

Sound's Story – a teleological journey

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the story of sound – a teleological journey into the system of sound

*Have you ever wondered what the "Big Bang" actually sounded like? Surely, you may be thinking, this is a trick question – didn't it just sound like, well, a really big bang? Surprisingly, perhaps, the answer is "no, not really". As is often the case with Nature, things are not so simple, and a more accurate description would be something like this: a descending scream, building into a deep rasping roar, and ending in a deafening hiss. As if this were not impressive enough, the entire acoustic show is itself the prelude to a wonderful transformation: the highest pitch sounds ultimately spawn the first generation of stars, while the deep bass notes slowly dissolve to become the tapestry of galaxies which now fills all of space. The birth of the Universe, it turns out, had its own primal scream. * Sound...ever since I was old enough to walk, I have spent most of my time outside, listening to the sound of the wind as it passes through the leaves of the trees, the sound of my feet as they meet the earth, or the pebbles on the beach. I love that I can tell how moist that earth is just by its sound, how 'in order' the life of the forest I walk in is, depending on the sounds of the birds, their placement, their anxiety level. The sea communicates with sound as it responds to the wind, to the cycles of the moon, to the shingle underfoot as it drags the stones ever towards its vast, moving body. It is all communicated, visible in sound – no secrets. The joy in these sounds is that life is communicating, not necessarily to me, but just communicating itself out loud through its own motions of being and, in particular, the motions of interacting with the neighbors of its environment.*

Growing up, I also spent the majority of my time listening to music and, as I grew as a musician myself, I developed a very personal relationship to music: I write it, listen to it, perform it, sing it, record it, feel it. It is something that feeds me in ways that defy logic, per se, but feel also absolutely legitimate within the realms of science as well as those of aesthetics and imagination. Developing these skills has developed in me an ability, a desire, to really listen and to know 'sounds story'. Where does it come from? What is it doing?

In order to better understand its story, I have decided to explore sound by asking five questions. They are as follows: 1) What *is* sound? 2) How does sound travel? 3) Why is sound important? 4) How do different species use sound/vibration? 5) When does sound become music? It is easy to be romantic with this subject and it is also difficult not to become too 'cold' or analytical, dealing only with figures. I am hoping to find the middle ground where both my desire for 'fact' can be met by my desire for 'feeling' and interpretation. Because if I cannot speak to my own feeling and thinking around this then it is no longer a story but a subject and,

in an intersubjective universe, the personal needs to be present to create any chance of meaning and therefore of significance. We take for granted that we know what sound is, but I wonder if we really do.

I started my journey with a conversation. Mark Whittle – responsible for the above, opening, quote – is Professor of Astronomy at University of Virginia and an extremely nice chap. He has a personal background in music, playing classical guitar, and an interest in how sound began, going as far back as the Big Bang. One of the properties of sound is that it is meant to only be able to travel through a medium. That being the case, space has long been considered 'a vacuum' and therefore doesn't 'qualify' for the presence of sound. So, how can it have been present at the Big Bang? However, I race ahead of myself. First let me create some definitions around the terminology of sound, its methods of travel and why the conversation with Mark Whittle becomes therefore extraordinary given our conventional knowledge of sounds' location. I will return to Mark, and our conversation, later. First I wish to clarify some of the physics of sound.

Sound is a wave movement that we can hear. It has to travel through a medium. And it has to create resonance in a receiver (e.g. your ear) in order to be 'heard'. Three of the most commonly known mediums that I wish to refer to in this paper are air, water and earth. Those three mediums are made up of molecules, which are made up of atoms. Within a given medium the density of that medium is influenced by its own mass, temperature and pressure. The density and temperature affect the speed at which sound can travel through it. In air, sound travels at approximately 1100 ft/second, in water it travels at approximately 5,000ft/second and in earth at approximately 8,000 ft/second. The number of times a wave passes a certain point per second is its frequency, which is measured in Hertz (Hz). Frequency is commonly referred to as 'pitch', i.e. the actual sound that we *hear* (e.g. 'a' or 'c#'). The distance between each wave motion is its wavelength; it is a measure of the distance between each pulsing compression of molecules within a given medium. The relationship between a sounds' wavelength and its frequency will give us the speed at which it is traveling, aka its velocity. Longer wavelengths are able to travel further distances than shorter wavelengths. Sound can travel faster through a dense medium than a less dense medium as the energy has less far to travel between the more tightly packed molecules and therefore less of its kinetic energy is lost in the transformation to heat energy.

Sound occurs when a medium is disturbed energetically and that disturbance is then projected through the medium by the compression and the rarefaction (coming together and stretching apart) of its molecules. The efficiency (speed and distance) with which a sound can travel is dictated by the elasticity of the medium and the more compacted something is, the more elastic it is seen as being, since the molecules are more tightly packed together. A measure of somethings' elasticity is a measure of how quickly a disturbed medium is able to come back to itself – rere turn to its original shape and form - however microscopically small-

scale it might be to us, i.e. beyond our ability to actually perceive the movement with our naked eye.

To take a step back from this for a moment, I wish to also comment on vibration, as one of my questions was about the relationship between sound, frequency and vibration – what do they have in common and where do they differ? And are sound and light related?

Sound and light are both an expression of vibration. Whereas sound is mechanical in nature in order for us to hear it, (our ears are also mechanical, in that an inner membrane resonates with the incoming sound which then gets translated by our brains into pitch, patterns and information), light is part of an electromagnetic spectrum and does not require a medium to travel through. It also travels much faster than sound, at 186,000 miles/second.

As Randall McClellan says in his book, *The Healing Forces of Music*,

At 44°F the speed of sound increases to 1100 feet per second (750 miles per hour), which is still very slow when compared to the speed of light, 186,000 *miles per second*. It takes only between eight and nine minutes for the light from the sun to reach the earth, yet a sound originating from the sun would not reach us for 591.4 days. (p. 19)

Light travels through space as it journeys from the sun to earth. Like sound, light is known to travel in waves (although they are of a different nature) – even though its speed is so different. There is a spectrum, known as the electromagnetic spectrum (ES) through which we can see the various wavelengths of rays of light, and distinguish their features. Light travels in a direction (whereas sound radiates out at 360° and is termed as naturally 'omni directional'). The ES is a way of acknowledging the differing wavelengths of light. Compared to sound waves, the frequency of light waves is short, as are the wavelengths it tends to travel in. Although both light and sound travel in waves, the nature of each wave is different. Sound travels as a longitudinal wave (i.e. the molecules move back and forth - vibrate - in the same direction as that of the wave and are, as previously mentioned, mechanical) and light travels as a transverse wave, in an electromagnetic field. A transverse wave is one in which the energy moves vertically rather than horizontally.

