

LAMBDOMA UNVEILED

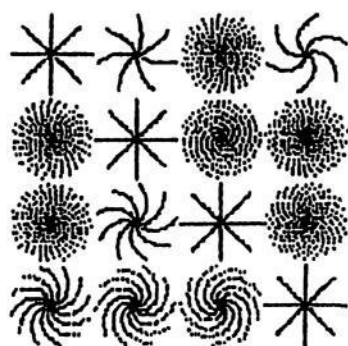
(The Theory of Relationships)

Second Edition

PRESENTATIONS, PAPERS AND LETTERS

by

Barbara Hero



STRAWBERRY HILL FARM STUDIOS PRESS

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PREFACE

LAMBDOMA UNVEILED is a part of my life work on the ancient mystery of the diagram attributed to Pythagoras. My work covers the period from the 1970's to the 1990's when I was giving lectures and workshops across the United States; reaching audiences of diverse interests from university Psychology and Art departments through Sound Healers, and Music Therapists to Architects. Some art exhibits and composer's performances were also given during this period based completely on the wisdom encoded in the Lambdoma Diagram.

Barbara Hero

**Wells, Maine
July, 1992**

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MUSIC OF THE GRAND GALLERY

*Presentation given at the 1988 conference of
the United States Psychotronics Association.
Commentary on Energy Systems added
by Donald Beaman in 1991.*

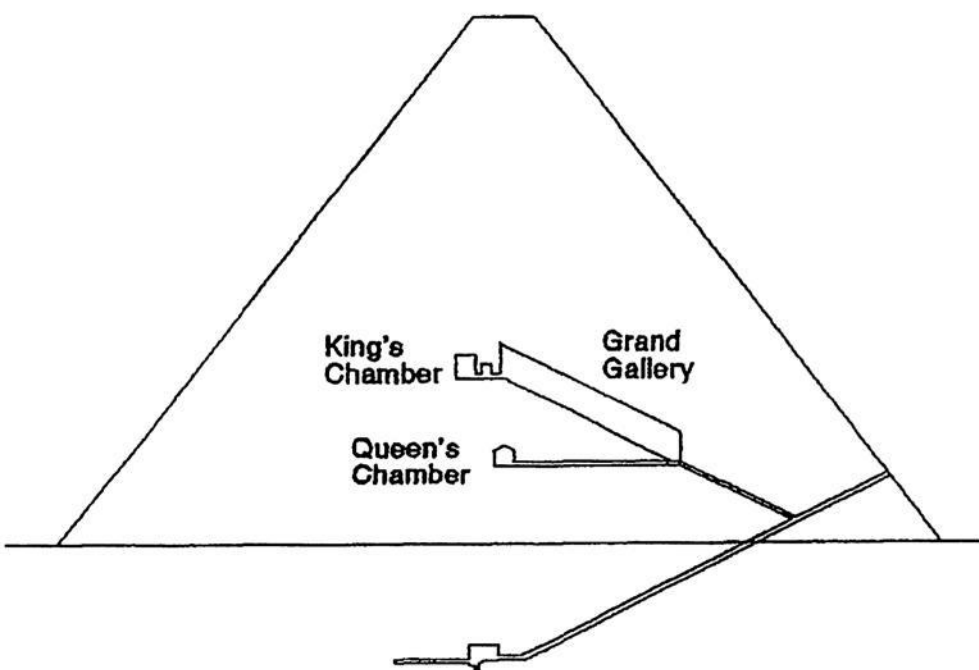
THE GRAND GALLERY AS AN ANCIENT MUSICAL SCALE

The focus of this presentation is to share the musical scale encoded in the dimensions of the Grand Gallery of the Great Pyramid at Giza in Egypt. A musical composition which stimulates the spiritual and emotional parts of the soul, will be played throughout this presentation. At the same time visual images will reinforce the musical composition and the verbal presentation. You will be able to simultaneously absorb audio, verbal and visual stimuli. You may find yourself in a creative, dream-like alpha state because of the nature of the sounds which reflect spiritual laws often hidden to the conscious mind.

It is hoped that you will learn how sounds are based on the musical scale inherent in the dimensions of this Messianic passageway. Since the intent of this presentation is for a conscious and subconscious awakening to a remembrance inherent in our evolution, its message is helpful to our own soul growth.

MY OWN MYSTICAL EXPERIENCE WHICH OCCURRED IN THE GRAND GALLERY

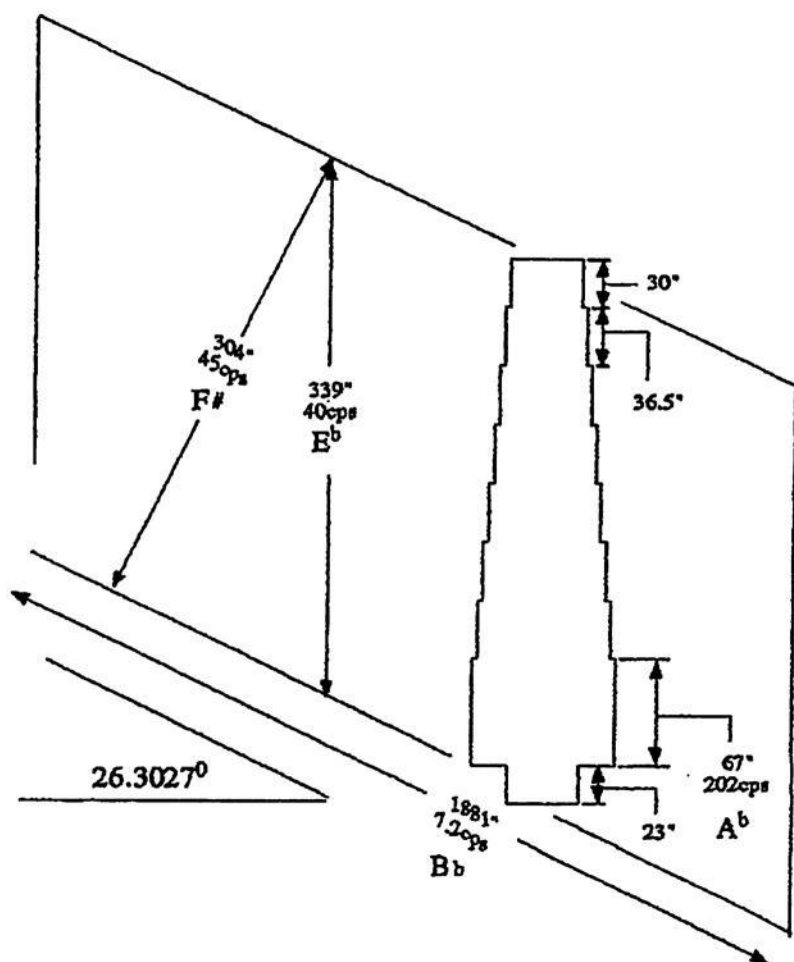
The Grand Gallery is a long sloping passageway in the Great Pyramid. One could think of it as a huge flute-like structure (Figure 1).



SECTION THROUGH THE GREAT PYRAMID
(Looking West)

Figure 1

I will begin with a story. In 1981 I made my first trip to the Great Pyramid. We all went single file up the ascending passageway. When I entered what is known as the Grand Gallery, I stopped briefly at the sight of the 157 foot long gallery with its 28 foot high walls, and its 7 foot width. (28 feet is the vertical height of the passageway, 25 feet is the height perpendicular to its inclined floor) (Figure 2). I felt an emotion that led me to emit great sobs as though something was sobbing through me. It was a recognition of the place. It was as though I was standing in a three dimensional representation of my drawings. For the previous eleven years I had been translating a Pythagorean diagram known as the Lambdoma Diagram into colors and



THE GRAND GALLERY In The Great Pyramid, Giza, Egypt

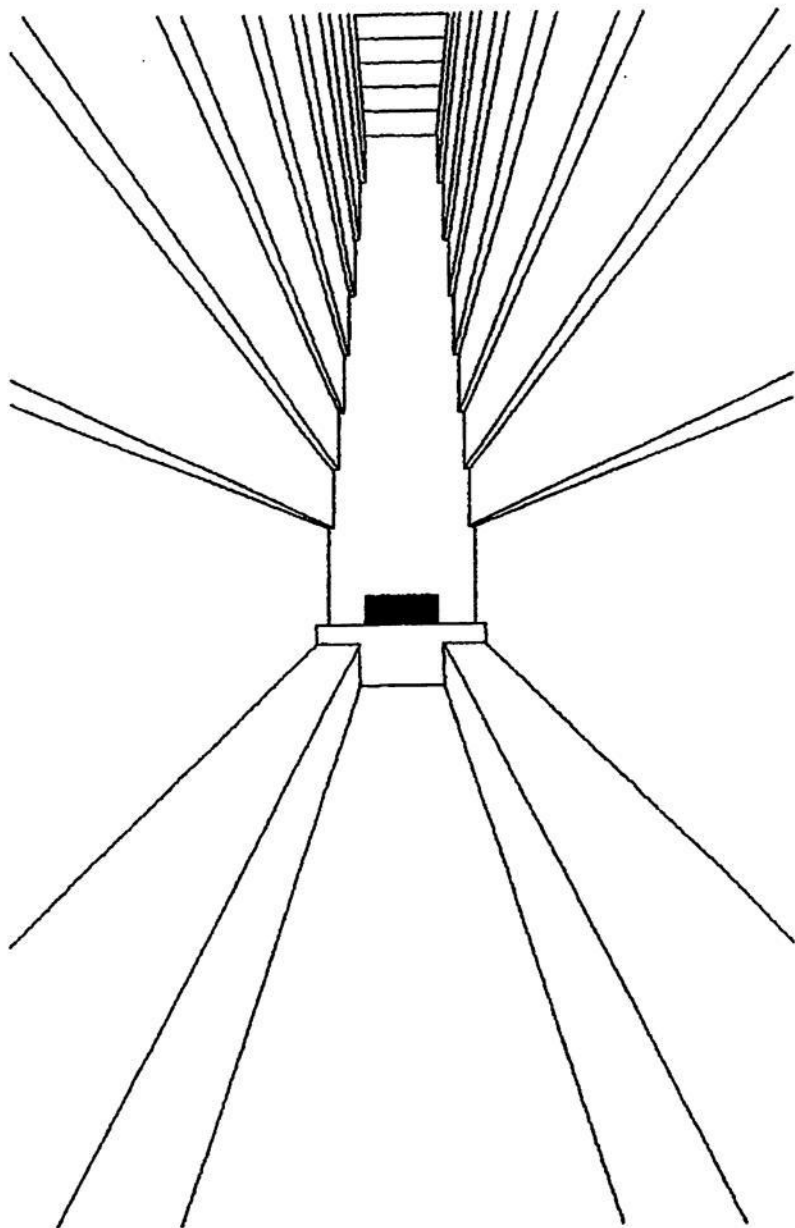
Figure 2

shapes. Ref. (1, 2, 3 & 4) These colors were all related to the harmonies of a musical scale. And suddenly there I was in its three dimensional manifestation (Figure 3).

Again, in 1984, I found myself in Egypt with nine other aspirants. This time the same sobbing occurred when I stood at the entrance to this "Grand Gallery" (Figure 4). This time, however, I felt the presence of the Master Jesus, and again a remembrance which caused something to sob through me. It was not necessarily sadness but more of an awakening of a remembrance. Later we recorded twenty minutes of music in the King's Chamber using one of the dimensions, the height of the King's Chamber (19 feet = 60 cycles per second = "B" in a musical scale), to define the fundamental musical note. It was the lowest note of the cello which is a "C" two octaves below "middle-C" on the piano. My colleague, Robert Miller Foulkrod, had devised an electronic tone generator which I set to 66 cycles per second representing the width of 17 feet which is a "C" musically. We used a battery powered frequency-counter to accurately set the frequency. The cellist then tuned her instrument to this same frequency which set up a resonant vibration in the chamber. Then five of us improvised with voice, flutes and cello. I am playing a portion of this recording here today to set the mood. While listening to this recording, in workshops, which I have given since that time, the participants have had past-life recall and other responses which seemed to be triggered by the experience of these sounds.

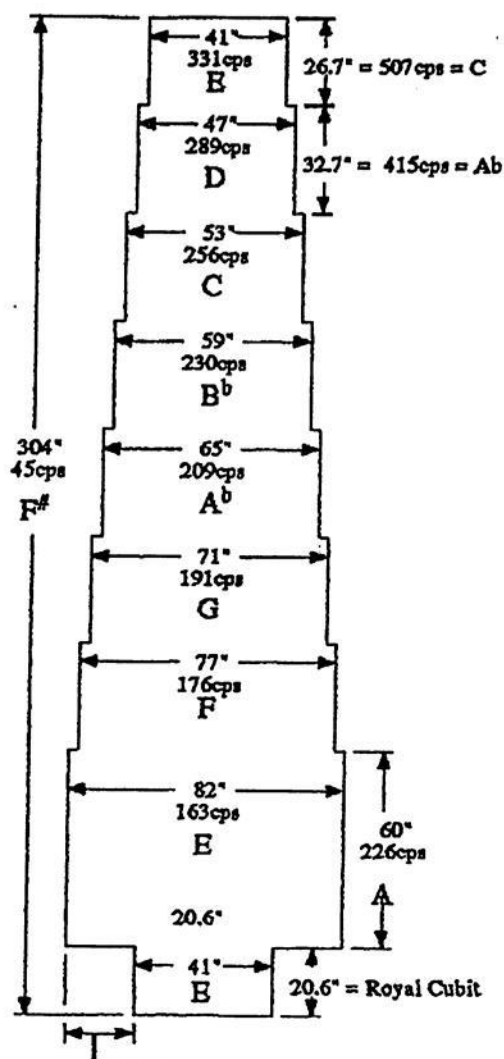
THE IMPACT OF THE HARMONICS OF THE GRAND GALLERY ON DIFFERENT LEVELS OF CONSCIOUSNESS

Because of my strong emotional response to the place I decided to focus my attention upon the dimensions of the Grand Gallery which had brought forth such a strong reaction. Ref.(5) Perhaps this focus could lead to discoveries relating the gallery to our brotherhood with the star system Sirius, the dimensions of the earth, the inverse nature of time and space, and whatever else might spring



**VIEW ALONG THE GRAND GALLERY
(Southward, upward, toward the Great Step)**

Figure 3



CROSS SECTION OF THE GRAND GALLERY
 (Perpendicular to the 26.3 degree slant of the gallery's floor)

Figure 4

forth. I decided I would do this all by analogies with musical intervals.

Hans Kayser's book, "Akroasis, The Theory of World Harmonics" and the Lambdoma Diagram have been "way-showers" in this field. The Hans Kayser Institute is located in Vienna, Austria. Hans wrote, "As a prerequisite for a penetration into the elemental facts of harmonics ...it is sufficient.....to have a simple familiarity with basic musical theory, arithmetic and geometry, and an inner receptivity to the spiritual and psychic results of harmonic experimentation."

Kayser also wrote that the way to study harmonics is "To descend again into the depths of Pythagorean thought, to experiment with scrupulous accuracy the number and tone laws thereby learned, and to interpret their meaning with the help of our modern scientific techniques." (Ref. 6) I decided to apply these musical theories to the Grand Gallery of the Great Pyramid.

RELATIONSHIPS BETWEEN THE CIRCUMFERENCE OF THE EARTH AND THE DIMENSIONS OF THE GRAND GALLERY

The circumference of the earth, through the poles, is estimated to be 24,884 miles. By multiplying the circumference of the earth, in miles, by 5,280 feet per mile, we convert its circumference into feet. By dividing this distance into the speed of sound through air at room temperature and pressure (1,130 feet per second) we obtain a frequency which expands by octave expansion to 9 cycles per second. Nine cycles per second represents an overtone interval in music. When nine cycles per second is used as an inversion or $1/9$ (undertone in music) and then expanded, the result is 7.1 cycles per second. Nine cycles per second is a "D", an overtone musically, while 7.1 cycles per second is a "Bb", an undertone musically. The Grand Gallery has a length of 157 feet, this gives us a frequency of 7.2 cycles per second. This is also a "Bb". Therefore, there seems to be an inverse musical relationship between the circumference of the earth and the length of the Grand Gallery.

ALPHA STATE REFLECTED IN THE LENGTH OF THE GRAND GALLERY

7.2 cycles per second is within the range of the alpha state when vibrations are in a certain range of frequencies. Because this is the frequency of the length of the Grand Gallery, there would be a continuous vibration of 7.2 cycles per second, a "Bb" musically throughout its entire length. This means that one would be propelled into this creative-other-worldly state the minute one stepped into the gallery and during the entire time it takes to climb its 157 foot incline. It would be like an initiation into what? The King's Chamber, a Messianic journey of the soul?

THE METHOD OF OCTAVE REDUCTION THE REFERENCE OCTAVE

First a reference octave must be chosen. One can use the whole number integers 2, 3, 5, 7, 9, 11, 13, and 15 where 2 = "C", 3 = "G", 5 = "Eb", 7 = "Bb", 9 = "D", 11 = "F#", 13 = "Ab" and 15 = "B".

Another reference octave could be defined by using the eighth through the fifteenth harmonics of an overtone scale beginning with 32 cycles per second (cps) as the fundamental frequency. This would give $8 \times 32 = 256$ cps = "C", $9 \times 32 = 288$ cps = "D", $10 \times 32 = 320$ cps = "Eb", $11 \times 32 = 352$ cps = "F#", $12 \times 32 = 384$ cps = "G", $13 \times 32 = 416$ cps = "Ab", $14 \times 32 = 448$ cps = "Bb" and $15 \times 32 = 480$ cps = "B". Frequencies which fall in between these numbers would be sharpened if higher or flatted musically if lower. See Table 1.

TRANSLATING DIMENSIONS INTO MUSICAL FREQUENCIES

To find the frequency that resonates with any given dimension, use the following formula from physics.

$$f = v / w$$

EIGHTH HARMONIC REFERENCE OCTAVE

HARMONIC	TIMES 32	FREQUENCY (cps)	MUSICAL NOTE
8th	x 32	256	"C"
9th	x 32	288	"D"
10th	x 32	320	"E ^b "
11th	x 32	352	"F [#] "
12th	x 32	384	"G"
13th	x 32	416	"A ^b "
14th	x 32	448	"B ^b "
15th	x 32	480	"B"
16th	x 32	512	"C"

- TABLE 1 -

Where: v = the speed of sound through air (1,130 feet per second)

f = frequency (in cycles per second)

w = wavelength (in feet)

For example given the perpendicular height of the Grand Gallery as 25.333 feet:

$$f = 1,130 / 25.333$$

Therefore the frequency resonant to that dimension is 44.6 cps.

Table 2 is a compilation of frequencies and musical notes for each distance from 2 feet to 156 feet.

TRANSLATING BETWEEN PLANETARY PERIODS OF ROTATION AND MUSICAL FREQUENCIES BY MULTIPLICATION AND INVERSION

One way to convert days per orbit, of a planet rotating around the sun, to a note in a reference octave is as follows:

1 - multiply the number of days per orbit by 24 to obtain the hours per orbit.

