to look at them or use them except to use them to identify arrestees and single out recidivists.

This, however, is not the case for cymatic images that do not include the data about their artifactual production. People still use and make cymatic pictures even when they are not scientifically valuable. They continue to be shared, archived, and produced in substantial numbers, mostly by enthusiasts, hobbyists, or do-it-yourself craftsmen who have a spare sheet of metal, a bag of sand, a subwoofer, and a camera. People enjoy making cymatic images for a variety of reasons, but some of the most frequently cited are that cymatic images are beautiful and fascinating. To put it bluntly, many people find cymatic images fun and easy to make and great to look at, even if they do not know the species of the sonorous figure being imaged, which can only be provided by doing as Jenny did by describing how he created each image. The majority of cymaticists use and create cymatic images for aesthetic purposes, as a kind of popular art. This is the primary way they remain present and growing on the internet.

Bertillon's police photos were never considered art in their own time and they may or may not ever be viewed as art in our time or the future. Cymatic pictures, though, contain some sort of aesthetic and artistic essence or kernel that draws onlookers, even if the scientific value of the photograph is stripped away by not recording the circumstances of its production. Singing bowls, some of the earliest cymatic imaging devices, served their purpose as aesthetic and artistic artifacts that were conducive to reflection and meditation, not as tools for empirical data collection and hypothesizing.

Given the history of human fascination with cymatics as an artistic practice, it is safe to assume that cymatics will most likely remain or grow in popularity as these images are shared on the internet for their artistic qualities, even if the scientific interest in cymatic images wanes or disappears due to obsolescence or disinterest from the scientific community. If a cymatic image has been collected but cannot be organized into a scientific atlas because the means of its production are not recorded with it, it can still serve as a working object of art, even if it cannot serve as a working object of science.

VIII: Conclusion

I remember the joy of looking at the cymatic sound patters, and the wonderful sense of "Yes!" that rippled through my being. Each picture was worth at least a thousand words and I felt as though I were reading volumes in just a few minutes. – Dr. John Beaulieu, "A Commentary on Cymatics" in the foreword of the 2001 edition of Cymatics by Hans Jenny

We can account for the scientific value of images that have no visual antecedent in the real world by showing how these images can be composed into scientific atlases of invisible phenomena. Dr. Jenny was successful in establishing the methods and practices necessary to create a cymatic atlas. Even though the images he produced were manufactured and took their form and their value from the means of their production, this data can be used to investigate the nature of sound.

It is arguable that cymatics does not necessarily tell us anything new about sound. In fact, by the time that Jenny was active, scientific understanding of acoustics and wave propagation was already quite advanced. An acoustical physicist would have been able to tell you that there would be nodal points and lines that exhibited no movement on a vibrating plate because the vibrations and reflections of the waves moving through the surface would interact and cancel each other out at certain points. Instead, cymatics provides a new way to perceive sound through sight, a sensory pathway that cannot normally be used to investigate this natural phenomenon. By creating this new visual set of data about sound, this cymatic atlas, we grant ourselves a new way to see a familiar phenomenon, and by doing this we can compare and study waves in a whole new way, a way that may lead to discoveries about sound that would not have been easily or even possibly uncovered without this new sensory access. The value of artifactual data has already been demonstrated historically: Bertillon's collection of manufactured anthropometric data allowed him to catalogue, organize, and compare his data about fugitives with unprecedented efficiency and accuracy. I hope that this paper will convince readers that artifactual and manufactured cymatic data could be just as useful for investigating sound by providing a whole new level at which sounds can be compared and categorized. With cymatics, we can bring the power of vision to bear on this fundamental natural phenomenon, and if a picture is truly worth a thousand words, then the creation and employment of cymatic atlases will be indispensable in expanding our understanding of acoustics and the relationship between sound and form.

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