Integrated Publishing state this in their Naval Electrical Training Series¹ on the subject of light, sound and vibration;

There are two main differences between sound waves and light waves. The first difference is in velocity. Sound waves travel through air at the speed of approximately 1,100 feet per second; light waves travel through air and empty space at a speed of approximately 186,000 miles per second. The second difference is that sound is composed of longitudinal waves (alternate compressions and expansions of matter) and light is composed of transverse waves in an electromagnetic field. Although both are forms of wave motion, sound requires a solid,

liquid, or gaseous medium; whereas light travels through empty space. The denser the medium, the greater the speed of sound. The opposite is true of light. Light travels approximately one-third slower in water than in air. Sound travels through all substances, but light cannot pass through opaque materials.

Frequency affects both sound and light. A certain range of sound frequencies produces sensations that you can hear. A slow vibration (low frequency) in sound gives the sensation of a low note. A more rapid sound vibration (higher frequency) produces a higher note. Likewise, a certain range of light frequencies produces sensations that you can see. Violet light is produced at the high-frequency end of the light spectrum, while red light is produced at the low-frequency end of the light spectrum. A change in frequency of sound waves causes an audible sensation - a difference in pitch. A change in the frequency of a light wave causes a visual sensation - a difference in color. (p. 1-32)

When talking about the ES, the same site points out that;

Light is one kind of electromagnetic energy. There are many other types, including heat energy and radio energy. The only difference between the various types of electromagnetic energy is the frequency of their waves (rate of vibration). The term SPECTRUM is used to designate the entire range of electromagnetic waves arranged in order of their frequencies. The VISIBLE SPECTRUM contains only those waves which stimulate the sense of sight. (p. 1-33)

Starting at the highest frequency on the ES spectrum, we have, in descending order, gamma ray waves, x-ray waves, ultra violet waves, visible light waves (which make up about 2% of the entire spectrum), infra red waves, radio waves and electric waves. These waves are measured in millicrons and/or Hz and have, like sound waves, frequencies and wavelengths. They are, in fact, photons, traveling as waves, through the vacuum of space initially and earth's atmosphere, ultimately, where they begin to slow down. At this point, the atmosphere in which any waves find themselves becomes 'cluttered' enough with molecules to enable sound to become apparent as a mechanical form of information transmission (i.e. it is now in a medium in which it can be heard again). Sound is, however, distinct from light.

One final point on the physics of sound is with regard to radio waves which are electromagnetic in nature, i.e. they are still light, not audio, but they are at the low end of the frequency scale in terms of their speed. There are both AM and FM waves. AM radio starts at a frequency of approx. 640,000Hz.² Radio waves, which travel at the speed of light, can be altered, or *modulated*, to carry the characteristics of a sound wave. Engineers combine audio information with radio waves. With AM, it is the amplitude i.e. how loud the signal is, that conveys the information itself. This is a slightly vague way of communicating information and the medium itself invites static - the higher the amplitude the higher the noise to signal ratio. With FM, however, since it is the frequency that is being altered, it is a more efficient audio carrier, with less interference. In navy communications, the radio waves frequency bands most

commonly used fall between 3kHz and 300 Ghz, although the "usable radio-frequency range is roughly 10 kilohertz to 100 gigahertz."³ (p. 2-7);

There is sound, there is music and there is noise. Music and noise somehow define each other and they are both relevant in any kind of philosophical debate on the values and properties of music and sound in a living system. McClellan puts it like this;

If tones become too complex or too great in irregularity of vibration form, the result is "noise". Sound with no distinguishable fundamental frequency, such as the hiss of a steam pipe, or ocean surf, or the roar of a jet plane, is called "white noise" because it contains all of the frequencies and harmonics of the sound spectrum. It is comparable to white light which contains all colors of the spectrum within it. White noise, then, stands at the opposite extreme of the sine tone; between them lies the incredibly rich and endless palette of our sound world, from the deep tones of the pipe organ to the crystal clear tones of the upper register of the piccolo. (p. 17)

NOISE: Etymologically the word can be traced back to Old French (noyse) and to eleventh-century Provençal (noysa, osa, nausea), but its origin is uncertain. It has a variety of meanings and shadings of meaning, the most important of which are the following: *Unwanted sound*. The Oxford Dictionary contains references to noise as unwanted sound dating as far back as 1225. *Unmusical sound*. The nineteenth-century physicist Hermann Helmholtz employed the expression noise to describe sound composed of nonperiodic vibrations (rustling of leaves), by comparison with musical sounds, which consist of periodic vibrations. Noise is still used in this sense in expressions such as white noise or Gaussian noise. *Any loud sound*. In general usage today, noise often refers to particularly loud sounds. In this sense a noise abatement by-law prohibits certain loud sounds or establishes their permissible limits in decibels. *Disturbance in any signaling system*. In electronics and engineering noise refers to any disturbances which do not represent part of the signal, such as static on a telephone or snow on a television screen. The most satisfactory definition of noise for general usage is still "unwanted sound." This makes noise a subjective term. One man's music may be another man's noise. But it holds open the possibility that in a given society there will be more agreement than disagreement as to which sounds constitute unwanted interruptions. It should be noted that each language preserves unique nuances of meaning for words representing noise. Thus in French one speaks of the bruit of a jet but also the bruit of the birds or the *bruit* of the waves. (p.273)

As Schafer says in the beginning of his book, *Soundscape*;

The soundscape of the world is changing. Modern man is beginning to inhabit a world with an acoustic environment radically different from any he has hitherto known. These new sounds, which differ in quality and intensity from those of the past, have alerted many researchers to the dangers of an indiscriminate and imperialistic spread of more and larger sounds into every corner of man's life. Noise pollution is now a world problem. It would seem that the world soundscape has

reached an apex of vulgarity in our time, and many experts have predicted universal deafness as the ultimate consequence unless the problem can be brought quickly under control. (p.3)

In such a description, I find myself falling into a more personal and poetic relationship to sound. I am drawn to my fishing village, Aldeburgh, Suffolk, (in England) where I learned what sound really is, from the elements, the land and the sea, as well as the people who live there. Natural sounds are essential. They tell us who we are. Part of what makes the natural sounds so essential is not only what they are communicating but how they are created. For instance, the wind. There is something quite incomparable and almost wordless about taking a walk on a pebble beach, alongside the North Sea, with a blustery wind brushing past your face until you feel it turn rose with vitality. All the while your feet are 'scrunching' on the stones, as they re-arrange themselves under your feet, moving aside for a brief moment of sand, revealed, glistening in its memory of salt water. What the wind is communicating to me is both imagined and real. It's telling me about itself, as weather, I feel it touch me, bringing with it stories of where it came from. I feel I am being incorporated into the story of its journey, the places it has seen, the fact that the air and moisture particles that are touching my face so openly, have traveled and seen other lands, other places, touched other life. There is a connection weaved wordlessly, beautifully, with a rawness and honesty that is entirely authentic. The wind is free, and so am I. Neither in charge of the other and yet still connecting somehow, like people passing on the pathway of their own intimate journeys, acknowledging both anonymously and intimately in only the way an absence of words can allow. There is sound. Do I want to call it music? Not exactly. It is musical in that it is poetic, it is not noise in that it is wanted, it is my equal. I wonder if I am music to it, perhaps that is a more interesting question. As the wind passes through an aeolian harp, revealing the notes of the air, I wonder if I am perceived as that harp, creating music in unison with its own fluid movement? As Kepler himself is quoted as saying in Berendt's *Nadha Brahma*;