NOTES AND FREQUENCIES FROM DIMENSIONS

FEET	FREQUENCY	NOTE	FEET	FREQUENCY	NOTE
2	283	D	80	452	B ^b
4	283	D	82	441	A
6	377	G	84	430	A
8	283	D	86	420	A
10	452	B ^b	88	411	A ^b
12	377	G	90	402	A ^b
14	323	E	92	393	G
16	283	D	94	385	G
18	502	C	96	377	G
20	452	B ^b	98	369	G ^b
22	411	A ^b	100	362	G ^b
24	377	G	102	355	G ^b
26	348	F	104	348	F
28	323	E	106	341	F
30	301	E ^b	108	335	F
32	283	D	110	329	E
34	266	D ^b	112	323	E
36	502	C	114	317	E
38	476	B	116	312	E ^b
40	452	B ^b	118	306	E ^b
42	430	A	120	301	E ^b
44	411	A ^b	122	296	E ^b
46	393	G	124	292	D
48	377	G	126	287	D
50	362	G ^b	128	283	D
52	348	F	130	278	D ^b
54	335	F	132	274	D ^b
56	323	E	134	270	D ^b
58	312	E ^b	136	266	D ^b
60	301	E ^b	138	262	C
62	292	D	140	258	C
64	283	D	142	509	C
66	274	D ^b	144	502	C
68	266	D ^b	146	495	B
70	258	C	148	489	B
72	502	C	150	482	B
74	489	B	152	476	B
76	476	B	154	470	B
78	464	B ^b	156	464	B ^b

- TABLE 2 -

2 - multiply this number by 3,600 to obtain the seconds per orbit.

3 - divide this number into one to convert to orbits per second.

4 - multiply this very low frequency by 2 (octave expansion) as many times as it takes to expand it to your range of interest (usually into a reference octave).

The undertone in music is simply the inversion of the overtone so that one always finds a consistent pattern as if one were always playing upon a celestial keyboard. The pattern of the Table of Lengths is an undertone pattern because it is based on dividing (inversion) or $1/n$ instead of multiplying or $1 \times n$. Multiplying by 2 or 3 or ... etc. expresses the overtone series in frequency, while dividing by 2 or 3 or ... etc. expresses the undertone series in frequency. See Undertone Scale / Overtone Scale in Table 3.

THE ROYAL CUBIT BECOMES A MODULE FROM THE SLANT ANGLE DIMENSIONS OF THE RAMP HEIGHT AS A MUSICAL "E"

By considering measurements perpendicular to the incline, of 26.3027 degrees, of the grand gallery, all of the vertical dimensions were reduced by multiplying them by 0.8964655.

This difference made the measurement of the height 304 inches instead of 339 inches. This defines a musical note of a slightly sharpened "F" at 44.6 cycles per second instead of an "Eb" at 40 cycles per second. Most importantly, the ramp height of 23 inches, a "D#" at 589.5 cycles per second becomes a royal cubit of 20.6 inches and an "E" at 658 cycles per second. This illustrates how a small change in dimension of less than 3 inches can lower a musical note one half of a step from a "D#" to an "E". What this small change of measurement also indicates is that there is more harmony than dissonance in the above dimensions when they are measured perpendicular to the incline of the Grand Gallery. And the gallery becomes more of a musical

**A COMPARISON OF AN UNDERTONE / OVERTONE
SCALE BASED ON FUNDAMENTAL "F" (88 cps)**

Undertone Scale (Sub-Harmonics)		Overtone Scale (Harmonics)		
Note	Frequency	Note	Frequency	Harmonic
F ³	(2816)	F	(88)	FUNDAMENTAL
F ²	(1408)	F	(176)	2ND HARMONIC
B ^{b1}	(920)	C ^m	(264)	3RD HARMONIC
F ¹	(704)	F ^m	(352)	4TH HARMONIC
D ¹	(576)	A ^m	(440)	5TH HARMONIC
B ^{b m}	(460)	C ¹	(528)	6TH HARMONIC
G ^m	(380)	E ^{b1}	(616)	7TH HARMONIC
F ^m	(352)	F ¹	(704)	8TH HARMONIC
E ^m	(330)	G ¹	(792)	9TH HARMONIC
D ^m	(288)	A ¹	(880)	10TH HARMONIC
B	(240)	B ¹	(484)	11TH HARMONIC
B ^b	(230)	C ²	(1056)	12TH HARMONIC
A ^b	(208)	D ²	(1144)	13TH HARMONIC
G	(190)	D ^{#2}	(1232)	14TH HARMONIC
F [#]	(186)	E ²	(1320)	15TH HARMONIC
F	(176)	F ²	(1408)	16TH HARMONIC

Superscript ^m = middle-C octave

Superscript ¹ = octave above middle-C

Superscript ² = two octaves above middle-C

Superscript ³ = Three octaves above middle-C

No Superscript = octave below middle-C

- TABLE 3 -

instrument. See Table 4. Note the close resemblance of most of the frequencies in Table 4 to the Sub-harmonic scale above in Table 3.

TIME AND SPACE

Now let us experiment with the design of the Grand Gallery by taking a theory of Professor Donald Beaman of

**DIMENSIONS OF THE GRAND GALLERY
PERPENDICULAR TO THE SLANT ANGLE OF ITS
FLOOR OF 26.3027 DEGREES FROM THE
HORIZONTAL**

Part of the Grand Gallery	Dimension (Feet) (Inches)		Frequency (cps)	Musical Note	Musical Interval Relationship With "E" (Royal Cubit)
Total Length	157	1881	7.2	Bb	Diminished 5th
Total Height	25.3	304	45	F#	2nd

- - - THE MUSICAL SCALE - - -

Ramp Height	1.72	20.6	658	E	
1st Course Width	6.85	82.2	165	E	Octave
2nd Course Width	6.42	77	176	F	2nd
3rd Course Width	5.92	71	191	G	3rd
4th Course Width	5.42	65	209	Ab	4th (Minor)
5th Course Width	4.92	59	230	Bb	5th (Minor)
6th Course Width	4.42	53	256	C	6th (Minor)
7th Course Width	3.92	47	289	D	7th
8th Course Width	3.42	41	331	E	Unison

Superscript ^m = middle-C octave
 Superscript ¹ = one octave above middle-C
 Superscript ² = two octaves above middle-C
 Superscript ³ = three octaves above middle-C
 No Superscript = octave below middle-C

- TABLE 4 -

Boston University, that the vertical height of the Grand Gallery represents time, and that the horizontal width represents space. First the top is 41 inches wide. The bottom is 82 inches wide or two times the top width. There are 6 courses of approximately 4 inch wide ledges on each side with vertical faces of 36.5 inch height with a bottom face of 73 inch height, or double the above. Now when drawing lines from the top down to the base we can say that there are 7 equal offsets, on each side, of 4 inches each. The width of the base is 82 inches. This base resonates to a frequency of 165 cycles per second, or to an "E" two octaves below "middle C" and is in our audible range. 41 inches resonates to a musical note of "E^m" at 330 cycles per second. This is a relationship of an octave in music with a ratio of 1:2. Now 304 inches or 25.33 feet equals 44.6 cycles per

second, an "F#". Therefor, there is a musical relationship between the height and the base. This relationship, because of the difference of 27 cycles per second, if expanded to the same octave, would be considered dissonant musically. Figure 2.

An improvisation was played on the piano with flute and cello using the notes representing the frequencies designed into the Grand Gallery, which elicited feelings of the ancient place.

In February of this year I had a dream about the Grand Gallery. It was that the material universe fits into the non-material as an interpenetrating part of a puzzle. At the same time the image of the Grand Gallery came to me as a place where time and space come together, so that they do not exist. This brings up the following question. Did the ancient people try to make time and space synonymous? 37 feet equals 36.5 cycles per second, and conversely 36.5 feet equals 31 cycles per second. This can be derived from the information presented in the table of length and frequency correspondences. Table 2.

Wave length and cycles per second are inversely related to each other. That means that as frequency increases in pitch the related wavelength becomes shorter. And conversely, as wavelength increases in length the related frequency becomes lower in pitch. Perhaps there is a place where wavelength and frequency are the same, where the inversion factor goes to zero. Is it the Grand Gallery, as one climbs from course to course? Does this create a sensation in our bodies of the non-existence of time and space? Is the Grand Gallery an initiation chamber where one moves wholly into the now? Is it the perfect meditation chamber? See Figure 3.

GALACTIC CYCLES

Some pyramid researchers have presented theories that propose that each small length along the passageways of the Great Pyramid represents time in years. John Mitchell in his book "New View Over Atlantis" calculates the precession of

the equinoxes as 25,920 years. That is the time it takes for our solar system to revolve around the center of our galaxy. By calculating the musical note of this time we arrive at either 382 cycles per second a "G", or it's inverse 344 cycles per second an "F". Remember that the length of the Grand Gallery gives a "Bb", this would be the third sub-harmonic (undertone) of the fundamental note "F". Therefore, we might conclude that the sound "F", for the rotation of the solar system around the galaxy, is valid. Then the Grand Gallery at "Bb" would represent the third harmonic which is an interval of a musical fifth or a dominant fifth (5th) in music.

There have also been theories about the star Sirius, often called the "dog star". Sirius takes 1,460 years in its cycle with regard to our solar system. The related musical note becomes an "F" at 343 cycles per second or its inversion a "G" at 382 cycles per second. So, musically, we can say there is a direct connection between our galaxy and the star system Sirius.

I had a dream one night in which a large number reduced to 51. The next morning I made an octave expansion multiplying by the n^{th} power of 2 of this number and reached 26,112. If this number represented the length of time in years of the precession of the equinoxes then by octave expansion the related musical note would also be 384 cycles per second, a "G", or its inversion 342 cycles per second, an "F". "G" is an overtone, while "F" is an undertone. An overtone ascends, an undertone descends in a musical scale, one spiritual, the other physical.

Let us determine the musical notes of our day of 24 hours, which equals 86,400 minutes, and 5,184,000 seconds. When any number adds up to nine, we can cast out the nines by division as the ancient Babylonians did. The number nine represents a "D" (ninth harmonic) or a "B" (ninth sub-harmonic) in music. The factors in this number are 2, 5, and 3 or 3, 4 and 5 a Pythagorean triangle number. The musical note is a "B" at 480 cycles per second.

Our year of 365 days relates to a musical note of "B" at 481 cycles per second.

There are also theories, which have been aired, that our planet was placed in the solar system from elsewhere. Along with this theory it has been proposed that the year should really have been 360 days in length. Let us see what musical notes are related to this "perfect" year. It would be a 276.2 cycles per second or a "Db". An inversion of the frequencies of "Db" (276.2 cycles per second) becomes 7.4 cycles per second or a "Bb". Remember that we found that "Bb" relates to the length of the Grand Gallery at 157 feet or 7.2 cycles per second, a "Bb". Could the Grand Gallery be making a compensation for this discrepancy in our year?

Is "Bb" sounding the third sub-harmonic of our visible universe which is a fundamental "F"?

The 60 cycle hum, which surrounds all of us who use electricity in the United States, represents a musical note of "Bb". This is also the note related to the 19 foot height of the King's Chamber of the Great Pyramid. Perhaps this 60 cycle hum has a greater purpose in aligning our psyches with an ancient past and reflects some of the mysteries of the Great Pyramid at Giza.

CONCLUSION

I have presented a glimpse of my own mystical experiences which occurred twice in the Grand Gallery. I walked into a 3-dimensional Pythagorean Lambdome Diagram and had an intense emotional experience.

You have heard and seen the effects of an ancient musical scale and have been made aware of the relationships between harmonious sounds and harmonious lengths. You have experienced how sounds can recreate the "feel" of a place even if one has never been there, and conversely, how lengths or dimensions can recreate the "feel" of the place.

The mood of the Grand Gallery in the Great Pyramid of Giza has been created through sounds based specifically on the wavelengths of its dimensions and their harmonics.

ANSWERS TO QUESTIONS FROM THE AUDIENCE

Question: *"How could you relate distance to frequency if distance is in feet but feet is arbitrary? If you took meters then you would relate."*

Answer: "In the chart we related distance with meters, inches and feet. The main thing is the relationships that happen whatever (measure) you choose. You could choose any length and then you take the speed of sound in air which is 1,130 feet per second or it could be (meters) or anything. But it has to be something. You divide that by whatever frequency you want to know the length of or whatever length you want to know the frequency of."

Participant's query: *"And the frequency is in cycles per second?"*

Answer: "If 1,130 feet per second is the speed of sound in air, you know that one foot equals a musical "D" at 1,130 cycles per second."

Participant's response: *"I understand."*

"That is the main way I go about determining lengths or frequencies. By the way, you can actually create architecture from using harmonics. Some people have done that in Switzerland. The Hans Kayser Institute has been working with the architecture (of music) too."

Question: *"In Egypt, besides the Great Pyramid, are there any other architectures that you have found that incorporate music in the architecture?"*

Answer: "As a matter of fact, although I haven't investigated it, the Karnac temple at Luxor is certainly another place. The temple almost resonates as you walk through it. There are very huge columns. I am so convinced that the ancients, the Atlanteans, or whoever they were, incorporated these lengths and sounds (frequency and wavelength) into everything they did. And so it is a perfect harmonious relationship whether it is in music, or whether it

is in architecture, or sculpture or art. But (in answer to your question) there are many other examples, I am sure."

Question: *"I wanted to ask a question. I have read Dean and Mary Hardy's work. How do you feel about using stones? I had an experience. I went to a presentation on Egyptology where I found myself "spaced out" in seeing stones come through the air and being set into the Pyramid."*

Speaker's query: "Singing stones?"

Participant's response: *"The singing of the Temple singers that used the voice to levitate and to bring down . . . When I saw the Hall of the Sphinx or the line of the Sphinx I saw personalities in each one of them as being the symbols of us being able to take any form."*

Answer: "I think that sounds wonderful. I think that every experience we have, wherever we are or wherever we go, kicks off remembrances. And it is really a whole adventure in becoming aware, wherever we are, whether it's here or at home, or where we travel. It is wonderful to just have insights such as you just did."

Question: *"Do you know anyone here in the United States that is currently designing architecturally with these principles or with similar ideas?"*

Answer: "No. I wish I did. There is an architect at the Portland School of Art who attended one of my lectures there and came over to our farm and spent three hours with me. I gave him everything that I had compiled. I talked with him recently and he said he still didn't understand how to do it. What is the saying? 'When the student is ready, the Master appears.' You can't really force any of this. It will be wonderful when people do understand. I am sure that maybe there are people who are hidden somewhere who are doing similar research. I would love to do this myself, to build some meditation spaces at least. If I ever have the funds to do something like this, I would like to try. And maybe that is what the message is. Once you start uncovering so much you almost have to finish it. I am realizing that. You can't really turn it over to somebody

else. And as one of the speakers said, 'Each one of us is supposed to give out ideas really, and we can't hold anything back.' And we just hope that everyone takes whatever ideas we throw out to them and creates their own flower, their own garden."

Question: *"This is not so much a question of you, but I would like to share. I was in Egypt last October and I was in Luxor and Karnac. And I had many experiences like you were talking about. And I would like to say that there is a point of remembrance. When I went down the steps in Karnac and looked ahead, you go through the eye and you can see the eye. And it is a physical thing. And you don't know that it is there. I felt like one person, a stone among all the rest of those people that saw that eye. I thought that maybe with sound . . . , that is one of the reasons I came forward. When you went around between Karnac and Luxor there is a pool there where they had their initiations or baptisms perhaps, I don't know. Nevertheless I separated from the group because I had started to cough. When I separated from the group there was a gentleman, I was with the Astara group, and it was a spiritual group, Dr. Cheney was doing a prayer and things for the world at that particular time. When I separated myself from the group, on this side of me there was a small temple that had fallen down, yet his voice resonated from there. And his voice went out and would have covered all of Luxor and I heard that."*

Answer: "Someone told me that the Parthenon, in Greece, was sort of an amplifier."

Participant's response: *"It was."*

"It is wonderful what the ancients must have known."

Participant's response: *"Thank you for letting me share."*

Answer: "Yes. Thank you very much for that."

ANSWERS TO FREQUENTLY ASKED QUESTIONS

Question: *"Why did you choose the Grand Gallery passageway in the Great Pyramid of Egypt to illustrate how sounds recreate an enclosed space?"*

Answer: "This passageway was chosen because of the the emotional effect it had on me and on other visitors."

Question: *"How did it effect you?"*

Answer: "The emotion of remembrance and recognition was very powerful even though I had never been there before."

Question: *"How did you determine what sounds recreated this feeling?"*

Answer: "By measuring the dimensions of a space one can translate resonant wavelengths into frequencies of sounds used in music."

Question: *"What was the result of these measurements?"*

Answer: "The passageway seemed to suggest a huge musical instrument somewhat like a flute because the dimensions translated into a musical scale beginning at the note 'E' and ending at the same note one octave higher."

Question: *"What sort of a musical scale is it?"*

Answer: "It is a scale which is something like a 'harmonic minor' in music and it is what I call a 'Lambdōma' scale."

Question: *"Were there any other analogies you made concerning this passageway?"*

Answer: "Yes, the Great Pyramid has been considered to have been built based upon the dimensions of the earth. When you take the wavelength of the circumference of the earth and translate this into a musical note it is a nine cycles per second frequency. Nine cycles per second represents the

note 'D' in music."

Question: *"What is the significance of this note?"*

Answer: "Again, by analogy, the note 'D' corresponds to the energy center of the second chakra, a regenerative energy."

Question: *"Are you implying that each note of the scale in the Grand Gallery also represents an energy center of the human body?"*

Answer: "Yes, and moreover every 'key note' of every musical composition written, represents the energy system of one of the chakras."

Question: *"Does each of these chakras have a wavelength as well?"*

Answer: "Yes, for instance, in the 'middle C' octave the wavelengths of each note of the scale measure several specific, characteristic lengths."

Question: *"I thought that color was measured in wavelength, which brings up the question; can you translate musical notes into color?"*

Answer: "Of course, and many have already done so. Pythagoras and Newton assigned the same rainbow colors to the musical scale starting with 'C' as red, 'D' as orange, etc. There is another complimentary color scale which assigns 'C' as green and 'D' as blue green, etc."

Question: *"You mentioned cycles per second earlier. What was the length of the Grand Gallery and the corresponding cycles per second?"*

Answer: "The length was 157 feet which translates to 7.2 cycles per second which corresponds to the note 'Bb' in music."

Question: *"It has been said that there is a modular dimension from which the the Great Pyramid was*

constructed. Do you have any ideas on this?"

Answer: "Yes, I believe it is the 21-inch, Royal Cubit, which translates to the musical note 'B', which corresponds to the solar plexus in the chakra energy system."

Question: *"What does this chakra signify?"*

Answer: "Many feel that it is the 'mental / emotional' energy center, from which many people operate, at this time, here on earth. It is not only the note 'E' in music but it represents the color yellow or its complementary color blue-violet."

Question: *"You have spoken often of overtones and undertones. Would you elaborate on this?"*

Answer: "An overtone pattern is in an ascending order from its fundamental key-note and could be considered as a spiritual striving. The undertone pattern is a descending order from its fundamental and relates to the physical plane."

Question: *"You also talk of time and space being synonymous in the passageway. Could you explain this?"*

Answer: "Time at 31 cycles per second represents space at 36 feet."

Question: *"Could that dimension, combined with a sound close to that frequency, create a good meditation space?"*

Answer: "I believe so."

Question: *"You have said that we can recreate space with sounds. Please explain how?"*

Answer: "By taking the measurements of an enclosure or a room, (length, width and height) one can translate these dimensions into musical notes which will recreate the sound and therefor the feeling of the room by taking the velocity of sound in air at room temperature as one of the factors."

"The equation becomes;

$$\text{Note} = 1,130 / \text{Dimension},$$

or the Musical Note (in cycles per second) = 1,130 (in feet per second) divided by the Room Dimension (in feet),

where the Constant 1,130 is the speed of sound in air near standard conditions (in feet per second)."

Question: *"What if the room is so big that its note would not be an audible note, but a mere beat as if it were a drum beat?"*

Answer: "Then you would use the mathematics of music which is simply octave doubling of the frequency until it resides within your reference octave."

Question: *"What is your reference octave?"*

Answer: "My reference octave is in the 'middle C' range from the note 'C' at 256 cycles per second to the note 'C' at 512 cycles per second."