"Give air to the sky, and truly and really music will sound. There is a "Concentus Intellectualis," a 'mental harmony,' which gives pleasure and delight to beings of pure spirit and in a certain way even to God Himself, no less than which musical chords give to the human ear." (p.63)

Once I begin to consider the music or sounds of the elements, I find my mind drawn to the sea. Not just for its own sounds but for the sounds of its inhabitants. What we perceive as silent is in fact livid with sound. There is a cacophony of sea anemones, fish, crabs, dolphins and whales, to name a minute handful, that are alive with sound. Truly, everything is creating sound as it is vibrating and vibration creates sound. The larger the mass the more likely it is that we are going to hear that sound, although, as humans, we are limited to a frequency range perception of 20Hz - 20KHz. Anything below that human range of hearing, is referred to as infra (or sub) sonic and beyond that, ultra sonic.

These are not the only frequency ranges of hearing, just humans. Dolphins, for instance can hear up to approx. 200kHz and baleen whales can hear and create sounds as low as 4Hz.

Sound is not exclusive to humans but our dictionaries tend to specialize in the definitions that affect only us, which gives that impression. The existence and experience of sound is dependent on hearing, which is subject to each species own physiology and environment.

As Roger Payne puts it, in *Among Whales*;

In the darkness of the abyss another manifestation of life permeates everything – the calls of the distant whales. They carry over vast distances, the sounds traveling in long, majestically curving paths and completely filling the vast, vaulted spaces – at times echoing off the ceiling a mile or two overhead, or off the oozy floor as far beneath. To many human ears these sounds are very beautiful, even though whales and people have vastly different evolutionary histories and therefore might be expected to appreciate very different kinds of sounds. (p.20)

To me their sounds *are* beautiful. I feel that something ancient in me is being called to awaken and to feel, when I hear the songs and sounds of the whales. I am aware of being in the presence of a different kind of intelligence, one that feels somehow superior and awe inspiring.

When I spoke with Whittle, on Tuesday 15th June, 2004, I was not expecting a delightful conversation – more of a lecture, perhaps, or a question and answer event on the study of sound in space. As we have already seen sound is not expected to occur in space as it is a vacuum. However, as he said in both the interview and on a paper, entitled "*Primordial Sounds: Big Bang Acoustics*", at the time of the big bang, space was so cluttered with stuff, that it wasn't a vacuum, it was a busy place! Hence there was a medium for sound to travel in.

Space wasn't so empty when the Universe was young. Remember, the Universe is expanding so it was smaller in the past, and all the matter we now see in stars and galaxies was spread out uniformly to make a hot thin gas, a kind of cosmic "atmosphere". It is within this atmosphere that sound waves could form, grow and move. (p.1)

The scale and conditions are somewhat different from what we're used to here, on earth; the sound **pitch** is way to low for us to hear, by about 50 octaves. Imagine a sequence of progressively deeper "bass pianos" extending below the lowest notes of a regular piano: the cosmic concerto is played on the **seventh** piano in this sequence. Compared to concert pitch A, for which 440 sound waves pass us each second, a typical cosmic wave takes more like 50,000 years to pass by. (p.1)

We are able to detect these "primordial sound waves" (p.3) thanks to "the discovery of a faint microwave glow across the whole sky in 1963 by Arno MacKenzie and Robert Wilson" (p.3) and they appear frozen in place as they crossed the wall of fog, caught just as the Universe turned transparent. The situation is not unlike looking down over the ocean and taking a photograph: a whole collection of water waves is visible, little ones on top of bigger ones on

top of even bigger ones, all superposed. Analyzing the complex pattern of patches, using a computer, can yield the relative number and strength of waves of different sizes – in other words the relative loudness of high and low pitch notes (p.3).

Why is the sound of the universe important and so evocative of meaning? Whittle would say that “the sound an object makes is like a fingerprint: it is unique to the object, and reveals much about its nature” (p.3/4). He analogues it to our own, human development:

Just 380,000 years into the life of the Universe is equivalent to just 12 hours into the life of a human. Now, 12 hours after conception, a human is tiny and formless, and all that is present is its DNA. Yet within that DNA, hidden and encoded, is information which determines much of what the developing child and adult will become. So too with the microwave background. It depicts a compact Universe which is virtually formless, and yet hidden within its delicate patchiness is encoded a huge amount of information, much of which determines how the Universe will subsequently evolve and grow. (p.4)

In terms of the story of sound – I feel we have found it's inception, at just less than a “nanosecond after the Big Bang” (p.3). Whittle, when talking about one of the early transformation of sounds in the forming universe, when he comments on the creation of the “first generation of newborn stars” (p.2). He speaks to the transformation of early gas that held the sound waves, not letting them through, until the universe began to cool (to below approx 5000F) (p.2), eventually releasing the gas which then fell into “the smallest dark matter clumps, ultimately condensing to become the first generation of newborn stars. In a sense, then, these first stars were born from primordial sound.” (p.2)

I wish to speak to sound as it relates to vibration. I wish to understand the symmetry and beauty of the universe. The way it continues to elaborate upon itself so *appropriately*, so *eloquently* is *worth* observing, *worth* relating to. From a musical perspective, I am interested in how music can also be experienced as *useful*, as alchemical, as *moving*, as *connected* to the universal laws of creation. What does its inherent make-up speak to in us and our relationship to it? In order to do that, I feel drawn to examine, firstly, the relationship between myself and sound, through an exploration of vibration.

In Science, two gentlemen; “John Schwarz of the California Institute of Technology and Michael Green of Queen Mary College in London” (Superstrings, p.4) created a theory known as a Theory of Everything (TOE). Otherwise known as “Superstring Theory”. Superstring theory suggests that; the ultimate building blocks of nature consist of tiny vibrating strings. If correct, this means that the protons and neutrons in all matter, everything from our bodies to the farthest star, are ultimately made up of accordingly to the superstring theory, our world only appears to be made of point particles, because our measuring devices are too crude to see these tiny strings.(Superstrings p.4/5)

So, how does this relate to music?

The superstring theory can produce a coherent and all-inclusive picture of nature similar to the way a violin string can be used to "unite" all the musical tones and rules of harmony. Historically, the laws of music were formulated only after thousands of years of trial-and-error investigation of different musical sounds. Today, these diverse rules can be derived easily from a single picture – that is, a string that can resonate with different frequencies, each one creating a separate tone of the musical scale. The tones created by the vibrating string, such as C or B flat, are not in themselves any more fundamental than any other tone. What is fundamental, however, is the fact that a single concept, vibrating strings, can explain the laws of harmony. (p.5)

And then we can go on to look at how sound creates form and therefore can affect it.

Knowing the physics of a violin string, therefore, gives us a comprehensive theory of musical tones and allows us to predict new harmonies and chords. Similarly, in the superstring theory, the fundamental forces and various particles found in nature are nothing more than different modes of vibrating strings. The gravitational interaction, for example, is caused by the lowest vibratory mode of a circular string (a loop). Higher excitations of the string create different forms of matter. From the point of view of the superstring theory, no force or particle is more fundamental than any other. All particles are just different vibratory resonances of vibrating strings. (Superstring p.5)

Looking at McClellan's book and examining the concept of vibration in direct relationship to music, we can see how the physics and the biology of vibration are linked to our human experience. The possibilities for how sound and music impact our lives (and our bodies) become more apparent.

Within the dense physical body is the muscular system, the skeletal system, the blood circulation system, respiratory system, digestive system, endocrine system, nervous system, excretory system, reproductive system, and various fluids. All of these structures and fluids consist of atoms. These atoms form molecules which, in turn, form the various cells of the muscles bones, organs, glands, nerves, blood and other fluids. A highly magnified film of a cell shows a constant movement that folds within itself, though the external shape is maintained. As Dr. Guy Manners describes it "Where there is movement, there must be friction and where there is friction, there must be sound. However minute it may be the sound has got to be there. So therefore you've got the sound in that little cell" (p.38)

So a reference has been made to the physiology of the human body, to its biology. McClellan now points to the electro-magnetic field that this kind of movement makes on the microscopic level;

The atoms that form each cell contain electrons that are in constant motion and which therefore radiate electromagnetic waves. These waves are measurable as frequencies, the rate of which vary according to the particular form of matter. It would appear, then, that all matter exhibits its own natural rate of vibration and that the frequency is dependent on the oscillation rates of the electron charges. Atoms possessing the same frequency rate tend to combine and strengthen each other through the principle of resonance. (McCl. p.39) In other words, the rate at which the electrons orbit around the nucleus create a particular frequency of vibration which appears to maintain a certain stability, around its own rate. These particular atoms then 'recognize' each other, so to speak, and form a natural coalition based on resonance.

To be a little more explicit:

Thus far, the emerging concept of our physical bodies is one wherein each atom emits its own natural frequency rate which, through resonance, combines with similar atoms to form the molecules whose natural frequency is a harmonic of the atoms. Molecules of the same harmonic form the cells of the various structures and fluids, each of which emits its own natural frequency. In every case the external shape of the structure is maintained as long as the frequency for each remains constant, while within the structure there is constant movement. (p.40)

And now we begin to explore the possibility of sound creating form again, just as with Whittle earlier, except on the micro level.

This phenomena occurs in all forms of matter, both inert and living cells. Cells whose natural frequency rates are the same combine to form the various structures and systems that are an integral feature of our physical existence. Each structure is a harmonic of the cells through which it is formed and maintained. It may be said, then, that sound creates the structures of our bodies. (McCl. p.39)

As previously mentioned, various people have been exploring the effect of imposing frequencies on matter in order to see how it might affect its structure. The people I cited earlier are German physicist, Ernst Chladni (18th Century) and Swiss scientist, Hans Jenny (20th Century). It is amazing to see the results of the symmetry inherent in the forms they created through the use of sound.

Chladni took metal plates, approximately 1ft/1ft in size and sprinkled very fine sand on to them. At this point he experimented with placing his fingers (index and middle) at different points along the edge of the plate and then drew a violin bow down, perpendicular to the edge of the plate. He observed the emergent patterns on the plate.

When he sustained one tone for a long period of time he discovered that the sand moved into geometric patterns of interlocking and concentric circles. Changing the pitch resulted in

the movement of the sand particles into other organic shapes – spirals, radiating wheel spokes, and hexagonal grids.(McCl. p.50)

These experiments were the birth of the field of study, Cymatics, which is the science of how sound creates structure. I am curious, since these experiments are more two dimensional, how that translates into the 3D – how does my body structure itself? What gives it strength and structure in its form? Hans Jenny seems to have gone a long way towards asking and answering these questions as he took up the baton that Chladni left behind. He used electronic equipment to create pure sine frequencies (i.e. they have no harmonics) as well as the human voice and classical music, and experimented with “sand, iron filings, water, mercury, and other liquids” (p.50) on metal plates, just like Chladni.

He discovered that the evolving forms repeated themselves in predictable ways and resembled the growth patterns of the organic living organisms: chromosomes, cells, molecules, bone tissue, growth rings in trees as well as crystals. He demonstrated that music produces a visible texture that resembles the weavings of cloth. He discovered that when the syllable “O” was spoken into the microphone, the sand on the metal plate took the shape of “O”. When the syllables of the ancient languages of Sanskrit and Hebrew were pronounced, the sand took the form of the written symbols for those sounds, whereas our modern languages did not produce the same effect. (p.50)

As McClellan says – he points out that it was “Jenny's conviction that biological growth was the result of vibration and that the nature of the vibration determined the resulting structures.” (p.51). He also points to the basic principle of Cymatic Therapy which is “that all material units – atoms, molecules, cells, organs – are in a state of continuous vibration. The wave forms resulting from vibration are neither random nor chaotic but produce patterns of complex unity.” (p.52) Another spokesperson cited by McClellan for his observations on this field is Dr. Peter Guy Manners “osteopath and rayologist of Evesham, Worcestershire” (p.52). As McClellan quotes Manners:

Careful observation of structure excited by vibration and sound shows that, when they move, they invariably move as a whole. They do not disintegrate or fragment, but move collectively. It is therefore legitimate to speak of a total or wholistic process. Again, we see unity in the way structural patterns and dynamic processes appear in one and the same configuration. All are sustained by the underlying vibratory process.

Each unit has its own frequency of vibration and produces its own characteristic wave pattern as the result of its frequency. The frequencies of larger units are the algebraic sum of their smaller components. According to Cymatic therapy, disease is the result of a change in the fundamental frequency of vibration. (p.53)

Again, as Manners is quoted as saying in McClellan's book;

But we are of the opinion now that it [virus or bacteria] is not the cause of that disease, but the result of that disease. The cause is an imbalance, the harmonics of the body have been disturbed...There is a harmonic of the heart, the liver, the bones, the muscles and so long as they're all playing in that harmony, we are in harmonic pulse. We are healthy. But if any part loses its tune or goes out of phase then we are in trouble. Until we could reproduce these harmonic signals – even though we believed it – we could do nothing about it and we had to rely solely on medicine.¹⁵ (p.53)

Before going into the realms of harmonics, which have been referred to a few times in the various quotes, I want to interject with another perspective, related to the above subject, which will require a rather large quote from the book, *Turbulent Mirror*, by John Briggs and David Peatt. They are talking about research on Solitons and Equipartition. To clarify, a Soliton is an unexpected, solitary (hence Soliton) wave: - whereas a normal wave tends to break up over time and lose energy, a Soliton is a wave that becomes reinforced and bound by other waves joining together and can pass through other waves without losing its integrity. As Peatt and Briggs put it:

A soliton is born on the edge. If too much energy is involved in the initial interaction, the wave breaks up into turbulence. If too little energy, the wave dissipates...nonlinear interactions at critical values don't produce chaos, they produce spontaneous self-organizing forms. (B&P, p.120)

This becomes relevant in a series of experiments three scientists performed in 1955. They were researching Equipartition of energy. Equipartition is the assumption, or the action of newly introduced energy into a system, to even itself out over the range of that system, as opposed to gathering in one place. Physicist Enrico Fermi and mathematicians Stanislaw Ulam and J. Pasta were exploring the movement of vibrations through metal.