Question: *"Could one take a smaller range say 8 cycles per second to 16 cycles per second?"*

Answer: "Yes and that would form a recognizable but sub-audible scale, that you could play in music, but as I said before it would sound more like drum beats of a harmonic minor scale."

Question: *"Could you explain what you mean by harmonic?"*

Answer: "Harmonics are a series of sounds called partials or overtones in music. These overtones are part of the physics of music. A vibrating string will vibrate between different nodes along a string. These nodes are points at which the vibration ceases and are found at certain places along the string. They divide the string into certain definable parts, which are always half wavelengths."

Question. *"Tell me again what relationship wavelengths have with frequency?"*

Answer: "They are in inverse relationship to one another. That is as frequency increases, the wavelength decreases, and as frequency decreases the wavelength increases. You can see this when you are at the beach and notice that the greater the distance between the wave crests the slower the periods or frequencies."

Question: *"Are you talking about time and space when you talk about frequency and wavelength?"*

Answer: "Exactly, and since you have made that analogy, you can conclude that as time contracts space expands, and as time expands, space contracts. They are in inverse relation to one another."

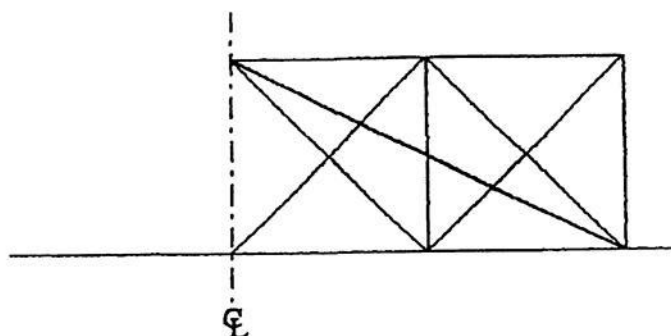
ENERGY SYSTEMS IN THE GRAND GALLERY

The following commentary is the result of conversations with Professor Donald Beaman, in March, 1991, about the additional Wisdom encoded within the geometry of the Grand Gallery.

We begin by forming two squares along a base line drawn on the floor of the corridor to the "Queen's Chamber" anchored at the point where the ramp of *The Grand Gallery* intersects this horizontal - and limited in height along the vertical center line of the pyramid in a North / South section. See Figure 5.

This upper limit is marked by "The Great Step".

The two squares that we have formed imply a diagonal that indicates the slope and the floor of the *Grand Gallery*, and the figure also demonstrates a 2:1 ratio that echoes the octave in music.



CREATIVE GEOMETRY IN THE SLOPE OF THE FLOOR OF THE GRAND GALLERY

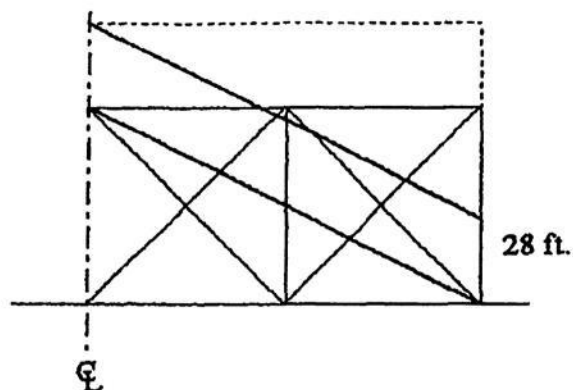
Figure 5

This diagonal that is the "floor" of the ramp completes a first triangle. Reflected above the ramp is the serrated ceiling of the Gallery separated by the equivalent of 28 feet in a vertical section. See Figure 6.

If we square the figure we have produced, at the point where the ceiling cuts the center line above "The Great Step", we will produce a rectangle whose diagonal is also the diagonal of the Gallery. See Figure 7.

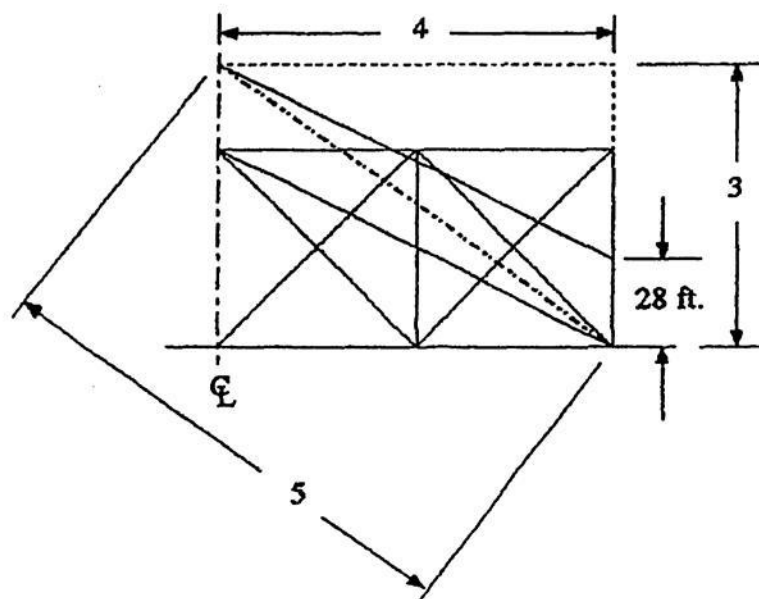
The two halves of this rectangle demonstrate the character of the classic Pythagorean 3 - 4 - 5 triangle.

Step 2 - If we now divide the line of the ramp in the Gallery into 28 divisions, as the ancients did, we will indicate part of the construction module of the whole fabric, as follows:



GEOMETRY INCORPORATED IN THE CEILING OF
THE GRAND GALLERY

Figure 6



THE LONG DIAGONAL OF THE GRAND GALLERY

Figure 7

- 28 divisions along the hypotenuse of a triangle on a base of two squares -

- we divide the side of the square along the center line, up to the height of "The Great Step" into 28 increments.

- by dropping the modules of the hypotenuse down, we also divide the base into 28 units.

The over-all grid implied is in the horizontal, a 2:1 ratio. See Figure 8.

If we give approximate measure to the module, it will be close to 3.2 feet by 6.4 feet as a prototype building block.

This grid can be applied over the entire face of the section, implying courses of construction (although, in fact the courses may vary) - the module is theoretically useful.

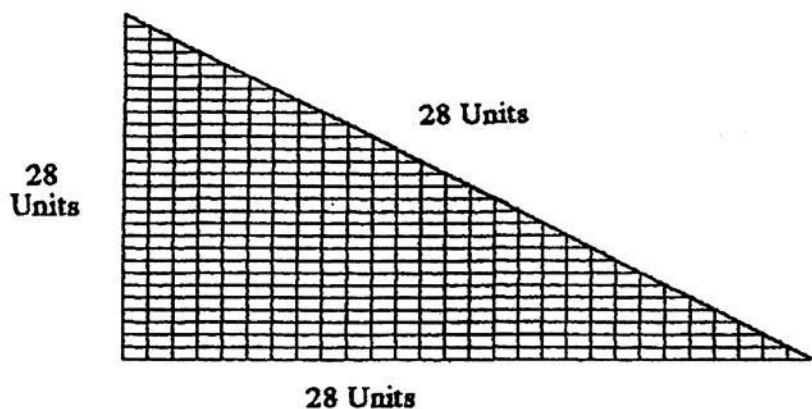
Step 3 - Returning to the rectangle that would enclose the Grand Gallery; - we can see that the height of the gallery rises above the floor of the ramp, and that a theoretic triangle of modules can be implied above its ceiling. See Figure 9.

The 28 increments along the ramp indicate 28 vertical sections along the length of the volume.

Step 4 - Presuming that we already understand the general concept of the emanating Lambdoma, we can apply the pattern over the base point of our greater rectangle at the center line. We might say that this is an apex (A) of emanation of energy from the inner-earth source that reaches up to the ramp of the Gallery, and we might then call this "*the undertone series*"

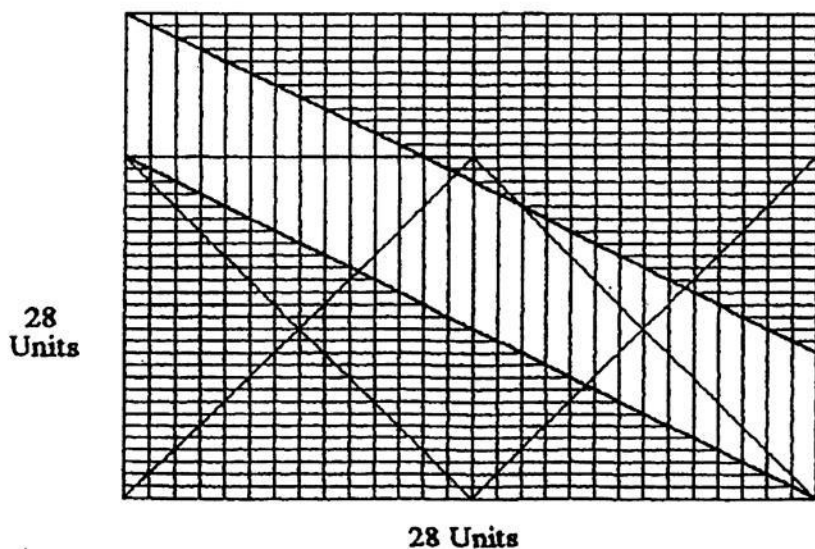
If we imagine a mirror image - Lambdoma projecting downward from the opposite apex (B) - toward the ceiling of the Gallery - we could call this "*the upper or outer source*" and we might assume it to represent *the overtone series*. See Figure 10.

Theoretically, if sound was emanating from each apex,



CONSTRUCTION MODULES OF THE GRAND GALLERY

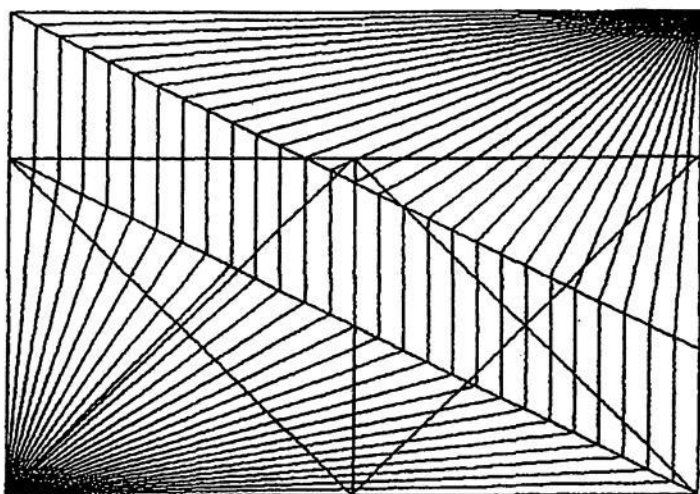
Figure 8



THEORETICAL MODULES ABOVE THE CEILING

Figure 9

B



A

LAMBDOMA RAYS OF THE GRAND GALLERY

FIGURE 10

culminating as a mixed or compound sound within the volume of the Grand Gallery, we might realize sound becoming light in this less dense cavity of air.

One may assume that sound travels at a greater speed through limestone and granite than it does through air. Though this scientific fact may sound illogical to common sense, we might assume that the effect of slowing down within the Gallery could produce light in a form of a "rainbow" corresponding to the seven stages of reduction in the profile of the Gallery above the line of the human module of 5 feet - 7 inches.

The "human Module" of height indicates a fourth factor; presuming that we have undertone volume, overtone volume

and gallery volume in place. The human, standing at the base of the ramp adds the factor of it's own "keynote" or drone, sounding and radiating a Lambdome matrix of its own harmonics and sub harmonics.

The equation would not be complete if we did not recognize the fourth "apex" in the greater rectangle, which is at the ceiling, above "The Great Step" and in the working section, N. / S., is located on the center line. We could call this the *supernal apex* - crowning the entrance to the antechamber to the volume beyond which we term "The King's Chamber".

"The Great Step" might cause us to stop to consider that it may indicate, in height, the particular cubit used in the entire fabric - that is; 20.6 inches.

The supernal apex, as symbol, in its emanation might be said to sound the *keynote of the cosmos*, making two more Lambdome matrices as a combination of four harmonic and subharmonic drones.

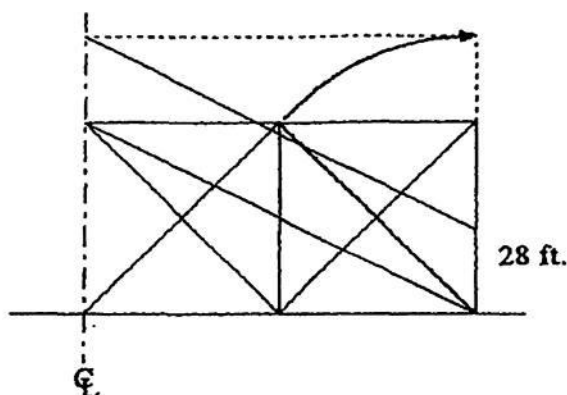
To assess what we have assumed: -

A rectangle enclosing the diagram of the Grand Gallery up to a line at the center of a North / South section, produces a classic 3 - 4 - 5 triangle when its diagonal is drawn.

A triangle drawn on a base of the horizontal length of the Grand Gallery, rising to the height of "The Great Step" produces a ramp (hypotenuse with 28 divisions) that is the diagonal of two squares.

(The diagonal of one of these squares, rotated to vertical produces the square root of two which is the vertical height or lesser side of the 3 - 4 - 5 triangle) - this determines, perhaps the vertical dimension of the Gallery's height. See Figure 11.

Energetically, the complex within the outer or greater triangle, is enlivened by a resident chordal drone composed of a mix of at least two interacting overtone / undertone compounds, obviously producing a sort of four part inherent



GRAND GALLERY HEIGHT CREATED FROM THE
DIAGONAL OF A CONSTRUCTION SQUARE

Figure 11

drone as an architectural continuum.

The human factor is what we might term the quintessential "catalyst" adding or over laying a fifth drone to the ongoing chord.

We might ask - when the human enters this "sound crucible" of the Grand Gallery, - does the human instrument become "tuned" to its ideal possibility, by degrees, as it ascends toward "The Great Step"?

Is this an intelligent analysis of this implied mystery?

- The geometry is evident -
- The "Physics" of materials and sound / light is codified -
- The suggestion of the emanation of the Lambdoma seems probable -
- The human could be termed a tunable instrument -

The Great Pyramid remains - enigmatic - pulsing -
challenging us to become one - with it -
- becoming more -
- becoming all -.

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AWAKENING CONSCIOUSNESS THROUGH GENERATING PATTERNS OF HARMONIC SOUNDS

*Presented with Robert Miller Foulkrod at the
United States Psychotronics Association
Conference in Atlanta, Georgia in 1984.*

Computer generated shapes formed by the ratios found in the harmonic matrix called the Lambdoma will be presented. Among these will be Lissajous Figures, Fibonacci series patterns and a color coding of intervals coupled with the actual sounds of the matrix indicating the ray nature of the harmonic series.

The main point to be made will be the demonstration of the awakening of consciousness by perceiving symbols, shapes, colors and sounds of an ancient law of the universe known as the Lambdoma Diagram. It is believed by some that Pythagoras brought this diagram to the Greek world from the Egyptian temples.

Some examples of the awakening nature of the sounds themselves will be illustrated by slides of art work from an Art / Sound workshop made by residents of a residential drug rehabilitation program.

A laser and scanner system will be used to demonstrate the shapes of different harmonic intervals in sound. Other equipment used during the presentation will be sine wave

generators, and a frequency counter to illustrate the importance of the calculation of exact mathematical relationships in order to create the most beautiful and precise shapes from each musical interval.

Most of us know that the whole planet is in the process of awakening, an awakening to a New Age. Many of the old modes of learning are becoming antiquated. We learn not only from our mental levels, but also from our emotional, intuitive and spiritual levels.

The consciousness of the human race is being rediscovered by us all. Some of the subliminal ways the consciousness is being stimulated is by pattern or symbol and harmonic sounds.

Most people are not yet aware that sound can actually create shapes. Intervals of sound in precise mathematical relationships can create almost any form, and any shape known on the planet, from circles and figure eights, to complex square shapes formed by a lacy network of lines.

We will present computer generated shapes, which become like modern day hieroglyphs, arrayed on an ancient diagram which represents graphically and mathematically a cosmic energy law of the universe, well known to the ancients.

We will show how a color coding of the same diagram brings out a characteristic shape of seven rays, whose philosophical meanings have been investigated and hinted at in many esoteric studies.

We will show examples of the awakening nature of the sounds when frequencies in the audible range were played to residents in a drug rehabilitation center. Visual images of all styles, and feelings long hidden were released upon hearing the sounds. This was evidenced when the listeners were asked "to draw what the sounds look like" and when they

were subsequently asked to write the feelings which they had while creating the drawings.

We will use a laser / scanner system to show how each harmonic interval has a different characteristic shape. We will show how these shapes, generated by the sounds themselves, exactly match those shapes drawn by a computer, based on mathematical ratios alone. These shapes are called Lissajous figures.

Also we will illustrate how important it is to calibrate the sounds, more precisely than by conventional keyboard instruments, by means of a frequency counter in order to have the mathematical relationships required for perfect intervals both in sound and shape.

Basically there are at least seven different shapes, which are easily identified as to interval relationships. These shapes are determined by ratio alone. An interval in music is defined as the steps from a beginning keynote as it is related to the second, third, fourth, fifth, sixth and seventh steps of a musical scale. Since a beginning keynote can be any one of the seven steps we have chosen, the subsequent steps are always different notes but always exhibit the same intervallic relationship with each change in key.

SHAPE	QUALITY	RATIO	IDENTITY
Circle	Stability	1:1	Unison
Arch	Progression	2:1	Octave (up)
Square	Disintegration	5:4	Minor Third
Figure Eight	Maintaining Stability but Divided	1:2	Octave (down)
Fish	Energy	2:3	Fourth
Folded Arms	Separation in a New Way	4:3	Fourth
Rotated Fish	Becoming Whole in a New Way	3:2	Fifth

Table 1

We will give you glimpses of the Pythagorean formula, known as The Lambdome Diagram [1, 2], which is an ancient diagram made up of a matrix of fractions, or ratios with an exact correspondence to musical harmonics or overtones. This ancient diagram most probably originated in Atlantis, surfacing later in Egypt, then even later in Greece, then in Syria under the wing of Iamblichus, a mathematician and philosopher who lived in 200 AD. It surfaced next in Germany with a Count Von Thimus [2], and finally in English in a book on acoustics by Levairie and Levy entitled "Tone: A Study in Musical Acoustics" [1].

Now, the diagram is surfacing again here at the United States Psychotronics Association, in Atlanta, Georgia.

This Pythagorean matrix, the Lambdome, presents a specific relationship of a mathematics of musical intervals. It is unusual in that not only is it composed of rational numbers but it links each rational number entry to a specific interval or step in a musical scale. It might be defined as a harmonic matrix, harmonic in the sense that one axis on the Cartesian coordinate plane defines an overtone, while the other axis defines an undertone. The idea of undertones is extremely controversial partly because it is theoretical and not based on the physical reality of a vibrating string, where on the physical plane a string cannot be stretched two or three or more times its given length.

The first historical mention of the Lambdome matrix dates from the neo-Pythagorean Iamblichus or "Jamblichus" (200 AD) who indicated how Pythagoras set up a correspondence with the letters of the Greek alphabet and particular intervals in music, and rational numbers. The first appearance of the Lambdome diagram seems to have been recorded by the mathematician Nicomachus of Gerasa [3] (c 100 AD). This diagram was composed of two lines forming a triangle. (Figure 1)

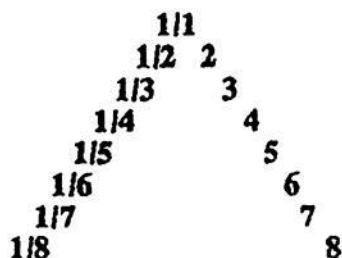


Figure 1

This original Lambdoma was described as a "Lambdoid". One leg was made up of fractions while the other leg was composed of whole number integers, the inversions of the fractions.

Figure 2, of the Lambdoma, shows the Overtone / Undertone relationships. Overtones have been described many ways. Webster's definition is "One of the secondary sounds of a tone, set higher in pitch, which along with the fundamental produces timbre; a harmonic" [4]. A standard definition of overtones is that they are notes formed from an ascending series of harmonic intervals which are simple multiples of a fundamental tone. On the other hand, undertones are controversial because their existence has been questioned. However, undertones have been aptly described in the 1870's by Riemann [5] as "Undertone is that name given to that series of tones which, as opposed to the upper tone series, extends downward . . . the consonances of the minor chord, as the upper tone series for that of the major chord".

It is important to explain that every tone produces undertones, just as every tone produces overtones. Therefore, we are going to assume that convention.

A vibrating string implies measurement by wavelength.

RATIOS OF FREQUENCIES: (FOURTH

FUNDA- MENTAL	C = 256 Hertz	1:1 C	2:1 C	3:1 G	4:1 C	5:1 B	6:1 G	7:1 Bb
OCTAVE		1:2 C	2:2 C	3:2 G	4:2 C	5:2 B	6:2 G	7:2 Bb
4 TH		1:3 F	2:3 F	3:3 C	4:3 F	5:3 A	6:3 C	7:3 Bb
OCTAVE		1:4 C	2:5 C	3:4 G	4:4 C	5:4 B	6:4 G	7:4 Bb
6 TH minor		1:5 Ab	2:5 Ab	3:5 Bb	4:5 Ab	5:5 C	6:5 Bb	7:5 Gb
4 TH		1:6 F	2:6 F	3:6 C	4:6 F	5:6 A	6:6 C	7:6 Bb
2 ND		1:7 D	2:7 D	3:7 A	4:7 D	5:7 Gb	6:7 A	7:7 C
OCTAVE		1:8 C	2:8 C	3:8 G	4:8 C	5:8 B	6:8 G	7:8 Bb
7 TH minor		1:9 Bb	2:9 Bb	3:9 F	4:9 Bb	5:9 D	6:9 F	7:9 Ab
6 TH minor		1:10 Ab	2:10 Ab	3:10 Bb	4:10 Ab	5:10 C	6:10 Bb	7:10 Gb
5 TH diminished		1:11 Gb	2:11 Gb	3:11 Db	4:11 Gb	5:11 Bb	6:11 Db	7:11 B
4 TH		1:12 F	2:12 F	3:12 C	4:12 F	5:12 A	6:12 C	7:12 Bb
3 RD minor		1:13 B	2:13 B	3:13 B	4:13 B	5:13 G	6:13 B	7:13 Db
2 ND		1:14 D	2:14 D	3:14 A	4:14 D	5:14 Gb	6:14 A	7:14 C
2 ND minor		1:15 Db	2:15 Db	3:15 Ab	4:15 Db	5:15 F	6:15 Ab	7:15 B
OCTAVE		1:16 C	2:16 C	3:16 G	4:16 C	5:16 B	6:16 G	7:16 Bb
		O C T A V E	5 TH	O C T A V E	3 RD	5 TH	7 TH minor	

Figure 2A

A LAMBDOMA TABLE QUADRANT)

A = 430.5 Hertz

8:1 C	9:1 D	10:1 E	11:1 Gb	12:1 G	13:1 Ab	14:1 Bb	15:1 B	16:1 C
8:2 C	9:2 D	10:2 E	11:2 Gb	12:2 G	13:2 Ab	14:2 Bb	15:2 B	16:2 C
8:3 F	9:3 G	10:3 A	11:3 Bb	12:3 C	13:3 Db	14:3 Eb	15:3 E	16:3 F
8:4 C	9:4 D	10:4 E	11:4 Gb	12:4 G	13:4 Ab	14:4 Bb	15:4 B	16:4 C
8:5 Ab	9:5 Bb	10:5 C	11:5 D	12:5 Eb	13:5 F	14:5 Gb	15:5 G	16:5 Ab
8:6 F	9:6 G	10:6 A	11:6 Bb	12:6 C	13:6 Db	14:6 Eb	15:6 E	16:6 F
8:7 D	9:7 E	10:7 Gb	11:7 Ab	12:7 A	13:7 B	14:7 C	15:7 Db	16:7 D
8:8 C	9:8 D	10:8 E	11:8 Gb	12:8 G	13:8 Ab	14:8 Bb	15:8 B	16:8 C
8:9 Bb	9:9 C	10:9 D	11:9 Eb	12:9 F	13:9 Gb	14:9 Ab	15:9 A	16:9 Bb
8:10 Ab	9:10 Bb	10:10 C	11:10 D	12:10 Eb	13:10 F	14:10 Gb	15:10 G	16:10 Ab
8:11 Gb	9:11 A	10:11 Bb	11:11 C	12:11 Db	13:11 Eb	14:11 F	15:11 G	16:11 Ab
8:12 F	9:12 G	10:12 A	11:12 Bb	12:12 C	13:12 Db	14:12 Eb	15:12 E	16:12 F
8:13 E	9:13 Gb	10:13 G	11:13 A	12:13 B	13:13 C	14:13 Db	15:13 D	16:13 E
8:14 D	9:14 E	10:14 Gb	11:14 Ab	12:14 A	13:14 B	14:14 C	15:14 Db	16:14 D
8:15 Db	9:15 Eb	10:15 F	11:15 G	12:15 Ab	13:15 Bb	14:15 B	15:15 C	16:15 Db
8:16 C	9:16 D	10:16 E	11:16 Gb	12:16 G	13:16 Ab	14:16 Bb	15:16 B	16:16 C
O C T A V E	2 ND	3 RD	4 TH aug- men- ted	5 TH	6 TH minor	7 TH minor	7 TH major	O C T A V E

Figure 2B

Since wavelength is in inverse relationship to frequency, much confusion can be clarified by using a frequency table rather than the traditional wavelength table which had been handed down to us by the Pythagoreans. In our times sound is measured in frequencies in cycles per second. Therefore, using frequency is topical. However it is important to remember that every sound that is made has its own wavelength as well as its own frequency, and that any object with length, width or height has its own frequencies as well as its own wavelengths.

We can determine the pitch or frequency of a given length because of the properties of inversion of frequency to wavelength. The ancients could measure wavelength by ropes, therefore their formulas could read:

$$w = v / f$$

where w = wavelength

v = velocity

and f = frequency

While ours reads: $f = v / w$ (1)

or: $v = f w$ (2)

The above formula (1) is one of the ways we can measure our height, and determine the exact tone of our height. We can create our own harmonic space by intoning the sounds of our own measurements. Harmonic sounds awaken the consciousness on the physical, mental, spiritual, and emotional levels. It is the exact relationship of the intervals that creates the harmonic balance which in turn generates the patterns of Lissajous Figures. Here the Lambdoma Matrix is encoded in shapes called Lissajous Figures, trigonometrically computer generated according to the specific ratios inherent in the table itself.

By taking some of the simple ratios inherent in the Lambdoma table, and plotting the resulting curves repre-

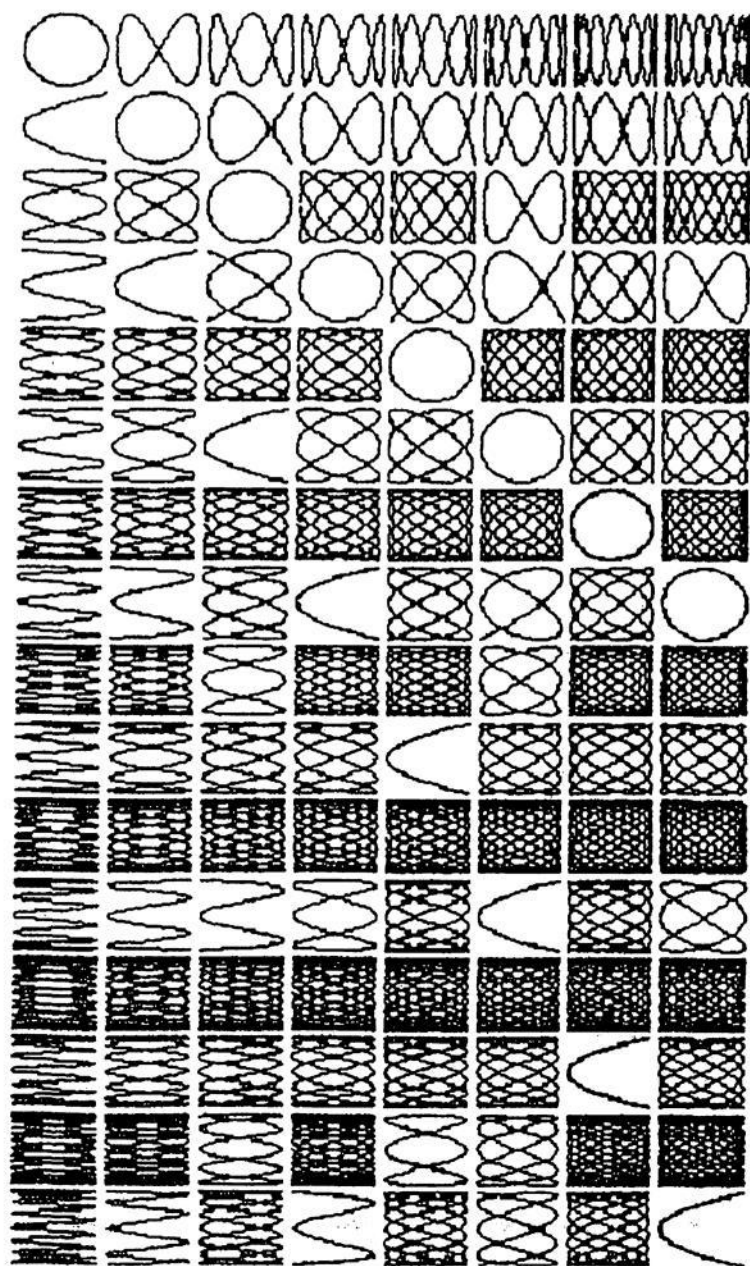
sented by these ratios, characteristic and distinct patterns emerge showing how each ratio representing its specific musical interval differs in shape. (Figure 3) This is analogous to the different pitches in music that we hear when using these ratios and multiplying them by an audible frequency in a suitable octave range. These ratios show a fixed and consistent characteristic patterning.

We can easily, visually trace the rays which emanate from the apex of the diagram by noting the repetition of each characteristic shape along its own ray path.

Here is the Lambdoma again coded in music notation on the top line, and color notation underneath each line, and you will see the actual colors on the computer generated Lambdoma. Notice the rays coming out from the apex as they have a particular significance. (Figure 4) The energies of the cosmos seem to be revealed in the seven rays which radiate out from the array. Seven rays are inherent in much esoteric literature, especially in the work of Alice Bailey [6] who was the vehicle for the channel D.K., a Tibetan Master, of whom it has been said that he was a reincarnation of St. Francis of Assisi, and before that of Pythagoras. These works, of five volumes, on a "Treatise of the Seven Rays" are examples of awakening the consciousness of the human race from a Psychological, Astrological, Healing and Initiation focus.

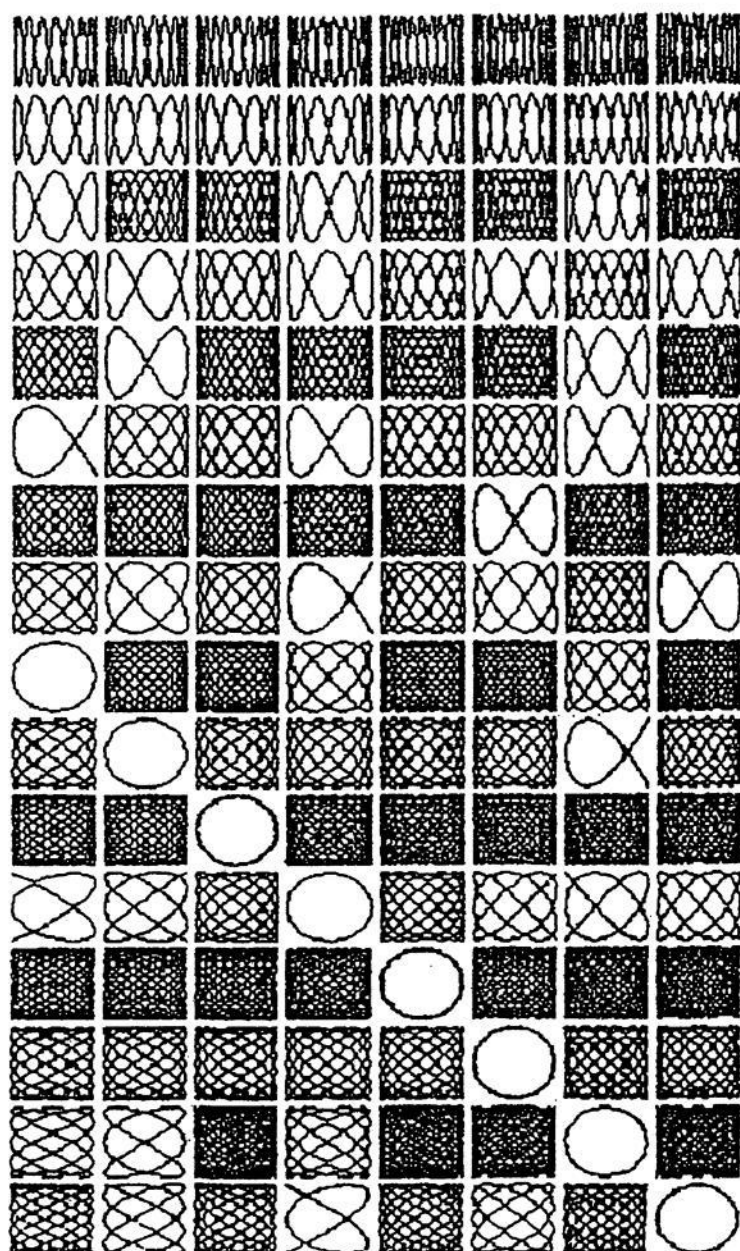
Each of these rays has its own color, sound, personality type and kingdom ie: vegetable, animal, human, soul, planetary, and solar. Each of the rays has correspondences with the chakras. Each ray has its own methods of activity, such as the destruction of forms, the construction of forms, the vitalizing of forms, or the perfecting of forms.

It seems that the seven rays which appear in the codings of the Lambdoma might also exemplify the above functions when investigated further. We can reduce the rational numbers on the Lambdoma matrix (Figure 5) to their relative



LISSAJOUS FIGURES REPRESENTING
MUSICAL INTERVALS

Figure 3A



LISSAJOUS FIGURES REPRESENTING
MUSICAL INTERVALS

Figure 3B

FUNDAMENTAL	G Gn	G Gn	G Mg	C Gn	E Bl-Vi	G Mg	Bb Or-Yl
OCTAVE	G Gn	C Gn	G Mg	C Gn	E Bl-Vi	G Mg	Bb Or-Yl
4 TH	F Vi	F Vi	C Gn	F Vi	A Or	C Gn	Eb Bl
OCTAVE	C Gn	C Gn	G Mg	C Gn	E Bl-Vi	G Mg	Bb Or-Yl
6 TH minor	Ab Pe	Ab Pe	Eb Bl	Ab Pe	C Gn	Eb Bl	Gb Lv
4 TH	F Vi	F Vi	C Gn	F Vi	A Or	C Gn	Eb Bl
2 ND	D Bl-Gn	D Bl-Gn	A Or	D Bl-Gn	Gb Lv	A Or	C Gn
OCTAVE	C Gn	C Gn	G Mg	C Gn	E Bl-Vi	G Mg	Bb Or-Yl
7 TH minor	Bb Or-Yl	Bb Or-Yl	F Vi	Bb Or-Yl	D Bl-Gn	F Vi	Ab Pe
6 TH minor	Ab Pe	Ab Pe	Eb Bl	Ab Pe	C Gn	Eb Bl	Gb Lv
5 TH diminished	Gb Lv	Gb Lv	Db Gn-Bl	Gb Lv	Bb Or-Yl	Db Gn-Bl	E Bl-Vi
4 TH	F Vi	F Vi	C Gn	F Vi	A Or	C Gn	Eb Bl
3 RD minor	E Bl-Vi	E Bl-Vi	B Yl	E Bl-Vi	G Mg	B Yl	Db Gn-Bl
2 ND	D Bl-Gn	D Bl-Gn	A Or	D Bl-Gn	Gb Lv	A Or	C Gn
2 ND minor	Db Gn-Bl	Db Gn-Bl	Ab Pe	Db Gn-Bl	F Vi	Ab Pe	B Yl
OCTAVE	C Gn	C Gn	G Mg	C Gn	E Bl-Vi	G Mg	Bb Or-Yl

5 TH

OCTAVE

3 RD

OCTAVE

5 TH

7 TH
minor

- Pe = Peach
 - Or = Orange
 - Or-Yl = Orange-Yellow
 - Yl = Yellow
 - Gn = Green
 - Gn-Bl = Green-Blue
 - Bl-Gn = Blue-Green
 - Bl = Blue
 - Bl-Vi = Blue-Violet
 - Vi = Violet
 - Lv = Lavender
 - Mg = Magenta

LAMBDOMA NOTES AND COLOR RELATIONSHIPS

Figure 4A

C	D	E	G ^b	G	A ^b	B ^b	B	C
Gn	Bl-Gn	Bl-Vi	Lv	Mg	Pe	Or-Yl	Yl	Gn
C	D	E	G ^b	G	A ^b	B ^b	B	C
Gn	Bl-Gn	Bl-Vi	Lv	Mg	Pe	Or-Yl	Yl	Gn
F	G	A	B ^b	C	D ^b	E ^b	E	F
Vi	Mg	Or	Or-Yl	Gn	Gn-Bl	Bl	Bl-Vi	Vi
C	D	E	G ^b	G	A ^b	B ^b	B	C
Gn	Bl-Gn	Bl-Vi	Lv	Mg	Pe	Or-Yl	Yl	Gn
A ^b	B ^b	C	D	E ^b	F	G ^b	G	A ^b
Pe	Or-Yl	Gn	Bl-Gn	Bl	Vi	Lv	Mg	Pe
F	G	A	B ^b	C	D ^b	E ^b	E	F
Vi	Mg	Or	Or-Yl	Gn	Gn-Bl	Bl	Bl-Vi	Vi
D	E	G ^b	A ^b	A	B	C	D ^b	D
Bl-Gn	Bl-Vi	Lv	Pe	Or	Yl	Gn	Gn-Bl	Bl-Gn
C	D	E	G ^b	G	A ^b	B ^b	B	C
Gn	Bl-Gn	Bl-Vi	Lv	Mg	Pe	Or-Yl	Yl	Gn
B ^b	C	D	E ^b	F	G ^b	A ^b	A	B ^b
Or-Yl	Gn	Bl-Gn	Bl	Vi	Lv	Pe	Or	Or-Yl
A ^b	B ^b	C	D	E ^b	F	G ^b	G	A ^b
Pe	Or-Yl	Gn	Bl-Gn	Bl	Vi	Lv	Mg	Pe
G ^b	A	B ^b	C	D ^b	E ^b	E	F	G ^b
Lv	Or	Or-Yl	Gn	Gn-Bl	Bl	Bl-Vi	Vi	Lv
F	G	A	B ^b	C	D ^b	E ^b	E	F
Vi	Mg	Or	Or-Yl	Gn	Gn-Bl	Bl	Bl-Vi	Vi
E	G ^b	G	A	B	C	D ^b	D	E
Bl-Vi	Lv	Mg	Or	Yl	Gn	Gn-Bl	Bl-Gn	Bl-Vi
D	E	G ^b	A ^b	A	B	C	D ^b	D
Bl-Gn	Bl-Vi	Lv	Pe	Or	Yl	Gn	Gn-Bl	Bl-Gn
D ^b	E ^b	F	G	A ^b	B ^b	B	C	D ^b
Gn-Bl	Bl	Vi	Mg	Pe	Or-Yl	Yl	Gn	Gn-Bl
C	D	E	G ^b	G	A ^b	B ^b	B	C
Gn	Bl-Gn	Bl-Vi	Lv	Mg	Pe	Or-Yl	Yl	Gn
O C T A V E	2 ND	3 RD	4 TH aug- men- ted	5 TH	6 TH minor	7 TH minor	7 TH major	O C T A V E