The internal structure of metal contains a stable pattern, called a lattice, of atoms. When energy, in the form of heat, is given to the metal it causes the atoms to vibrate. But because these atoms are all bound together in the lattice they vibrate in a collective way, producing a single "note". In fact, there are many notes, many different modes of vibration within the lattice, and each of these is associated with a characteristic energy.

According to the principle of equipartition, if all the heat energy were to be given to a certain note – that is, to a particular vibration of the lattice – then pretty soon that energy would spread out and distribute itself to all the other "notes" of the lattice. This was the great assumption of thermodynamics and, since no one could actually get inside a lattice to see what was happening, it had never been observed directly. But with the coming of the computer the lattice could be looked at indirectly, through a mathematical model. To observe the way energy was shared between all the vibrational notes in the lattice, Fermi, Pasta, and Ulam set up a model containing five notes or modes. The plan was to feed one mode with energy and

watch how this energy obeyed the strictures of thermodynamics by distributing itself through the other modes. In order to mathematically represent this sharing of energy it was necessary to add a tiny extra term – a nonlinear term – corresponding to the interaction between modes. If it was not added there was no way that “energy” in the model could pass from one note to another. As it turned out, this tiny additional term dominated the whole system and transformed it from a linear, well-behaved lattice into an arena for solitons.

In the 1950s when the Fermi-Ulam-Pasta calculation was carried out no one was seriously thinking about solitons, so the three scientists were quite confident that once the system had settled down from its initial burst of energy, the energy would soon be parceled out among all the other vibrational modes.

As expected, after a few hundred cycles of the calculation, mode 1 began to fall rapidly in energy and modes 2,3,4 and 5 began to gain. And after 2,500 iterations of the equation everything was still going according to plan. Then something wonderlandish occurred. While vibrational mode 1 continued to lose energy, mode 4 began to gain at the expense of all the other modes. By 3,500 cycles mode 4 had peaked and now mode 3 was beginning to gather energy. To the complete surprise of the scientists, energy was not being shared out equally but was bunching itself together in one or another of the modes. By the end of 30,000 cycles, energy was not equipartitioned at all but had returned and gathered itself again into the first mode!

The result was especially shocking because it was found that this concentration of energy doesn't depend on the strength of the nonlinear interaction; even a very weak coupling of feedback will cause the system to bunch. The computer calculation indicated that the nonlinear lattice had a sort of “memory” not possessed by its linear counterpart. Given sufficient time, the system would return again and again to the state it was in when it first received its burst of energy...Analysis of the Fermi-Pasta-Ulam model shows that the phenomenon involved formation of a soliton – not of water or air but of energy – which moves through the lattice in a coherent wave.

The model is illuminating because it shows that the nonlinear world is holistic; it's a world where everything is interconnected, so there must always be a subtle order present. Even what appears on the surface as disorder contains a high degree of implicit correlation. Sometimes this below-the-surface correlation can be triggered and emerges to shape the system. Soliton behavior is, therefore, a mirror of chaos. On one side of the mirror, the orderly system falls victim to an attracting chaos; on the other, the chaotic system discovers the potentiality in its interactions for an attracting order. On one side, a simple regular system reveals its implicit complexity. On the other, complexity reveals its implicit coherence. (B&P p.127)

I am particularly interested in the 'lattice' idea, since it is one that I came across in Hans Jenny's book *Cymatics*. As he puts it when referring to liquids:

The wave lattice generated in a liquid by the action of sound...imposes a spatial pattern on a diffusion process occurring there. Into the vibrating liquid we drip some of the same liquid which has been colored with a marker dye, expecting that we shall see it mix intimately with the outspread film. However, instead of diffusing uniformly [as expected in the previous experiment: equipartition], the colored liquid first shoots, as it were, in jets, through the meshes of the lattice. If we greatly intensify the process, say by turning up the volume of the tone (increase of amplitude), we see how the colored liquid jets forth but always in a particular direction. If we examine one of these jets more closely... we can see that the liquid moves through the lattice in a complicated manner... observation is guided forward step by step by the phenomenon itself. We might note that structural patterns generated in a particular medium by vibration do in actual fact exercise a spatially directive function" (p.13)

This last part of the description is remarkably similar to the previous description of a Soliton and I find myself wondering how the presence of a Soliton accelerates, impacts or influences the movement of tone, or energy, within a system any more than its constituent parts i.e. If waves of energy or tone were generated and this Soliton effect did not happen, does 'healing' and resonance still occur, for instance, with individually resonating waves? In other words, is a Soliton a by-product or a necessity to sonic and vibrational influences in, and on, a system, with particular emphasis on its health and well-being?

Finally we have reached the explication of harmonics. In music, when one goes to a concert or hears someone sing, moment by moment, we are hearing a fundamental tone; otherwise known as the first partial, the root, the tonic. The reason it is pointed out, so to speak, is because it is not the only tone that is occurring, even if, for some of us, it is the only one that we think we are hearing, or are in fact hearing. The way I perceive it is like a ladder; the first note, the 'visible' and obvious note is, for example, 'middle C' (256 Hz) is sounded. Once that note is sounded out, whether struck, blown, bowed or sung, an immediate rainbow of other notes is revealed, embedded within the outward movement of the selected note. There is an order to this *apparently* secret set of notes and this order is something that can be found throughout the Universe. It is an order of ratios based on mathematical principles that is constant, i.e. the harmonic 'scale' is itself consistent. What differentiates the sound (timbre/character) of one instrument or persons voice from another is the shape and the material of each body (aswell as its temperature and humidity and various other organic as well as personal factors) as these two main elements dictate which of the infinite number of harmonics get automatically accentuated. There is no efforting involved here, it is involuntary, especially on the part of a human's voice.

One thing I will say at this point though, is that I am very aware of how we, as individuals, impact the timbre of our voice, through our relationship to spirit, to our own selves – our

psychology – and even in relation to our thinking. How we hold ourselves and with how much awareness, to each of these systems, impacts the timbre of our voice. i.e. We reveal ourselves in the way we speak (or sing), not only via the content of our words but by their timbre. As a voice teacher, this is something that I find particularly exciting within a person as their ability to transform themselves becomes immediately apparent in their presence, particularly represented in their voice. In other words, self- transformation is real and it affects our relationship to a cosmic architecture, if you will, as different notes, perhaps even different fundamentals get selected as we grow and change.