LAMBDOMA NOTES AND COLOR RELATIONSHIPS

Figure 4B

REDUCING RATIONAL NUMBERS (SHOWING INTERVALS AND RATIOS)

Fundamental	$\frac{1}{1}$	$\frac{2}{1}$	$\frac{3}{1}$	$\frac{2^2}{1}$	$\frac{5}{1}$	$\frac{3(2)}{1}$	$\frac{7}{1}$
Octave	$\frac{1}{2}$	$\frac{1}{1}$	$\frac{3}{2}$	$\frac{2}{1}$	$\frac{5}{2}$	$\frac{3}{1}$	$\frac{7}{2}$
4 th	$\frac{1}{8}$	$\frac{2}{3}$	$\frac{1}{1}$	$\frac{2^2}{8}$	$\frac{5}{8}$	$\frac{2}{1}$	$\frac{7}{3}$
Octave	$\frac{1}{2^2}$	$\frac{1}{2}$	$\frac{3}{2^2}$	$\frac{1}{1}$	$\frac{5}{2^2}$	$\frac{3}{2}$	$\frac{7}{2^2}$
6 th minor	$\frac{1}{5}$	$\frac{2}{5}$	$\frac{3}{5}$	$\frac{2^2}{5}$	$\frac{1}{1}$	$\frac{3(2)}{5}$	$\frac{7}{5}$
4 th	$\frac{1}{3(2)}$	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{2}{8}$	$\frac{5}{3(2)}$	$\frac{1}{1}$	$\frac{7}{3(2)}$
2 nd	$\frac{1}{7}$	$\frac{2}{7}$	$\frac{3}{7}$	$\frac{2^2}{7}$	$\frac{5}{7}$	$\frac{3(2)}{7}$	$\frac{1}{1}$
Octave	$\frac{1}{2^3}$	$\frac{1}{2^2}$	$\frac{3}{2^3}$	$\frac{1}{2}$	$\frac{5}{2^3}$	$\frac{3}{2^2}$	$\frac{7}{2^3}$
7 th minor	$\frac{1}{9^2}$	$\frac{2}{9^2}$	$\frac{1}{8}$	$\frac{2^2}{9^2}$	$\frac{5}{9^2}$	$\frac{2}{9}$	$\frac{7}{9^2}$
8 th minor	$\frac{1}{5(2)}$	$\frac{1}{5}$	$\frac{3}{5(2)}$	$\frac{2}{5}$	$\frac{1}{2}$	$\frac{3}{5}$	$\frac{7}{5(2)}$
5 th diminished	$\frac{1}{11}$	$\frac{2}{11}$	$\frac{3}{11}$	$\frac{2^2}{11}$	$\frac{5}{11}$	$\frac{3(2)}{11}$	$\frac{7}{11}$
4 th	$\frac{1}{8(2^2)}$	$\frac{1}{8(2)}$	$\frac{1}{2^2}$	$\frac{1}{8}$	$\frac{5}{8(2^2)}$	$\frac{1}{2}$	$\frac{7}{8(2^2)}$
8 th minor	$\frac{1}{19}$	$\frac{2}{19}$	$\frac{3}{19}$	$\frac{2^2}{19}$	$\frac{5}{19}$	$\frac{3(2)}{19}$	$\frac{7}{19}$
2 nd	$\frac{1}{7(2)}$	$\frac{1}{7}$	$\frac{3}{7(2)}$	$\frac{2}{7}$	$\frac{5}{7(2)}$	$\frac{3}{7}$	$\frac{1}{2}$
2 nd minor	$\frac{1}{5(3)}$	$\frac{2}{5(3)}$	$\frac{1}{5}$	$\frac{2^2}{5(3)}$	$\frac{1}{3}$	$\frac{2}{5}$	$\frac{7}{5(3)}$
Octave	$\frac{1}{2^4}$	$\frac{1}{2^3}$	$\frac{3}{2^4}$	$\frac{1}{2^2}$	$\frac{5}{2^4}$	$\frac{3}{2^3}$	$\frac{7}{2^4}$
		Octave	6 th	Octave	8 th	6 th	7 th minor

Figure 5A

TO THEIR RELATIVE PRIMES ON SEVEN RAYS) FREQUENCY

$\frac{2^8}{1}$	$\frac{8^2}{1}$	$\frac{5(2)}{1}$	$\frac{11}{1}$	$\frac{8(2^2)}{1}$	$\frac{13}{1}$	$\frac{7(2)}{1}$	$\frac{5(3)}{1}$	$\frac{2^4}{1}$
$\frac{2^2}{1}$	$\frac{8^2}{2}$	$\frac{5}{1}$	$\frac{11}{2}$	$\frac{8(2)}{1}$	$\frac{13}{2}$	$\frac{7}{1}$	$\frac{5(3)}{2}$	$\frac{2^8}{1}$
$\frac{2^8}{9}$	$\frac{8}{1}$	$\frac{5(2)}{9}$	$\frac{11}{9}$	$\frac{2^2}{1}$	$\frac{13}{9}$	$\frac{7(2)}{9}$	$\frac{5}{1}$	$\frac{2^4}{9}$
$\frac{2}{1}$	$\frac{8^2}{2^2}$	$\frac{5}{2}$	$\frac{11}{2^2}$	$\frac{8}{1}$	$\frac{13}{2^2}$	$\frac{7}{2}$	$\frac{5(3)}{2^2}$	$\frac{2^2}{1}$
$\frac{2^8}{5}$	$\frac{8^2}{5}$	$\frac{2}{1}$	$\frac{11}{5}$	$\frac{8(2^2)}{5}$	$\frac{13}{5}$	$\frac{7(2)}{5}$	$\frac{8}{1}$	$\frac{2^4}{5}$
$\frac{2^2}{8}$	$\frac{8}{2}$	$\frac{5}{8}$	$\frac{11}{8(2)}$	$\frac{2}{1}$	$\frac{13}{8(2)}$	$\frac{7}{8}$	$\frac{5}{2}$	$\frac{2^8}{8}$
$\frac{2^8}{7}$	$\frac{8^2}{7}$	$\frac{5(2)}{7}$	$\frac{11}{7}$	$\frac{8(2^2)}{7}$	$\frac{13}{7}$	$\frac{2}{1}$	$\frac{5(3)}{7}$	$\frac{2^4}{7}$
$\frac{1}{1}$	$\frac{8^2}{2^3}$	$\frac{5}{2^2}$	$\frac{11}{2^3}$	$\frac{8}{2}$	$\frac{13}{2^3}$	$\frac{7}{2^2}$	$\frac{5(3)}{2^3}$	$\frac{2}{1}$
$\frac{2^8}{9^2}$	$\frac{1}{1}$	$\frac{5(2)}{9^2}$	$\frac{11}{9^2}$	$\frac{2^2}{9}$	$\frac{13}{9^2}$	$\frac{7(2)}{9^2}$	$\frac{5}{9}$	$\frac{2^4}{9^2}$
$\frac{2^2}{5}$	$\frac{8^2}{5(2)}$	$\frac{1}{1}$	$\frac{11}{5(2)}$	$\frac{8(2)}{5}$	$\frac{13}{5(2)}$	$\frac{7}{5}$	$\frac{8}{2}$	$\frac{2^8}{5}$
$\frac{2^8}{11}$	$\frac{8^2}{11}$	$\frac{5(2)}{11}$	$\frac{1}{1}$	$\frac{8(2^2)}{11}$	$\frac{13}{11}$	$\frac{7(2)}{11}$	$\frac{5(3)}{11}$	$\frac{2^4}{11}$
$\frac{2}{8}$	$\frac{8}{2^2}$	$\frac{5}{8(2)}$	$\frac{11}{8(2^2)}$	$\frac{1}{1}$	$\frac{13}{8(2^2)}$	$\frac{7}{8(2)}$	$\frac{5}{2^2}$	$\frac{2^2}{8}$
$\frac{2^8}{13}$	$\frac{8^2}{13}$	$\frac{5(2)}{13}$	$\frac{11}{13}$	$\frac{8(2^2)}{13}$	$\frac{1}{1}$	$\frac{7(2)}{13}$	$\frac{5(3)}{13}$	$\frac{2^4}{13}$
$\frac{2^2}{7}$	$\frac{8^2}{7(2)}$	$\frac{5}{7}$	$\frac{11}{7(2)}$	$\frac{8(2)}{7}$	$\frac{13}{7(2)}$	$\frac{1}{1}$	$\frac{5(3)}{7(2)}$	$\frac{2^8}{7}$
$\frac{2^8}{5(3)}$	$\frac{8}{5}$	$\frac{2}{9}$	$\frac{11}{5(3)}$	$\frac{2^2}{5}$	$\frac{13}{5(3)}$	$\frac{7(2)}{5(3)}$	$\frac{1}{1}$	$\frac{2^4}{5(3)}$
$\frac{1}{2}$	$\frac{8^2}{2^4}$	$\frac{5}{2^3}$	$\frac{11}{2^4}$	$\frac{8}{2^2}$	$\frac{13}{2^4}$	$\frac{7}{2^3}$	$\frac{5(3)}{2^4}$	$\frac{1}{1}$
O c t a v e	2nd	3rd	4th sup- men- ted	5th	6th minor	7th minor	7th major	O c t a v e

Figure 5B

primes, showing clearly the repetition of the factored ratios as rays. These rays represent vectors connecting like ratios. These rays also represent the undertone wavelengths 3:1, as an interval of a fourth in music, 2:1 as an octave below, 3:2 as another fourth, and 1:1 as a fundamental or unison of two of the same notes sounded together. The rays on the other side of the diagonal represent the overtone wavelengths of 2:3 as a musical fifth, 1:2 as an octave higher, 1:3 as another fifth. It is important to note that the musical intervals in frequency instead of wavelength are in inverse proportion. Frequency implies sound while wavelength implies distance. By considering frequency in this array and realizing that frequency represents musical sounds overtones (harmonics) and undertones (sub-harmonics) allows one to identify emotional qualities of specific intervals with an abstract table of rational numbers. On the other hand taking the table as a measurement of wavelength allows one to create or interpret structures harmonically having a similar emotional impact which corresponds to the same mathematical ratios as the musical intervals.

This table of rational numbers can also be coded by angle. We can say that undertones in wavelength have slopes less than 45 degrees, in a lower triangular matrix, and overtones have slopes greater than 45 degrees in an upper triangular matrix. We determine angles by taking the arc tangent of the ratios in the table, using the x and y values. (Figure 6) The arc tangent of $1/2$ is 26 degrees, 33 minutes, and 54 seconds, and being less than 45 degrees it would be considered an undertone in the lower triangular matrix.

We can visualize this as the angle of the passageway of the Grand Gallery in the Great Pyramid of Giza, and realize that it is a simple ratio of one to two.

The undertone series (based again on wavelength in this case) is identified with the intervalic relationships of every horizontal row. Each horizontal row begins with a different keynote and is based on a multiple of the beginning note 1:1

1:1	2:1	3:1	4:1	5:1	6:1	7:1	8:1	9:1	10:1	11:1	12:1	13:1	14:1	15:1	16:1
45	63	72	76	79	81	82	83	84	84	85	85	86	86	85	86
1:2	2:2	3:2	4:2	5:2	6:2	7:2	8:2	9:2	10:2	11:2	12:2	13:2	14:2	15:2	16:2
27	45	56	63	68	72	74	76	77	79	80	81	81	82	82	83
1:3	2:3	3:3	4:3	5:3	6:3	7:3	8:3	9:3	10:3	11:3	12:3	13:3	14:3	15:3	16:3
18	34	45	53	59	63	67	69	72	73	75	76	77	78	79	79
1:4	2:4	3:4	4:4	5:4	6:4	7:4	8:4	9:4	10:4	11:4	12:4	13:4	14:4	15:4	16:4
14	27	37	45	51	56	60	63	66	68	70	72	73	74	75	76
1:5	2:5	3:5	4:5	5:5	6:5	7:5	8:5	9:5	10:5	11:5	12:5	13:5	14:5	15:5	16:5
11	22	31	39	45	50	54	58	61	63	66	67	69	70	72	73
1:6	2:6	3:6	4:6	5:6	6:6	7:6	8:6	9:6	10:6	11:6	12:6	13:6	14:6	15:6	16:6
9	18	27	34	40	45	49	53	56	59	61	63	65	67	68	69
1:7	2:7	3:7	4:7	5:7	6:7	7:7	8:7	9:7	10:7	11:7	12:7	13:7	14:7	15:7	16:7
8	16	23	30	36	41	45	49	52	55	58	60	62	63	65	66
1:8	2:8	3:8	4:8	5:8	6:8	7:8	8:8	9:8	10:8	11:8	12:8	13:8	14:8	15:8	16:8
7	14	21	27	32	37	41	45	48	51	54	56	58	60	62	63
1:9	2:9	3:9	4:9	5:9	6:9	7:9	8:9	9:9	10:9	11:9	12:9	13:9	14:9	15:9	16:9
6	13	18	24	29	34	38	42	45	48	51	53	55	57	59	61
1:10	2:10	3:10	4:10	5:10	6:10	7:10	8:10	9:10	10:10	11:10	12:10	13:10	14:10	15:10	16:10
6	11	17	22	27	31	35	39	42	45	48	50	52	54	56	58
1:11	2:11	3:11	4:11	5:11	6:11	7:11	8:11	9:11	10:11	11:11	12:11	13:11	14:11	15:11	16:11
5	10	15	20	24	29	32	36	39	42	45	47	50	52	54	55
1:12	2:12	3:12	4:12	5:12	6:12	7:12	8:12	9:12	10:12	11:12	12:12	13:12	14:12	15:12	16:12
5	9	14	18	23	27	30	34	37	40	43	45	47	49	51	53
1:13	2:13	3:13	4:13	5:13	6:13	7:13	8:13	9:13	10:13	11:13	12:13	13:13	14:13	15:13	16:13
4	9	13	17	21	25	28	32	35	38	40	43	45	47	49	51
1:14	2:14	3:14	4:14	5:14	6:14	7:14	8:14	9:14	10:14	11:14	12:14	13:14	14:14	15:14	16:14
4	8	12	16	20	23	27	30	33	36	38	41	43	45	47	49
1:15	2:15	3:15	4:15	5:15	6:15	7:16	8:15	9:15	10:15	11:15	12:15	13:15	14:15	15:15	16:15
4	8	11	15	18	22	25	28	31	34	36	39	41	43	45	47
1:16	2:16	3:16	4:16	5:16	6:16	7:16	8:16	9:16	10:16	11:16	12:16	13:16	14:16	15:16	16:16
4	7	11	14	17	21	24	27	29	32	35	37	39	41	43	45

LAMBDA MATRIX OF RATIOS AND ANGLES
Figure 6

by 2, 3, . . . 16, yet the intervalic relationships are conserved in each row and each column. This means that the entire matrix conserves its intervalic relationships throughout the matrix. And this principle holds whether we are dealing with wavelength as shape or form, or frequency in periodicity or music. This principle may also be interpreted to suggest that as shape expands, time (periodicity) contracts, or vice versa.

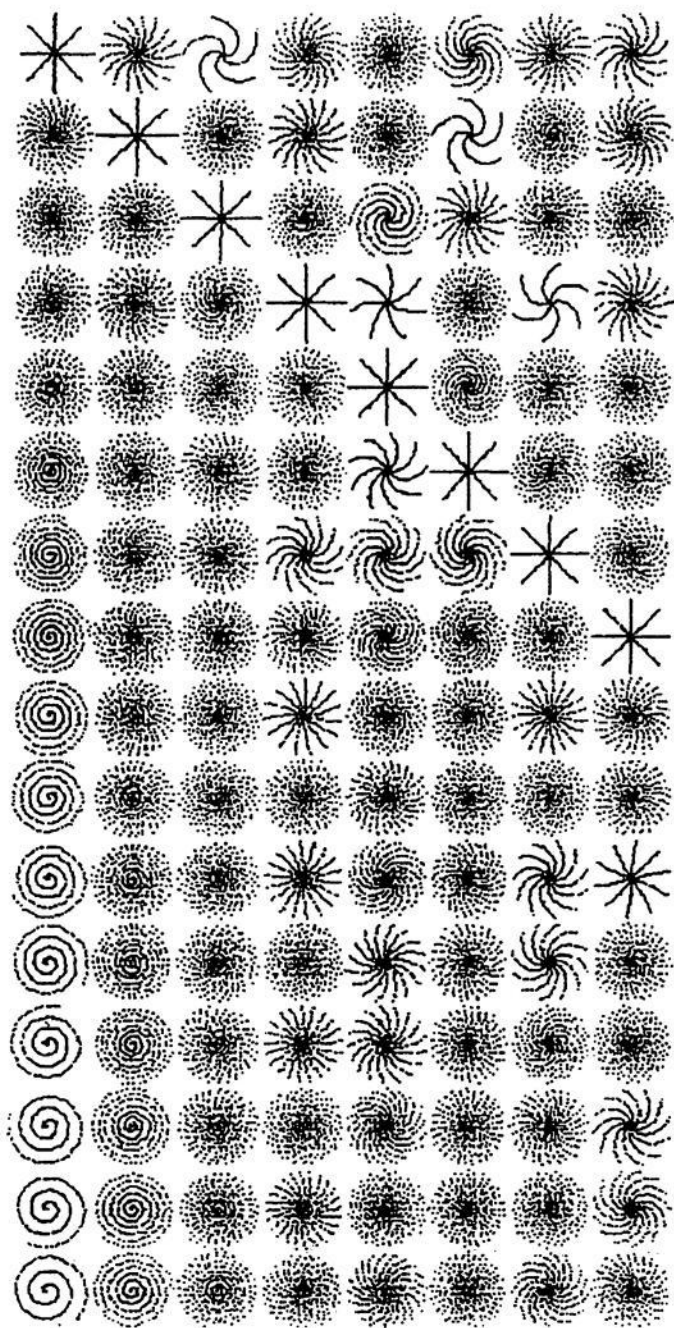
Now we can take these same ratios (representing space and time, or mass and energy) and plot them on the computer in polar coordinates and find that for each degree, a significantly different pattern emerges. These patterns are somewhat like mandalas, upon which we can reflect. This reflection we all know stimulates an awakening of consciousness. We are in an age of increasing vibratory levels of frequency. These levels of frequency determine the varying densities of our universe. We, of denser materials, must keep up with the vibrations that are pushing our evolutionary progress more into the light. We are becoming beings of light, less dense. The universal pattern is everywhere, and this pattern is based upon harmonics, a harmonic series that vibrates from one end of our universe to the other end, from the microcosm to the macrocosm. When we attune ourselves to this pattern we are in perfect harmony and health.