Without wishing to go into too much detail on harmonics (aka 'the overtone series') at this point, I will outline their form, taking 'A' @ 220Hz (found an octave + m3 below middle C) as the fundamental in this example. The ascending tones are all considered in relation to the fundamental. The rules are simple: each consecutive harmonic is a whole multiple of the fundamental. And the intervallic ratio between each ascending harmonic and its predecessor diminishes (i.e. Fundamental, 8ve, P5, P4, M3, minor 3 etc.). The ratios *between* the partials (harmonics) thus look like this 2:1, 3:1, 4:1, 5:1 etc. - which corresponds to the length of a string on a monochord in terms of whether the string is being held down in the middle, in thirds, in four places etc.- Whilst the mathematical relationship between the harmonics and the fundamental are a direct I/Thou relationship, *not in relation to each of the other harmonics*. So if the fundamental note is 'A' at 220Hz, the first harmonic (at 2:1) is $2 \times 220 = 440\text{Hz}$, the 2nd harmonic (at 3:1) is $3 \times 220 = 660\text{Hz}$, the third harmonic (at 4:1) is $4 \times 220 = 880\text{Hz}$ and the fourth harmonic (at 5:1) is $5 \times 220 = 1100\text{Hz}$. These particular note names are therefore A (fundamental), A (8ve above), E (P5 above), A (P4 above), C# (M3 above). [Pse. Refer to p.52 Sound at back for full description w/diagram]

There is one other point to make here, and that is the existence of so many different types of scales and musical systems. This harmonic system is based on what is commonly known as the 'just intonation' system. This is a reference to pure tone, i.e. tone that has not been manipulated or adjusted. There is also the fact of the microtonal and quarter tone system commonly used in China, India and the Middle East, whereas here, in the West, we have Bach to thank for the development of the piano which, in turn, introduced the tempered system (it was the only way the instrument could be made that would work for cross-platform i.e. Group playing, with the ability to modulate easily and still 'make sense' musically). The tempered system is an adjustment of the natural pure tuning of the 'just intonation' system, and is made up of intervals of steps and half steps (i.e. c, c#, d, d#).

When we refer to 'A' @ 440Hz or 220Hz, we are referring to the 'equal tempered' system. In this system, 'middle c' is actually 261.6Hz, whereas in the 'just intonation' system (pure tunings) it is, in fact, 256Hz. It seems that this system was introduced by 'squishing down' (!) an octave so that a 'perfect octave' (i.e. perfectly predictable) could exist. Rather like chaos theory, if this wasn't done, the incremental changes in increasing and decreasing octaves would become so large that they would render the idea of an exact octave with exact and

predictable intervals impossible and therefore playing in large groups would be disastrous without an exceptionally high level of musicality.

Hans Jenny, in *Cymatics*, points to the wonderful link between harmonics and form in Nature:

The resultants of harmonic vibrations are at all times so strictly law-ordered that it is possible to draw up a systematology of morphogenesis. What one must bear in mind is that under this or that quite specific set of conditions Nature produces this form only and no other. Nothing here is diffuse and indeterminate; everything presents itself in a precisely defined form.

The more one studies these things, the more one realizes that sound is the creative principle. It must be regarded as primordial...Tone and sound are, so to speak, the entelechies which are active here. (p.100)

I don't know if I consider sound to be primordial, that feels somehow unbalanced to me, not enough of the story. I do see it as creating form and structure and also meaning, but it cannot do it alone. I feel that sound could not exist without matter, just as it seems that matter might not exist without sound, without vibration. Which came first? As I see it, with regards to sound and matter, it is more useful to acknowledge that they somehow came together, each describing, releasing, the other. There is no need for hierarchy or for even complete understanding, but I feel there is a need for some kind of relationship to ourselves as being somehow embedded and resultant of an organizing field of vibration.

As a trained Reiki Practitioner (the emphasis in this system of Practice is on moving energy through the endocrine system, with a view to facilitating the release of toxins in the body), I became very aware of the fact that we have an electromagnetic field which we work with when we give healings to clients. As McClellan puts it:

Emerging from the dense physical body and extending about three inches beyond is a web of energy that completely surrounds us...The etheric field is an electro-magnetic vibrational field that shields and energizes the dense physical body and integrates it with the Earth's energy fields. It fluctuates continually in response to vibrational waves with which it comes into contact. (p.43)

The exploration into and mapping out of this realm of the electromagnetic, as it relates to humans, was carried out by "Professor Harold Saxon Burr, a neuro-anatomist, and for 43 years a faculty member of the Yale University School of Medicine".(p.43)

We are modeled on the earth. When I read about the electromagnetic field that protects the earth from radiation, that emanates through space and influences all of our communication

systems, I am utterly captivated. I am the result of music and the result of physics. If the universe hadn't given birth to itself and all its own laws of being, I couldn't have been born. There are other elements here that I haven't even gone into yet, about how the planets orbit that make me fall in love with it all over again. In *Nadha Brahma*, Berendt speaks to this miracle of symmetry:

Kepler was the first to suppose that the orbits of the planets were elliptical. Only in this way did it become apparent how precise the harmonical structure of our solar system is. According to Kepler, God was master of the cosmic sounds, causing the planets to leave their initially inherent circular orbits and to adopt the conspicuously complicated elliptical orbit in order to produce even more beautiful sounds. The fact that the planets move in elliptical orbits is indeed remarkable but even more remarkable is the fact that from an unlimited wealth of possible orbits they have chosen precisely those which oscillate and sound in the proportions of undivided numbers [harmonic ladder] prevalent in our "earthbound" music...The overtone scale that is produced when a valveless horn in C is blown or when one listens to the flageolet tones of a viola's C-string corresponds to certain properties in the planetary orbits.(NB p.60)

I mentioned earlier on in this paper that I felt that Whales were 'up to something'. I'd like to try and expand on that. I have noticed that all creatures create sound, to varying degrees and at varying pitches, through various mediums. This activity seems to create a vivid web of sound, some heard by us (which qualifies as sound in the human realm), some felt and some perhaps simply intuited. At some level though, sound is being experienced by all creatures to wavelengths that I cannot even speak to. I do not let that limit me in my thinking. Twice I have seen dolphins moving up the Californian coastline as if on some kind of mission. Strange as that may sound, my imagination and my felt experience was that they were doing something with sound. Some kind of sonic sweeping. There was thinking going on, a certain deep concentration that was absolutely palpable – indeed it stopped me in my tracks from trying to go out and play with them, as they were obviously busy. I should qualify this by saying that I do not see imaginary people (unless you are one of them) and do not hear strange voices in my head. In other words, I believe I am relatively normal and yet I have noticed things that would not necessarily qualify as such to even my own preferred logic. Such are the challenges of treading into new territory.

Earlier on, I brought up the subject of noise pollution. I wish to refer back to that as it was not a subject introduced casually. Given that we have seen through the work of Chladni and Jenny that sound creates form, and knowing how little we are able to expound on that subject at this time, I am aware of a concern I have that has everything to do with the fact that we are a multi-sonic, harmonic universe based on a 'solid' structure that repeats out into the universe. For instance, chemistry, rainbows, the human body, earth nutrients, these things refer to, and are absolutely based on, a repetition of harmonic structure, cross- platform. Kepler, as was mentioned earlier saw harmonic structure in the planets.

McClellan referred to it in the human body, in all our organs and even our atoms. What if, not only with noise pollution, but with all the mass extinctions that are going on, we are ridding ourselves of the innate structure that this planet, this cosmos needs in order to not only sustain itself, but to hold its actual form? We're not just talking about beauty here, we're talking about life. I believe there is a unity in sound and in vibration. I believe that unity is characterized by the various frequencies that each living component brings into existence with its own. I believe that as we destroy life, we destroy more than our resources, we could possibly be destroying the capacity to grow them again, from an etheric point of view.

There is such a thing as Kirlian photography which has the ability to take electromagnetic photographs of phantom leaves, of auras around living organisms. As far as I know, the etheric body doesn't last all that long. If we destroy life too quickly, it will not be able to grow back and I don't know how far back (into dimensions) we'd have to reach in order to touch upon that which created us in the first place...would it be sound? Would it be something beyond the etheric?

Noise pollution is affecting us. It is affecting our health and well-being, both physically, mentally and emotionally. We are being cut off from natural sounds. These sounds, whether we can hear them or not, are essential for our well-being. They nurture us in ways that we need to know about, apparently, in order to pay attention and stop. Sound has the capacity to heal – this is not a romantic notion. It also has the capacity to damage (for example, Navy Sonar, which blasts sounds at approximately 245/250DB in the ocean, which houses creatures that generally don't expect to hear beyond 150DB).

I am aware of the probable cry of bio-technology that it doesn't matter if we destroy the trees or our natural food resources, as we can genetically modify all of it – apparently. However, I feel fairly certain, that to try and recreate nature artificially and expect to get the same quality of life, both known and unknown – i.e. the source of life that is inherent in our harmonically based system - is rather like the idea that we can enjoy the same level of nourishment from a keyboard as we can from a concert piano, or an acoustic piano of any size. Although manufacturers can mathematically impose harmonics into the system of a keyboard, the result is not the same. I do not feel moved when I sit near a synthesizer, whether I am playing it or someone else is. I do, however, resonate with a piano – especially emotionally - even if just one note is being played. The music that it is playing is alive within itself, not merely simulated. The key word there is resonance. This resonance has a value that is above aesthetics, it is a need beyond reasonable doubt. Resonance actually plays the strings, the synthetic merely describes it.

I asked the question earlier about when does sound become music, and I think it becomes music when it becomes something that we need. Whether that need be on an emotional level, a spiritual, an emotional or the physical level. I believe those qualities within ourselves define what is music, just as our physiology defines what is sound.

Music is important then, because it can give us what we need. In a very real sense, when I play music I am touched, I am made alive, I resonate harmonically. People in the vicinity (and I've watched this many times) become moved. This speaks to vibration, to resonance and to community. I think music is important because it creates community. Perhaps that is how music could be defined, as something that creates a certain inner-harmony, a sense of belonging to the spaciousness outside of mind, beyond mental/individual thinking, and into global thinking/feeling.

McClellan has something to say on this subject;

Music results from our biological, affective cognitive and spiritual processes...we respond to music on all four levels. Biological response involves body processes such as breathing rate and depth, heart rate and the like. Affective response involves emotion. Cognitive response involves aesthetic satisfaction and stimulation. A spiritual response is transpersonal in that we experience something transcendental. We feel a wholeness greater than individual awareness and a unity of universal forces and human experience. (p.32)

Music is important because it reminds us who we are. Sound is important because it informs us, quite literally and quite practically, and vibration is what brings all of these movements into being – indeed it is the primordial movement. I believe that noise distracts us from who we are, like advertising on television or the radio. It is a harsh experience, an invasive one, which prompts a certain withdrawal on the part of each person and a high level of stress, and possibly pain or numbing, on many levels. As Don Campbell says in *Mozart Effect* when describing a scene at a car rally.

The American Academy of Otolaryngology estimates that more than twenty million Americans are regularly exposed to dangerous levels of sound. Children are most vulnerable. Recently, I passed a domed sports arena that held races for "monster trucks" with giant tractor wheels. As the trucks were revving up their engines and speeding down hundreds of yards of track, the low frequency sounds were so loud and hideous that most of the children in the crowd of several thousand were weeping, screaming and holding their ears...I would guess that the sounds exceeded 120 decibels; these children were literally being *injured*. (p.36) He also points out, in *Mozart Effect* that, in America, "an estimated 60 million Americans have hearing loss and a third of those losses are caused by exposure to loud sounds"(p.36)

There is a final thought I want to leave you with, and it comes again from McClellan's *The Healing Forces of Music*;

Itzhak Bentov⁵ states that the atoms of our bodies vibrate at the rate of about 10^{15} c.p.s., that the molecules, formed of atoms, vibrate at the rate of 10^9 c.p.s., and that the frequency response of cells is 10^3 c.p.s., a step down in range of six octaves you arrive at the frequency of 7.8 c.p.s. Which some researchers have identified as being the frequency of the human

body.⁸ If these calculations are correct, they may indicate that as the various systems of our bodies – and all matter as well – becomes more dense and as they gain more mass, the natural frequency of the structure also decreases. Therefore the frequency of the nervous system may be of a higher rate than that of the organs. The organs, in turn, may be higher than that of the bone structures. (p.40)

Various experiments to explore the above quote were carried out at Cymatics Institute in Switzerland using a single drop of water, which was dropped onto a plate and subjected to various increased frequency rates. Here's what they found; the shape and form of the water changed radically as the frequency of the sound was changed. As long as the frequency remained constant, the resulting shape of the drop of water was held indefinitely, and the chemical property of the water did not change. As the frequency was increased, a more ethereal appearance began to emerge, rendering the drop of water unrecognizable. In the final photograph it can hardly be seen at all, yet it is still there. At each frequency change the water kept its external form but within the water itself, the molecules continued to move. Further experiments with other liquids displayed exactly the same patterns of change.(p.40) If all of this is being monitored by a sonic/vibratory architecture of the cosmos, and that changes, then the following note from Dr. Guy Manners becomes quite interesting:

Is it feasible then, and is it possible that you and I – all of us in here – living in this dimension and perpetrating this sound which holds you in the shape and form that you are ? It could be. And if the shape and the form, the vibration that is round this planet changes, we could all mutate? We really don't know.⁷ (p.40)

Even though I have talked about sound in its mechanical sense, I have also alluded to another quality of experiencing that is, I am posing, occurring at the same time, perhaps on some other 'level' or consciousness. In his book, *Music and the Mind*, Anthony Storr makes an interesting reference to this, our ability (and inability) to perceive, not only sound, but bigger realities in general;

We all know there are sounds which our ears cannot hear, and colors which our eyes cannot see, but which can be perceived by other species or by special instruments. Dogs can respond to tones of very high frequency which the human ear cannot hear; infra-red cameras can 'see' objects which the human eye cannot. The limitations of our perceptual apparatus restrict our apperception of the world; the limitations of our cerebral apparatus restrict the ways in which we can think about it. The world may not only be stranger than we think it is but stranger than we can possibly imagine.