Our windows to the vibrations of the universe are our senses, so we are awakening our consciousness by the windows of our hearing, and seeing tonight. Scientists call this vibrating string that stretches throughout the universe the "Electromagnetic Frequency Spectrum". VLF or very low frequencies are considered in the range of 10 cycles per sec, while EHF or extra high frequencies are in the range of 10 to the 6th power in cycles per sec. From 10 to the 6th power to 10 to the 12th power we are in the range of the visible spectrum. Above that we go into X-rays and perfumes. Below the 10 cycles per sec we find ourselves within the range of gravity. We can determine the speed of the planets around the sun, and multiplying days of one year on earth, of

365, by hours, minutes and seconds, we arrive at 86,400 seconds per cycle. If we multiplied this by doubling a certain number of times we could bring this frequency up into the range of audible sound and could say, "Oh, the earth rotates at a musical sound of G", which in the middle C range could be a frequency of 388 cycles per second. Should we be attuning ourselves to the earth by the frequencies harmonically related to it, or should we take the inversions of these frequencies and by calculating their velocities in air at say room temperature use these as measurements for our homes and other objects?

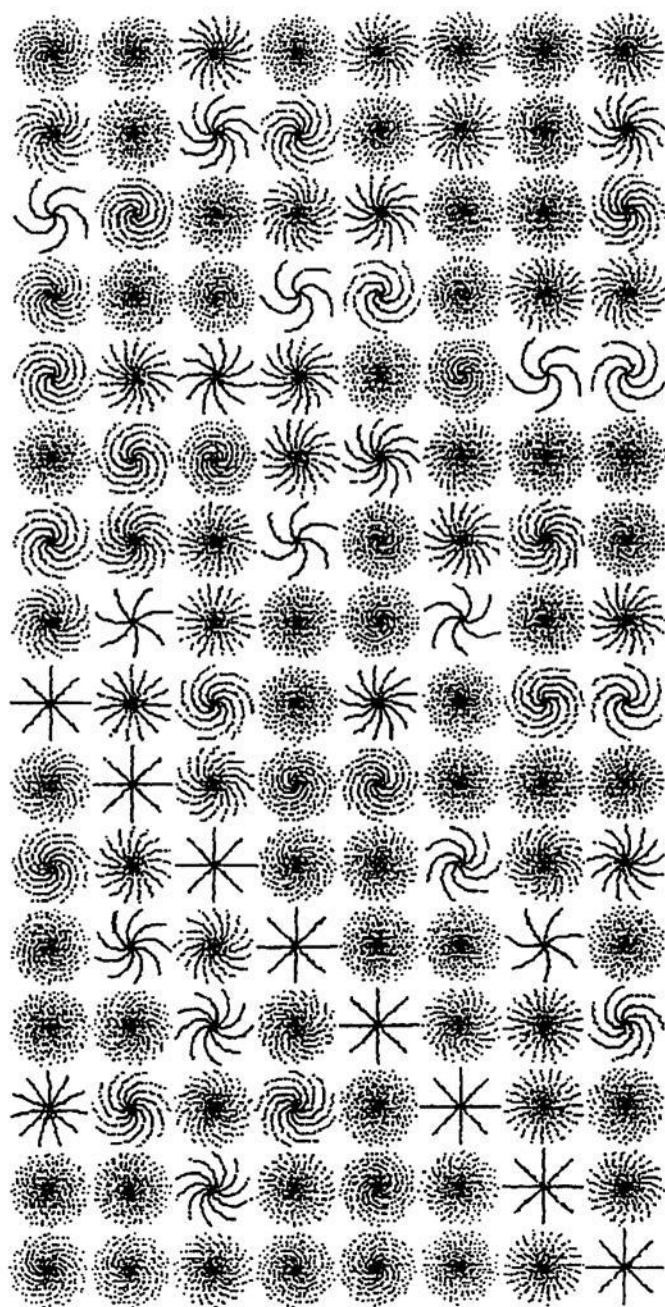
The interesting thing about the window of sound for most people, which extends from about 20 cycles per second to 20,000 cycles per second, is that if we calculated the wavelengths of these frequencies we would find them comfortably fitting into our human dimensions, ranging from about 60 feet to a fraction of an inch. The height of a person, who is five feet tall, resonates with a frequency of 226 cycles per second, or a B^b below middle C (Figure 7). If everything around this five foot person were attuned in the harmonics of wavelength, a harmonious environment would be the result, where dissonance would be at a minimum. It would be a place of inner peace and attunement. Consciousness could more easily be raised in such a place, an inner sanctuary, a meditative place.

We know that the alpha state is the state which is between waking and sleeping, an intuitive and creative state, a meditative state. This alpha state has a frequency of about seven and one half cycles per second. This is the sound which we would identify with a B^b musically if we expanded it by octaves by doubling it into its recognizable musical octave range. Curiously this is also the same frequency, of 60 cycles per second, as our generators of electric current in this country. We are the only country in the world that uses this frequency. Europe and the Middle East use 50 cycles per second, which becomes more of an A musically when brought up to the audible range by octave doubling.



RAY- SPIRAL FIGURES REPRESENTING
MUSICAL INTERVALS

Figure 7A



RAY- SPIRAL FIGURES REPRESENTING
MUSICAL INTERVALS

FIGURE 7R

FEET	FREQUENCY	NOTE	FEET	FREQUENCY	NOTE
1	283	D	40	452	B ^b
2	283	D	41	441	A
3	377	G	42	430	A
4	283	D	43	420	A
5	452	B ^b	44	411	A ^b
6	377	G	45	402	A ^b
7	323	E	46	393	G
8	283	D	47	385	G
9	502	C	48	377	G
10	452	B ^b	49	369	G ^b
11	411	A ^b	50	362	G ^b
12	377	G	51	355	G ^b
13	348	F	52	348	F
14	323	E	53	341	F
15	301	E ^b	54	335	F
16	283	D	55	329	E
17	266	D ^b	56	323	E
18	502	C	57	317	E
19	476	B	58	312	E ^b
20	452	B ^b	59	306	E ^b
21	430	A	60	301	E ^b
22	411	A ^b	61	296	E ^b
23	393	G	62	292	D
24	377	G	63	287	D
25	362	G ^b	64	283	D
26	348	F	65	278	D ^b
27	335	F	66	274	D ^b
28	323	E	67	270	D ^b
29	312	E ^b	68	266	D ^b
30	301	E ^b	69	262	C
31	292	D	70	258	C
32	283	D	71	509	C
33	274	D ^b	72	502	C
34	266	D ^b	73	495	B
35	258	C	74	489	B
36	502	C	75	482	B
37	489	B	76	476	B
38	476	B	77	470	B
39	464	B ^b	78	464	B ^b

A TYPICAL CONVERSION TABLE

Figure 8

The implications are rather interesting, if we consider that we are being subtly programmed to a slightly different frequency than the rest of the world. How does it affect us? The alpha state is one where we are the most creative.

Is there a link from the ancient culture of Egypt to us in the United States? When the King's Chamber in the Great Pyramid in Giza is translated from length, width and height we find the frequencies of 60, 66 and 33 cycles per second. Is it by accident or by plan that the United States is being bombarded by the 60 cycles per second frequency of the Kings Chamber? Incidentally, the Queen's Chamber in the same pyramid also resonates to the frequencies of 60, 66, and 55 cycles per second.

According to Edgar Cayce's "Source" we live in a technological age, very similar to that of ancient Atlantis. In fact, as Cayce's "Source" has pointed out, many of us, now living in the United States, have incarnated into this age because of the similarities in both civilizations. Some of the tools of this age, such as the computer, sine wave generators and frequency counter, I use to try to convince those who might be skeptical of the ancient truths. It is my belief that these are only tools which can be thrown away, as it is our own human tool, the mind, intuition, visualization and will which can create anything which we need in our universe, knowing that; "Thoughts are things.", "We manifest our own realities.", and "We are what we think.".

Our main purpose here tonight is to talk about awakening consciousness through generating patterns of harmonic sounds. I want to emphasize that harmonic vibrations hold matter together, as Hans Jenny demonstrated. Incidentally, disharmony creates disease on all levels, including; physical, mental, emotional and spiritual dimensions. Therefor, I want to show you some of the laws of harmonious vibrations based on ratio alone. The way I am going to show you this is through the visual window, illustrating with the window

of sound along the way. Some of the sounds and colors and shapes were computer generated by Robert, and others were drawn by the human hand. Both the computer generated and the human hand drawings were based on the same principles of the Lambdoma table of ratios, coded into shape, color, and sound.

These principles are:

- 1) exploring the nature of ratios,
- 2) ordering a sequence of rows and columns of a matrix of ratios
- 3) translating these into color, shape, and sound.

This matrix of the Lambdoma, which Pythagoras brought out from the temples of Egypt, proves mathematically that from one number, shape, sound or color can be generated many numbers, shapes, sounds or colors. The one God or sound generates an unlimited, ordered universe, which is infinitely large as well as infinitely small. The ONE generates ALL.

In attuning ourselves to the ONE and the ALL there are three laws which you might keep in mind.

1. The law of octaves: doubling or halving.

$$2n; 1/2n$$

2. The law of ratios: fractions.

$$1/2, 2/3, 3/4, 4/5, \dots n/m$$

3. The law of inversions of ratios: reciprocals of fractions.

$$2/1, 3/2, 4/3, 5/4, \dots m/n$$

One of these laws applies to the physical or material universe of which we are a part, and one of these laws applies to the non-physical or metaphysical universe of which we are also a part.

It is quite apparent that the ancients were aware of and

made use of the metaphysical as well as the physical aspects of our universe. For many unknown reasons, one of which might well be that humanity has not been ready for these, non-physical energies, they have remained concealed until the present time. The times we now live in are times in which mysteries which have been kept secret for centuries on every level are now being thrust into the public eye. However, those that hear *hear*, and those that don't hear *don't hear*. The mysteries are still protected from those who have not yet awakened in consciousness.

I want you to be sure to understand that I do not have all the answers. I feel I have dug around the foundations of this archeological site on a metaphysical level, and the site is called the Lambdoma. I have uncovered pieces of the puzzle. Within this room there are some who can greatly add to and expand this puzzle by bringing their own consciousness to bear. I feel that I along with others have found the threshold to an awakening consciousness, but I would like to see others walk through this particular doorway so that we might discover together more pieces to this puzzle.

I will now show some slides which I hope will be spring boards to your own insights, and I will play some of the sounds which are all related to Lambdoma theory, in the sense that they all make use of the scale and frequencies based upon the natural harmonics and sub-harmonics of a vibrating string. Some of the slides will be the work of drug addicts, or substance abusers as they prefer to be called, which shows the facility with which the human intuition can go back to visual beginnings when asked to "Draw what you think the sounds suggest". The sounds were, in almost every case, sounds related to the Lambdoma, either generated by computer, or with sine wave generators both applying the mathematical relationships within the Lambdoma in frequencies of musical sounds corresponding to the ratios in the matrix. Sounds which seem to come from ancient times into our own time.

Since the Lambdoma seems to portray the energies of

the cosmos, in its inherently perfect mathematical structure, and the soul of humans seems to long for an understanding of cosmic energy, which might be accessible to the soul only by symbols or patterns, what happens when the mind is entrained by the perfect symmetry of an ordered sound? If this ordered sound reflects the laws of the universe, will beautiful patterns result? The mind longs for order, for creating order out of chaos. The mind operates on many different levels of logic. If the mind were to be entrained by a beautiful pattern that defied analysis in words, what part of the brain would operate under those conditions? I would like to propose that the intuitive mind would be freed to operate and even create under such conditions. But let us take this analogy further and substitute sounds for color or shape in such a pattern. What would happen when the senses of the mind, which deal with hearing, were entrained by a logical sound structure entirely harmonically balanced which represented the energy of the universe itself?

This experiment has been done over a period of three years with residents of a drug rehabilitation community. The results are a wide range of over 200 samples of art, where the individuals released imagery, created abstract forms, harmonious color combinations, dreamlike visions, poetry and expressed feelings that had been deeply buried. Sounds other than those based upon the Lambdome have also been tried and the results seem to be less concentration, less productive work, and rather negative imagery. The sounds generated from the Lambdome matrix appear to awaken consciousness.

You are going to experience these sounds and slides. You are going to experience the same sounds that released the creativity from the residents in the Drug rehabilitation community. You are going to experience on a "sound" level, a sense of hearing level, the same formula which the ancients had which tied many aspects of their lives together based upon the mathematics of vibration, the mathematics of audible vibration. This formula is called the Lambdome. In

essence it reveals the mechanics of the overtone and undertone series in music in an audible range, harmonics, which by their very nature awaken consciousness.

Try to use your visual, symbolic and aural faculties. These are faculties which have not really been encouraged to be used in our present day society. Some people call them right brain faculties. Then when you have let go of your left brain consciousness, which has been operating as your mental aspect, bring it back or let it reconstruct what your visual or symbolic brain has taken in. You might be surprised at the answers which you have received.

There will be several minutes to experience these sounds and these slides, so experience all of this in silence.

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LETTER TO A TWELVE - YEAR - OLD

*A 1975 letter
explaining the Lambdoma
to a twelve year old.*

Dear David,

This is a birthday letter. I will try to explain in simple words some of my ideas, as you asked last week.

To start from the beginning, how would you go about finding something in common between something invisible, like sound waves, and something seen, that you can hold and touch? You would have to find something in common between the two opposites. What could possibly be the same between the seen and the heard?

People have been able to measure sound by determining on a length of string what tone of a scale sounds when a certain part of the string is plucked. This probably began when men first discovered the plucked string for a bow and arrow. Little bows would make a high sound because the string was shorter, and bigger bows would make a lower sound because the string was longer. Then they realized that certain tensions on a string by pulling the string more taut could also create higher tones.

In different parts of the world each people had different scales. Some, like the early Greeks, had 7 tones to an octave, and different modes of which our familiar major and minor scale modes were but two out of many. The Indian ragas had as many as 52 tones within a single octave. This matched the 52 sounds of the Sanskrit alphabet. They too had different modes which were played at certain hours of

the day, or season. The rules which governed these were very strict.

The rules which governed the Greek music were strict also. It is the Greek diagram, called the Lambdoma on which I base all of my drawings. (Figure 1)

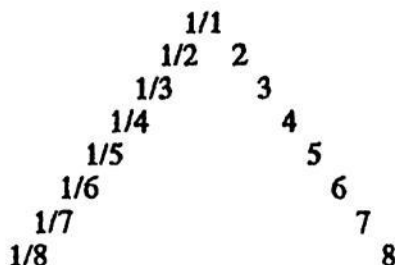


Figure 1

This Lambdoma was named by Iamblichus, a neo-Platonist, because the Greek letter lambda has the shape of an inverted V. This V shape, of the Lambdoma, is what results when one either draws lines or colors on each ratio position according to its musical tone.

The Lambdoma can represent tone intervals which follow the overtone series in music, when read down and to the right, and tone intervals which follow the undertone series when read down and to the left.

Overtones are tones which are heard faintly when any tone is sounded. These tones were the basis for our Western harmonic chords. Physicists too have discovered the scientific basis of the overtones, although as in many things they do not know the cause.

One could go as far as to say that our universe is contracting and not expanding as has been generally assumed.

We might even say that somewhere else in our universe, its opposite or mirror image is expanding. We could say this

just from deducing from the overtone and undertone series in music.

But we can do something else too. We can eliminate even the tones from our table and have only the mathematics which represents each tone. This mathematics is based on nothing but fractions. And it is very easy to make up this table. You start out by numbering along the horizontal $1/1$, $2/1$, $3/1$, $4/1$, . . . 'till $16/1$, and conversely numbering the vertical $1/1$, $1/2$, $1/3$, $1/4$, . . . 'till $1/16$. (Figure 2) The second row horizontally becomes $1/2$, $2/2$, $3/2$, $4/2$, . . . $16/2$, whereas the second row vertically becomes $2/1$, $2/2$, $2/3$, $2/4$, . . . $2/16$. It is easy to see that mathematically the horizontal row is much more than the vertical row. It is also easy to see that running diagonally down from $1/1$, $2/2$, $3/3$, . . . $16/16$ all equal 1 or unity.

Everything to the right of this diagonal is a larger fraction (more than 1), whereas everything on the left of the diagonal is a smaller fraction, (less than 1).

Now you remember that I played an overtone scale starting with F on the piano for you and it seemed to be what we would call a major key, while the undertone which descended became similar to a minor key. You know that a minor key seems to have a different effect on your feelings. It makes you feel a little sad, a little wistful. So we could say that the vertical row, the physically impossible lengthening of the string, or a different expanding universe, is something we remember from another time and feel a little sad about and miss.

To get back to judging these fractions as either overtones or undertones of sound, we must find a way to identify them so that we can tell just what tone we are looking at. So we decide to color each tone a different way, so we will be able to tell at a glance just what musical tone we are dealing with.

There are many ways we can do this. First let us see how many basic colors there are. There are the three primaries, red, blue, and yellow. There is black and there is white. And there are secondary colors which occur when we

RATIOS OF FREQUENCIES: (FOURTH

FUNDA- MENTAL	C = 256 Hertz						
	1:1 C	2:1 C	3:1 G	4:1 C	5:1 E	6:1 G	7:1 Bb
OCTAVE	1:2 C	2:2 C	3:2 G	4:2 C	5:2 E	6:2 G	7:2 Bb
4 TH	1:3 F	2:3 F	3:3 C	4:3 F	5:3 A	6:3 C	7:3 Eb
OCTAVE	1:4 C	2:5 C	3:4 G	4:4 C	5:4 E	6:4 G	7:4 Bb
6 TH minor	1:5 Ab	2:5 Ab	3:5 Eb	4:5 Ab	5:5 C	6:5 Eb	7:5 Gb
4 TH	1:6 F	2:6 F	3:6 C	4:6 F	5:6 A	6:6 C	7:6 Eb
2 ND	1:7 D	2:7 D	3:7 A	4:7 D	5:7 Gb	6:7 A	7:7 C
OCTAVE	1:8 C	2:8 C	3:8 G	4:8 C	5:8 E	6:8 G	7:8 Bb
7 TH minor	1:9 Bb	2:9 Bb	3:9 F	4:9 Bb	5:9 D	6:9 F	7:9 Ab
6 TH minor	1:10 Ab	2:10 Ab	3:10 Eb	4:10 Ab	5:10 C	6:10 Eb	7:10 Gb
5 TH diminished	1:11 Gb	2:11 Gb	3:11 Db	4:11 Gb	5:11 Bb	6:11 Db	7:11 E
4 TH	1:12 F	2:12 F	3:12 C	4:12 F	5:12 A	6:12 C	7:12 Eb
3 RD minor	1:13 E	2:13 E	3:13 B	4:13 E	5:13 G	6:13 B	7:13 Db
2 ND	1:14 D	2:14 D	3:14 A	4:14 D	5:14 Gb	6:14 A	7:14 C
2 ND minor	1:15 Db	2:15 Db	3:15 Ab	4:15 Db	5:15 F	6:15 Ab	7:15 B
OCTAVE	1:16 C	2:16 C	3:16 G	4:16 C	5:16 E	6:16 G	7:16 Bb
	O C T A V E	5 TH	O C T A V E	3 RD	5 TH	7 TH minor	

Figure 2A

A LAMBDOMA TABLE QUADRANT)

A = 430.5 Hertz								
8:1 C	9:1 D	10:1 E	11:1 Gb	12:1 G	13:1 Ab	14:1 Bb	15:1 B	16:1 C
8:2 C	9:2 D	10:2 E	11:2 Gb	12:2 G	13:2 Ab	14:2 Bb	15:2 B	16:2 C
8:3 F	9:3 G	10:3 A	11:3 Bb	12:3 C	13:3 Db	14:3 Eb	15:3 E	16:3 F
8:4 C	9:4 D	10:4 E	11:4 Gb	12:4 G	13:4 Ab	14:4 Bb	15:4 B	16:4 C
8:5 Ab	9:5 Bb	10:5 C	11:5 D	12:5 Eb	13:5 F	14:5 Gb	15:5 G	16:5 Ab
8:6 F	9:6 G	10:6 A	11:6 Bb	12:6 C	13:6 Db	14:6 Eb	15:6 E	16:6 F
8:7 D	9:7 E	10:7 Gb	11:7 Ab	12:7 A	13:7 B	14:7 C	15:7 Db	16:7 D
8:8 C	9:8 D	10:8 E	11:8 Gb	12:8 G	13:8 Ab	14:8 Bb	15:8 B	16:8 C
8:9 Bb	9:9 C	10:9 D	11:9 Eb	12:9 F	13:9 Gb	14:9 Ab	15:9 A	16:9 Bb
8:10 Ab	9:10 Bb	10:10 C	11:10 D	12:10 Eb	13:10 F	14:10 Gb	15:10 G	16:10 Ab
8:11 Gb	9:11 A	10:11 Bb	11:11 C	12:11 Db	13:11 Eb	14:11 E	15:11 F	16:11 Gb
8:12 F	9:12 G	10:12 A	11:12 Bb	12:12 C	13:12 Db	14:12 Eb	15:12 E	16:12 F
8:13 E	9:13 Gb	10:13 G	11:13 A	12:13 B	13:13 C	14:13 Db	15:13 D	16:13 E
8:14 D	9:14 E	10:14 Gb	11:14 Ab	12:14 A	13:14 B	14:14 C	15:14 Db	16:14 D
8:15 Db	9:15 Eb	10:15 F	11:15 G	12:15 Ab	13:15 Bb	14:15 B	15:15 C	16:15 Db
8:16 C	9:16 D	10:16 E	11:16 Gb	12:16 G	13:16 Ab	14:16 Bb	15:16 B	16:16 C
O C T A V E	2 ND	3 RD	4 TH aug- men- ted	5 TH	6 TH minor	7 TH minor	7 TH major	O C T A V E

Figure 2B

mix the primaries. Red mixed with blue creates purple. Blue mixed with yellow creates green, and red mixed with yellow creates orange. So far we have six colors which are visibly different and black and white. This makes eight colors. This matches with the eight tones to our scale.