But Schopenhauer goes further than this. Even if our ingenuity enlarges our perceptual grasp, by inventing special techniques which enable us to incorporate the sounds we cannot hear and the sights we cannot see into our incomplete picture of external reality, we can never transcend the limitations imposed by our concepts of space, time, and causality. Schopenhauer

therefore concluded that we could never perceive objects as noumena or 'things-in-themselves', as Kant called them. All we can do is register the ways in which they appear to us; that is, their 'representations' as phenomena in the external world.

But, if this is true, it must follow, as a correlative concept, that 'things-in-themselves' exist, and that they have their being in an underlying reality to which our categories of space, time and causality do not apply. For it makes no sense to say that our perceptions are subjective or partial unless there is a reality which is supposedly objective and complete, even if we have no access to it.

However, the underlying reality postulated must be one in which objects are not differentiated; in other words, a unity. For abolishing the categories of space, time and causality necessarily makes it impossible to distinguish one object from another. Hence Schopenhauer's vision is that ultimate reality is a unit – the *unus mundus* of medieval philosophy, which is both beyond our human categories of space, time and causality and also beyond the Cartesian division into physical and mental. (p.128/129)

There is still the issue of Teleology. Is sound teleological, i.e. Is there an inherent purpose in its movement, in its existence – a direction that it is headed in, regardless of its own sentient level, so to speak? Rudolf Haase, as edited by Joscelyn Godwin, in his paper *Harmonies and Sacred Tradition*, from the book *Cosmic Music*, points out the rather tellingly comprehensive picture of sound in life and raises the question that such symmetry must surely point to a teleology, by design. As he says;

Harmonic laws thus allow for interconnections between different areas, which since they often prove significant, cannot be dismissed as accidental or side effects. It is far more a matter of norms, structures, and forms occurring at the endpoints of evolutions: therefore in nature we must designate them as goals or aims. This important fact necessarily gives harmonic research a teleological perspective.(p.92)

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This is something that is interesting to ponder. My saying that sound and vibration is or isn't teleological won't affect its true reality, but my sitting with the question might affect my own. I offer it up as a thought, and a thought only, that sound is obviously here as part of our consciousness and part of our self-awareness and that all creatures that are able to participate in the world of sound are able to do so consciously, with self-awareness, at the point at which they have the capacity to hear and/or feel vibration within themselves. I don't doubt it, actually. Self awareness is not unique to humans and neither is the capacity to process, and be fed by, sound and its inherent information, even as our individual and group processing systems vary.

One thing I do feel is that, through sound and vibration, certain information is being processed and communicated. The point at which vibration becomes sound is the point at which we become aware of it, but there is also other information going on via vibration, defined, *purposed* perhaps, by its frequency. Rather like the navy and military and even commercial radio stations using radio waves to communicate audio information, perhaps vibration and sound have a similar relationship to other kinds of information, to do with architectural and even soul sustenance, i.e. Physical and non-physical information – some which we need to know (basic survival and relational information) and some which just occurs in spite of us.

I have included at the end of this paper, a brief outline of a company called Sonic Bloom, that has taken advantage of the properties of sound and vibration in order to facilitate growth of plants and crops. They are a good example of how we can work with sound in order to reinforce growth and it is a way of recognizing patterns of relationship.

There is much more to discuss but at this point I need to end, for now.

With thanks,
Clare Hedin

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*1 Retrieved June 14 2004 from printed web page;

http://www.tpub.com/content/neets/14182/css/14182_39.html

http://www.tpub.com/content/neets/14182/css/14182_39.htm

http://www.tpub.com/content/neets/14182/css/14182_39.htm*2 Retrieved June 14 2004

from web site: http://www.tpub.com/content/neets/14182/css/14182_39.htm

<http://wellmadewebs.co/public/atmo/lighting/light>

<http://wellmadewebs.co/public/atmo/lighting/light-theory-p.html>

http://www.tpub.com/content/neets/14182/css/14182_39.htm

http://www.tpub.com/content/neets/14182/css/14182_39.htm*3 Retrieved June 14 2004

from printed web page;

http://www.tpub.com/content/neets/14182/css/14182_39.html*4 Visited sonic Bloom, June

22 2004 at web site: http://www.relfe.com/sonic_bloom.html

Sonic Bloom:

http://www.relfe.com/sonic_bloom.html

It is important to look to actual lived experiences in order to gauge the value of ideas. I came across Sonic Bloom a number of years ago and went to their web site today, June 22nd 2004 in order to see how their idea is going. Dan Carlson invented a combination of birdsong recordings, at approximately 5000Hz. Alongside various recordings of classical music that had

the most positive effect on the stomata of leaves. When this music is played, he sprays an organic growth enhancer (not a fertilizer, apparently!) on the leaves in conjunction with playing the music. Apparently this has been having spectacular results. If interested, please visit the site for further details, as I do not wish to take up more of your time here! Some quotes from the web page follow:

To this oasis the birds had been attracted, not by a natural concert of their colleagues; but by a sonic diapason* closely resembling birdsong, which to human ears, incapable of distinguishing its varied harmonics, recalls the chirping of a chorus of outsized crickets.*
(diapason: The full range of notes)

This sonic symphony was being emitted from a series of black loudspeaker boxes set atop twenty-foot poles, each resounding over an oval of about forty acres. Its purpose was not so much to attract birds as to increase the size and total yield of a crop of fruit, 'hung', as they say in Florida, on trees as if it were a collection of decorative balls at Christmas time.

And some questions were asked about the process:

A: The special sound is made up of harmonic frequencies which stimulate the tiny pores of plant leaves to open. When these pores, called stomata, are open, the plant is able to increase its uptake of Sonic Bloom Balanced Nutrient (an organic fertilizer) by over 700%.

Q: That is a big increase! The sound is obviously very important, but what about the Nutrient?

A: The Nutrient itself is really the important thing. It's a combination of over 100 trace minerals, amino acids and naturally-occurring growth hormones. The sound is a tool to increase the effect of this organic foliar spray. 45 minutes minimum sound stimulation is necessary before and after the leaves are sprayed.

For further details visit site:

http://www.relfe.com/sonic_bloom.html

Last visited 22 June, 2004.

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