To accommodate the sharps or flats we would just mix further colors identifying tones next to one another.

But we must still find a way to arrange these colors. Many people have taken white for the beginning tone which is usually considered to be middle C on the piano. I decided to make middle C red. Now we know that in a color spectrum the colors range from red to orange to yellow to green and to blue and to purple and then back to red.

We also know that this color spectrum fans out in an angle of about 30 degrees. So if we simply take C as red, D would be orange, E would be yellow, F would be green, G would be blue, A would be purple and B would be dark purple or black. When we use the order and color in the squares for each of the overtones and undertones in our Lambdoma Table we will get a spectrum of these same colors which fan out like a visible light spectrum. This order follows in all quadrants of the Lambdoma Diagram. The different quadrants are just mirror images of each other.

You could work out different ways of colors to tones just to see what would happen.

With all my Love,

Barbara

RELATIONSHIPS BETWEEN CONSCIOUSNESS, SOUND, MUSIC AND ART

Visiting lecture given, at Professor Daniel Baer's, "Topics in Consciousness", psychology class, at Boston College on February 4, 1981.

I am going to show a video that I made, at Boston University as part of my Independent Studies course, while obtaining a Masters Degree in Mathematics Education. As you watch the video be aware that the sounds which you hear control the shapes. It is complicated trying to explain music and mathematics, and making these concepts visual has enormous ramifications which you will see. I am going to show slides, as well, which might help you in understanding a way of making principles of musical sound visible.

My life's work began for me upon seeing the diagram (Figure 1) in a book called "Tone: A Study in Musical Acoustics", by Levairie and Levy [1], in which this matrix appeared. Every single one of the fractions on the chart had associated with it a musical tone. The fraction $1/1$ would be the keynote sounded. No matter which musical note was sounded the relationships of all the other notes would be in fixed proportions. It could be the note C or the note F or A or any of the other notes of the scale.

Professor Baer: Barbara, could I ask a couple of questions about that? Those letters are they letters in the scale?

Barbara: Yes.

RATIOS OF FREQUENCIES: (FOURTH

FUNDA- MENTAL	C = 256 Hertz						
	1:1	2:1	3:1	4:1	5:1	6:1	7:1
	C	C	G	C	E	G	B ^b
OCTAVE	1:2	2:2	3:2	4:2	5:2	6:2	7:2
	C	C	G	C	E	G	B ^b
4 TH	1:3	2:3	3:3	4:3	5:3	6:3	7:3
	F	F	C	F	A	C	E ^b
OCTAVE	1:4	2:5	3:4	4:4	5:4	6:4	7:4
	C	C	G	C	E	G	B ^b
6 TH minor	1:5	2:5	3:5	4:5	5:5	6:5	7:5
	A ^b	A ^b	E ^b	A ^b	C	E ^b	G ^b
4 TH	1:6	2:6	3:6	4:6	5:6	6:6	7:6
	F	F	C	F	A	C	E ^b
2 ND	1:7	2:7	3:7	4:7	5:7	6:7	7:7
	D	D	A	D	G ^b	A	C
OCTAVE	1:8	2:8	3:8	4:8	5:8	6:8	7:8
	C	C	G	C	E	G	B ^b
7 T minor	1:9	2:9	3:9	4:9	5:9	6:9	7:9
	B ^b	B ^b	F	B ^b	D	F	A ^b
6 TH minor	1:10	2:10	3:10	4:10	5:10	6:10	7:10
	A ^b	A ^b	E ^b	A ^b	C	E ^b	G ^b
5 TH diminished	1:11	2:11	3:11	4:11	5:11	6:11	7:11
	G ^b	G ^b	D ^b	G ^b	B ^b	D ^b	E
4 TH	1:12	2:12	3:12	4:12	5:12	6:12	7:12
	F	F	C	F	A	C	E ^b
3 RD minor	1:13	2:13	3:13	4:13	5:13	6:13	7:13
	E	E	B	E	G	B	D ^b
2 ND	1:14	2:14	3:14	4:14	5:14	6:14	7:14
	D	D	A	D	G ^b	A	C
2 ND minor	1:15	2:15	3:15	4:15	5:15	6:15	7:15
	D ^b	D ^b	A ^b	D ^b	F	A ^b	B
OCTAVE	1:16	2:16	3:16	4:16	5:16	6:16	7:16
	C	C	G	C	E	G	B ^b
		OCTAVE	5 TH	OCTAVE	8 RD	5 TH	7 TH minor

Figure 1A

A LAMBDOMA TABLE QUADRANT)

A = 430.5 Hertz

8:1	9:1	10:1	11:1	12:1	13:1	14:1	15:1	16:1
C	D	E	G ^b	G	A ^b	B ^b	B	C
8:2	9:2	10:2	11:2	12:2	13:2	14:2	15:2	16:2
C	D	E	G ^b	G	A ^b	B ^b	B	C
8:3	9:3	10:3	11:3	12:3	13:3	14:3	15:3	16:3
F	G	A	B ^b	C	D ^b	E ^b	E	F
8:4	9:4	10:4	11:4	12:4	13:4	14:4	15:4	16:4
C	D	E	G ^b	G	A ^b	B ^b	B	C
8:5	9:5	10:5	11:5	12:5	13:5	14:5	15:5	16:5
A ^b	B ^b	C	D	E ^b	F	G ^b	G	A ^b
8:6	9:6	10:6	11:6	12:6	13:6	14:6	15:6	16:6
F	G	A	B ^b	C	D ^b	E ^b	E	F
8:7	9:7	10:7	11:7	12:7	13:7	14:7	15:7	16:7
D	E	G ^b	A ^b	A	B	C	D ^b	D
8:8	9:8	10:8	11:8	12:8	13:8	14:8	15:8	16:8
C	D	E	G ^b	G	A ^b	B ^b	B	C
8:9	9:9	10:9	11:9	12:9	13:9	14:9	15:9	16:9
B ^b	C	D	E ^b	F	G ^b	A ^b	A	B ^b
8:10	9:10	10:10	11:10	12:10	13:10	14:10	15:10	16:10
A ^b	B ^b	C	D	E ^b	F	G ^b	G	A ^b
8:11	9:11	10:11	11:11	12:11	13:11	14:11	15:11	16:11
G ^b	A	B ^b	C	D ^b	E ^b	E	F	G ^b
8:12	9:12	10:12	11:12	12:12	13:12	14:12	15:12	16:12
F	G	A	B ^b	C	D ^b	E ^b	E	F
8:13	9:13	10:13	11:13	12:13	13:13	14:13	15:13	16:13
E	G ^b	G	A	B	C	D ^b	D	E
8:14	9:14	10:14	11:14	12:14	13:14	14:14	15:14	16:14
D	E	G ^b	A ^b	A	B	C	D ^b	D
8:15	9:15	10:15	11:15	12:15	13:15	14:15	15:15	16:15
D ^b	E ^b	F	G	A ^b	B ^b	B	C	D ^b
8:16	9:16	10:16	11:16	12:16	13:16	14:16	15:16	16:16
C	D	E	G ^b	G	A ^b	B ^b	B	C
O C T A V E	2 ND	3 RD	4 TH aug- men- ted	5 TH	6 TH minor	7 TH minor	7 TH major	O C T A V E

Figure 1B

Professor Baer: The letter C would be the C note on the scale?

Barbara: Yes.

Professor Baer: Then each of the individual numbers in a sequence would be the tones? Are they harmonics?

Barbara: Yes, exactly, they are harmonics. And when you generate the horizontal rows musically you are multiplying and you get overtones which are called in physics "harmonics".

When you generate down the vertical columns, you are simply dividing and you get the "sub-harmonics", or the undertones as they are called in music. Many physicists still question the fact that these undertones even exist.

This diagram, by the way, dates back to Pythagoras and before that to the ancient Egyptian temples when mathematics, music, art and spirituality were one and not separate. In the 19th century there was a mathematician named Cantor who developed an array similar to this diagram which he called "transfinite". He considered himself a metaphysical mathematician. The similarity is almost exact with the exception that each one of the fractions representing a harmonic series in the array has a musical note with a one-to-one relationship of a rational number to an interval in music. For some reason this linkage of number to music was discarded between the time of the Greeks and the present day.

Question: Could you translate each one of those notes representing fractions into a particular cycle per second?

Barbara: Yes, this is exactly what this presentation is all about. If you took the note middle C as your beginning tone of ratio 1:1, you would enter 256 as your fundamental frequency in cycles per second. Then this frequency would be multiplied by 2, then by 3, and by 4 up to by 16, to obtain the frequencies of the overtones of the upper horizontal row. Then the same frequency would be divided by 2, 3, 4 and up to the entry 16 of the matrix in order to obtain the frequencies of the undertones in the first column on the left.

It becomes a process of continuously multiplying a row then continuously dividing a column, using a beginning constant frequency chosen in the audible range. This matrix is called a closed set in mathematical analysis. This matrix still defies our analysis, at least my analysis. It is a strange and mysterious matrix.

What I am going to show you now is a video so that you might experience the abstract numerical effects of this matrix in sound as well as shape.

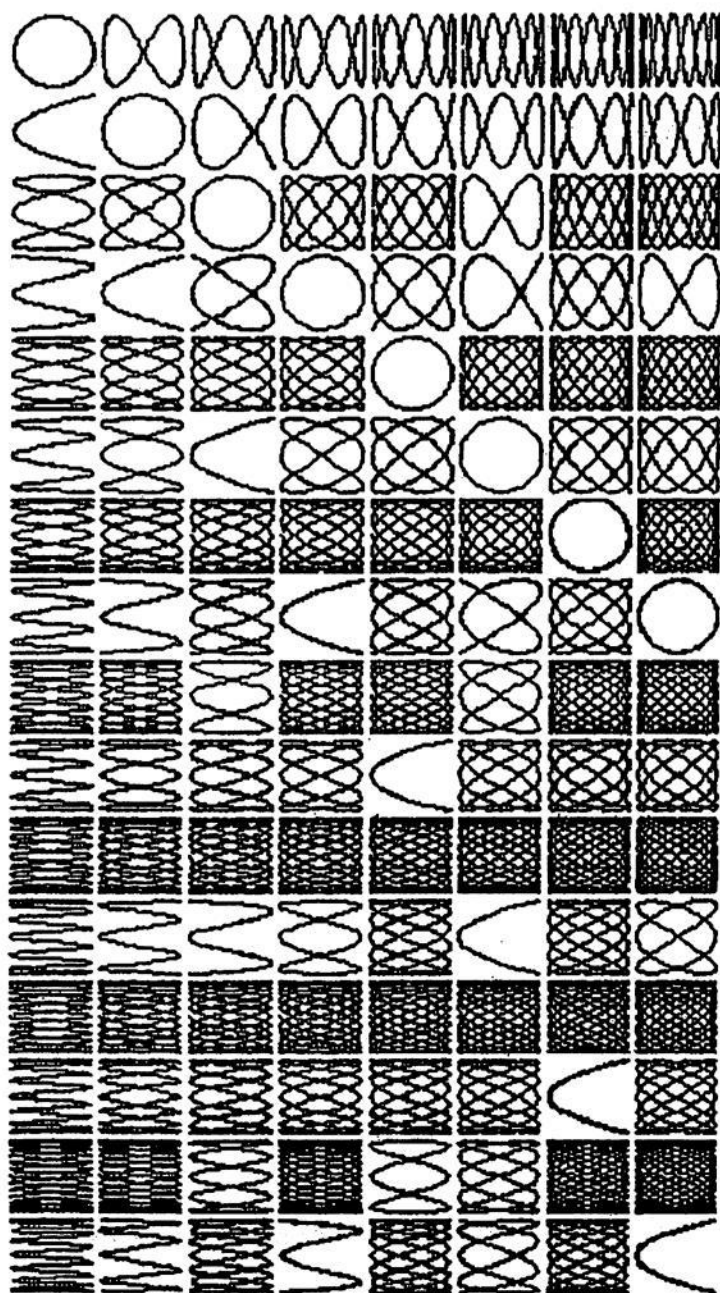
Question: How did you generate these sounds?

Barbara: These sounds were generated by a sine-wave generator which has a dial so that one can choose the frequencies in the table in their ratios of cycles per second. Then I recorded each frequency and mixed the result with a sound-on-sound technique. Then with a laser / scanner system I chose the patterns which were the most characteristic of the intervals sounded together and videotaped the result as an art form.

The shapes, which you see in Figure 2, are called Lissajous figures. In a way they are like a polar coordinate system in mathematics. You have to have two tones* sounded together to create the shapes. And you have to have a beginning tone sounded throughout, which is a fixed chosen frequency. Since the framework of the diagram is so "tight" any notes chosen within the matrix in cycles per second will be in harmony with any other entry in frequency in the matrix. I generated these particular intervals by callibrating the frequencies in the matrix on the sine wave generator and then callibrating the others in a sort of snake-like progression (Figure 3) from the 1:1 entry. Using this method you do not miss any of the entries in the matrix. This was one of Cantor's methods, which he developed as a pure mathematics system.

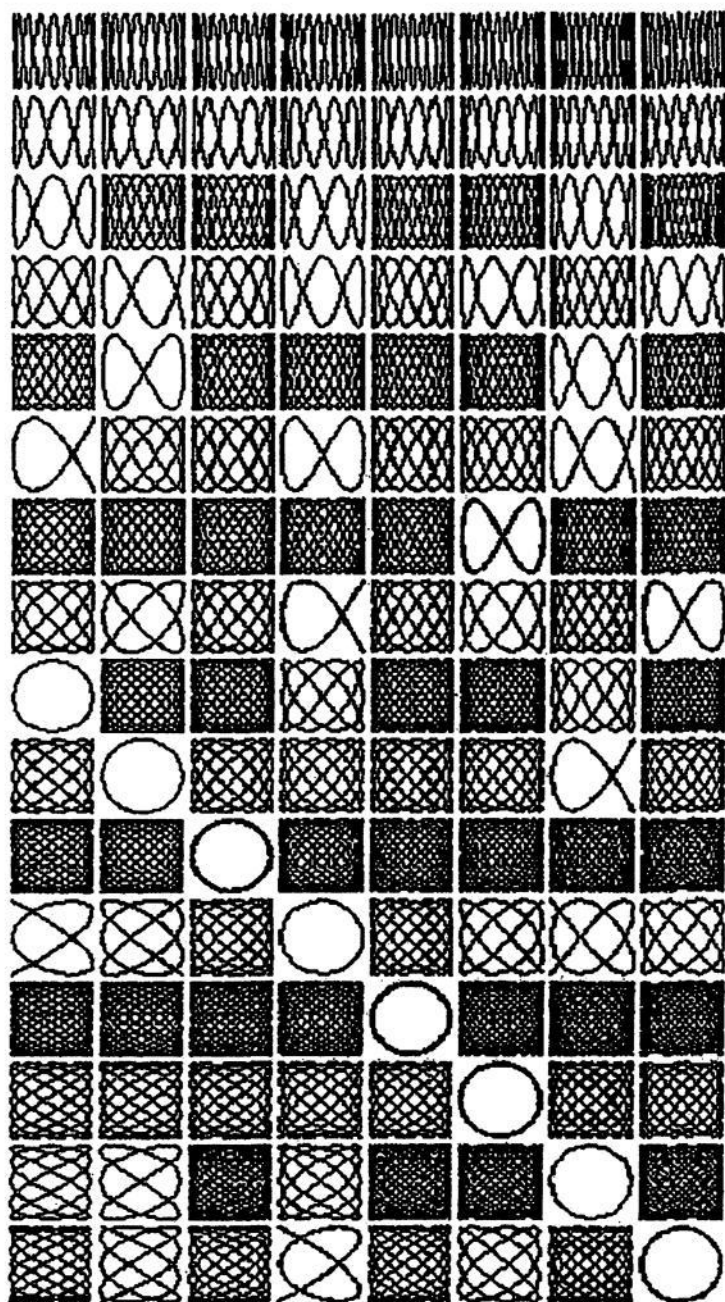
The particular sound you are hearing and seeing now is

* I use tone in this lecture as note rather than whole or half steps as it is generally considered.



MATRIX OF LISSAJOUS FIGURES

Figure 2A



MATRIX OF LISSAJOUS FIGURES

Figure 2B

CANTOR'S (FOURTH

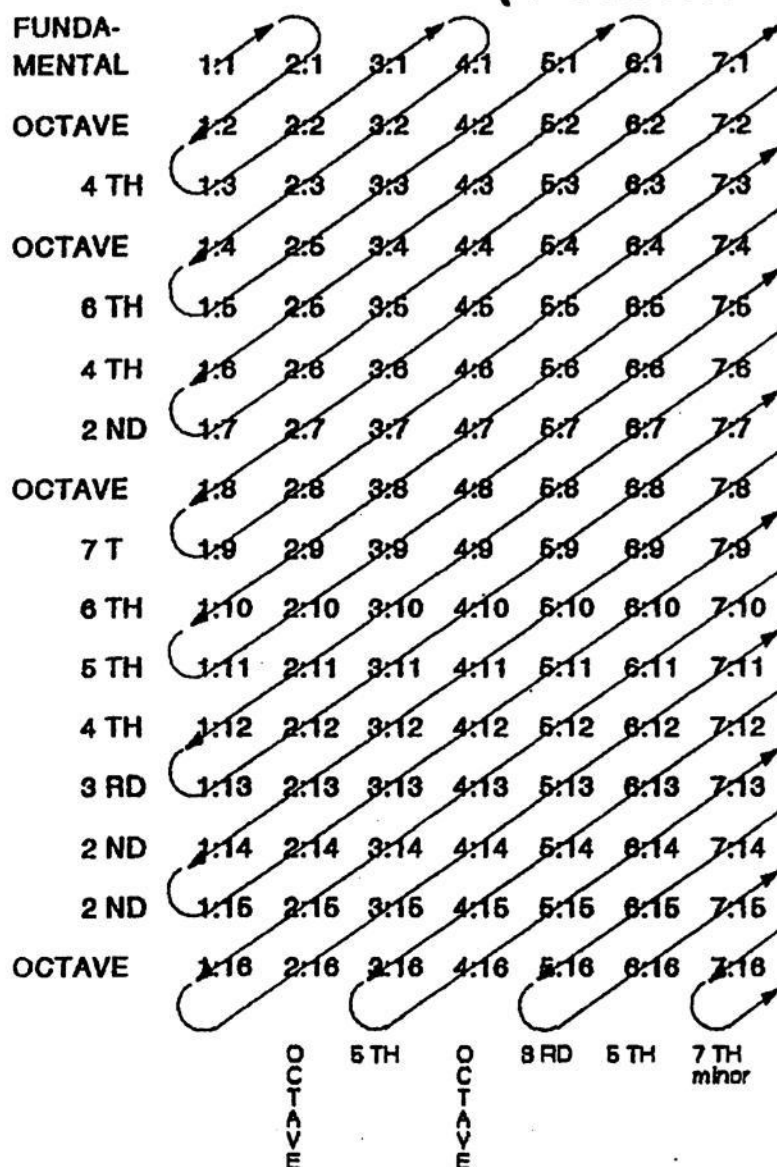


Figure 3A

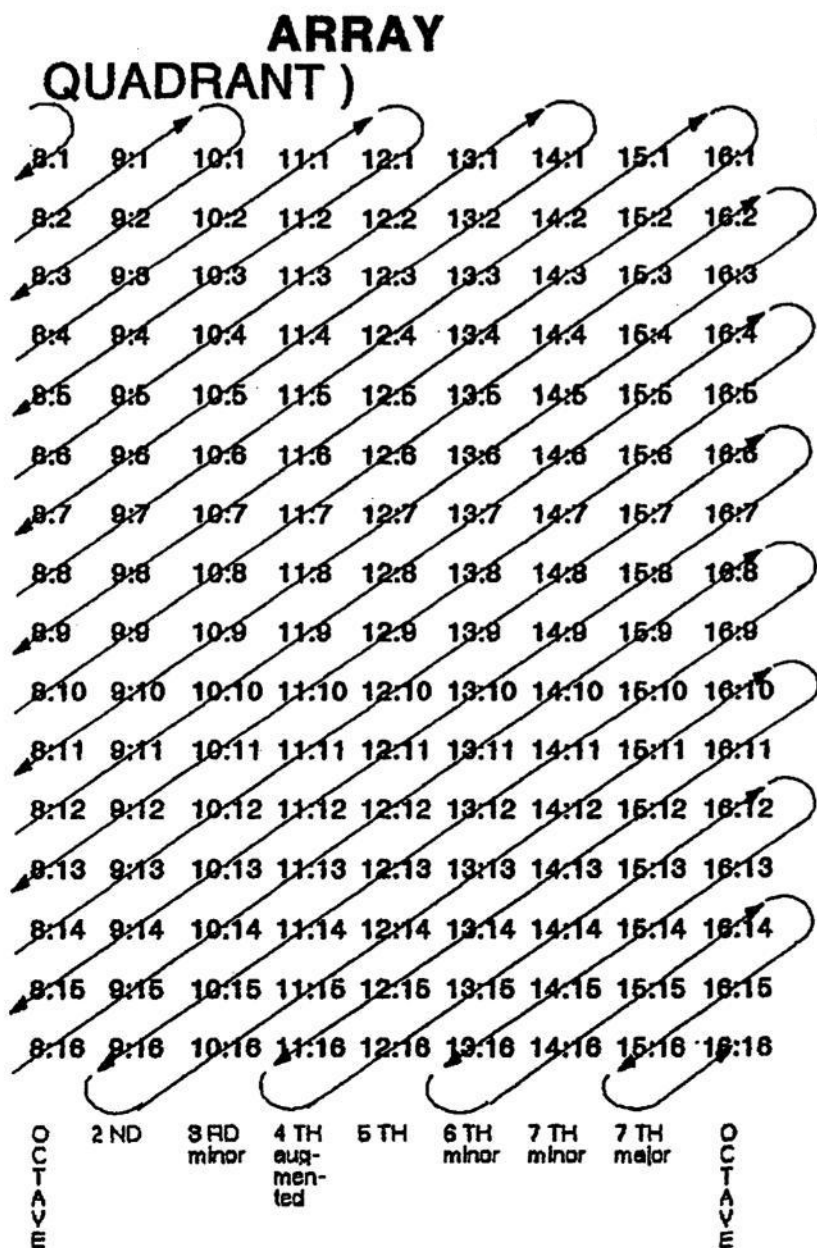


Figure 3B

when I brought my sine-wave generator and an oscilloscope to a friend's house who had an Oberheim Synthesizer. He tuned his synthesizer to a beginning frequency, and then did certain phasing to obtain the shapes seen on the oscilloscope. The main point to make is that two or more frequencies have to be sounded simultaneously in order to create any shape.

Each shape has its particular numerical as well as musical identity. When you see a circle it means unison, which is a sounding of two tones together at exactly the same frequency. Then, the second tone is identical with the beginning frequency and the ratio is 1:1. When you see a figure eight, the tones are in a ratio of 2:1 and the figure represents an octave. It means that you are cutting a vibrating string in half. Think of a vibrating string and every time you put your finger on a different point you would get certain different sounds. Use this as an analogy to the shapes you are seeing.

Barbara: Now I would really like you to ask questions.

Question: The music sounds like Steve Halpern's?

Barbara: Yes, it does. As a matter of fact I have an oscilloscope and I have played one of his cassettes using it and his music makes beautiful shapes. I don't know if he knows this about his music.

Question: Have people had experiences while watching this and listening to this?

Barbara: Yes, I have been playing these sounds in the Bridgewater Prison Art Workshop, and I have played these sounds in the Third Nail, a drug rehabilitation center, and also at Project Cope in Lynn, Massachusetts, another drug rehabilitation center. All of the listeners have been asked to draw what they hear. They don't see the shapes. I use only the music in an audio cassette recorder. The images they come up with are quite fascinating. I will show you some of the pieces of art from the Art Workshops. I might say that this presentation is the culmination of all of my efforts, which span almost 20 years since I began the restudy of

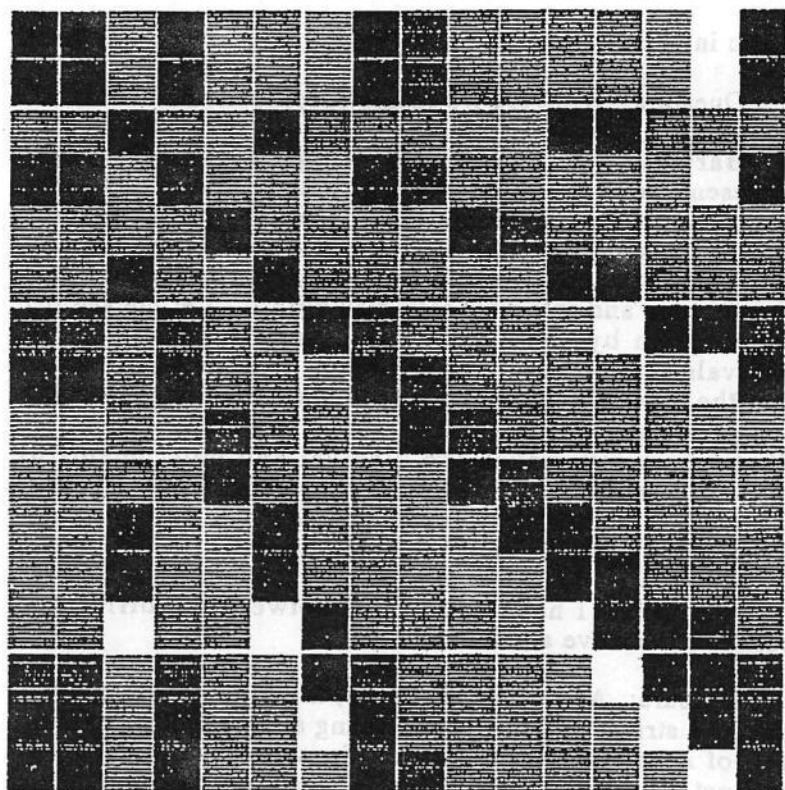
music in 1961.

Question: What are we seeing specifically here?

Barbara: What you see in Figure 2, is graphical representations of the interactions between pairs of sounds created from this mathematical matrix. When a sound or tone is chosen at certain cycles per second, any tone you pick is going to have its own frequency relationship with the chosen tone and intervals involved with it. Let me see if I can explain by the chart, which has its own ratios of intervals and its own visual patterns. For instance I found that the tone which works best to start with is one of 352 cycles per second, calibrated with a sine-wave generator. That frequency makes the clearest and most beautiful shapes. A multiple of 352 cycles per second, by doubling it, is an octave higher at 704 cycles per second. Both of these frequencies would be an $F^\sharp$ one octave apart.

Question: I have gotten lost between the difference between an octave and a tone.

Barbara: An octave is simply, thinking of this number line as a string, and you take a string and put your finger on half of it and that is an octave. So within that octave you will get all the different intervals. One ninth of that string would be a note of D. But on this particular line the D is three octaves above the beginning tone C. This diagram extends all the way to the entry 16. You can go out to 300 or more places by graphing it on graph paper and color-coding it. But instead of color-coding these fractions you code them in frequencies of cycles per second. Color coding gives you an image, a visual rather than an aural result. You take one of these arrays and make it into a quadrant. (Figure 4) This particular diagram would represent the lower right quadrant. You can draw all four quadrants, and if you color code all those intervals in their chosen colors you would have a dynamic looking explosion / implosion visual image. (Figures 5 and 6) Without the musical color coding system it would be really hard to know how to color code fractions. Mathematicians consider them to be gaps in the number line, and a difficult entity with which to deal. The ancient Egyptians dealt almost exclusively with fractions. Many

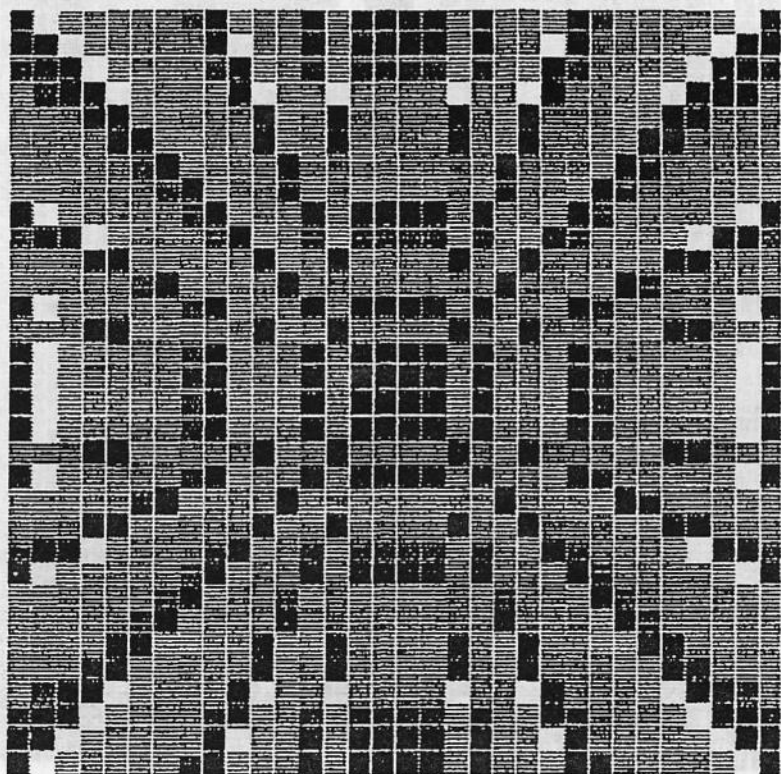


COLOR CODED LAMBDOMA MATRIX

Figure 4

ancient mathematical systems are based on doubling. I couldn't possibly explain all the ramifications of this diagram in such a short time, but this is giving you a taste for exploring, mathematics, musical sound and color.

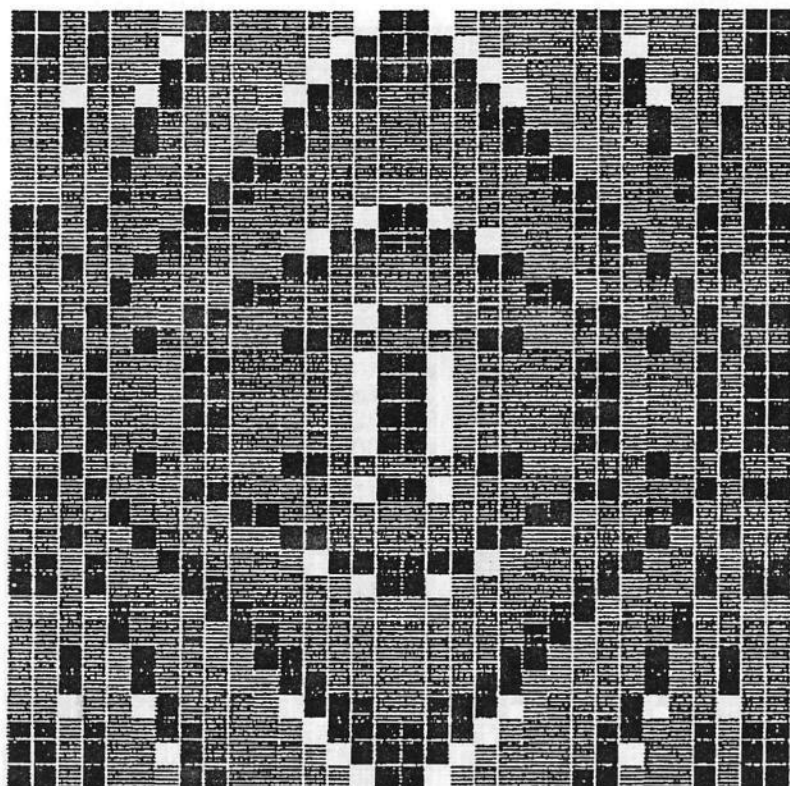
Professor Baer: Let me give a little perspective on what we are about here this morning. Because in all the mystery schools from the ancient Egyptians, Greeks, Middle Ages all the different types of high consciousness groups have always placed great stress on sounds as a vehicle for penetrating into these deeper mysteries. And in order for the initiates to



FOUR QUADRANT (EXPLOSION) LAMBDOMA

Figure 5

reach that, and we are going to be getting into the book "Initiation" pretty soon now and we will be hearing some of these same things from a different perspective. They required that all their initiates be well versed in music, in sound, in mathematics, in philosophy and in spiritual truths. All of these were felt to be needed as background before you could advance in consciousness. So what Barbara has been doing has been approaching the nature of consciousness from the form of sound and mathematics. And are you relating it to architecture?



FOUR QUADRANT (IMPLOSION) LAMBDOMA

Figure 6

Barbara: Well, I think one could. But this work has been on a two dimensional plane for me as my background is as a painter. That is how it all began! Although it certainly could be applied to architecture.

Professor Baer: So what we are talking about this morning is sort of a background experience related to some very deeper sense of the nature of consciousness. Do you feel that by exploring this we could somehow get a better understanding of other aspects of the psychology of this experience? What are you trying to show us this morning?

What is your main emphasis?

Barbara: I think that whenever people listen to this music even without seeing it, it puts them in a very tranquil sort of state and allows them to dream while awake. Some of the people I have had in my classes are writing poetry while listening to the sounds. One person in the workshop had done a little bit of art, and I said why don't you do something more and he said "I am doing something more, I am meditating".

When coded into the reality of sounds, the matrix has its emotional or feeling aspect. It is not just dry mathematics any more. But the music has some sort of transcendent quality that I think effects consciousness. One of the effects is also healing, and I think this is something which has not been explored as much as it should be, healing with sound. I would say that Steven Halpern is certainly one of the ones dealing with this aspect.

Question: Have you come to any conclusions that certain notes affect you in different ways? We were talking about Rudolf Steiner last week.

Barbara: I think that everyone has a resonant frequency, and probably different parts of the body resonate to different frequencies. I think we are all made up of intervals of vibrations of music. In physics they talk about quantum leaps and a quantum leap of an octave occurs right here between 1:1 and 2:1, on Figure 1. You take a string and cut it in half. That represents a wavelength of a note that is one octave higher. You can't see this visually because the linear charts are not in the correct physical proportions. It is interesting to notice that, by starting with a wavelength of one sixteenth of an inch and by doubling this wavelength (*lower octaves*) five or six times, you will expand the wavelength to beyond the reach of your arm. In mathematics it is difficult to show proportions as they really exist in the physical dimensions. One way to help us visualize them is to translate the ratios and sounds into color. This is what the book's cover illustrates. We call it a Lambdoma diagram. In Figure 7, the Lambdoma diagram is coded with the musical alphabet and also shows some of

RAYS ON THE NOTES: (FOURTH

FUNDA- MENTAL	C = 256 Hertz	1:1	2:1	3:1	4:1	5:1	6:1	7:1
		G	G	G	C	E	G	B ^b
OCTAVE		1:2	2:2	3:2	4:2	5:2	6:2	7:2
		G	G	G	G	E	G	B ^b
4 TH		1:3	2:3	3:3	4:3	5:3	6:3	7:3
		F	F	G	F	A	G	E ^b
OCTAVE		1:4	2:4	3:4	4:4	5:4	6:4	7:4
		C	C	G	C	E	C	B ^b
6 TH		1:5	2:5	3:5	4:5	5:5	6:5	7:5
minor		A ^b	A ^b	E ^b	A ^b	C	E ^b	G ^b
4 TH		1:6	2:6	3:6	4:6	5:6	6:6	7:6
		F	F	C	F	A	C	E ^b
2 ND		1:7	2:7	3:7	4:7	5:7	6:7	7:7
		D	D	A	D	G ^b	A	C
OCTAVE		1:8	2:8	3:8	4:8	5:8	6:8	7:8
		C	C	G	C	E	G	B ^b
7 T		1:9	2:9	3:9	4:9	5:9	6:9	7:9
minor		B ^b	B ^b	F	B ^b	D	F	A ^b
8 TH		1:10	2:10	3:10	4:10	5:10	6:10	7:10
minor		A ^b	A ^b	E ^b	A ^b	C	E ^b	G ^b
5 TH		1:11	2:11	3:11	4:11	5:11	6:11	7:11
diminished		G ^b	G ^b	D ^b	G ^b	B ^b	D ^b	E
4 TH		1:12	2:12	3:12	4:12	5:12	6:12	7:12
		F	F	C	F	A	C	E ^b
3 RD		1:13	2:13	3:13	4:13	5:13	6:13	7:13
minor		E	E	B	E	G	B	D ^b
2 ND		1:14	2:14	3:14	4:14	5:14	6:14	7:14
		D	D	A	D	G ^b	A	C
2 ND		1:15	2:15	3:15	4:15	5:15	6:15	7:15
minor		D ^b	D ^b	A ^b	D ^b	F	A ^b	B
OCTAVE		1:16	2:16	3:16	4:16	5:16	6:16	7:16
		C	C	G	C	E	G	B ^b
		OCTAVE	5 TH	OCTAVE	3 RD	5 TH	7 TH	minor

Figure 7A

A LAMBDOMA TABLE QUADRANT)

A = 430.5 Hertz

8:1 C	9:1 D	10:1 E	11:1 G ^b	12:1 G	13:1 A ^b	14:1 B ^b	15:1 B	16:1 C
8:2 C	9:2 D	10:2 E	11:2 G ^b	12:2 G	13:2 A ^b	14:2 B ^b	15:2 B	16:2 C
8:3 F	9:3 G	10:3 A	11:3 B ^b	12:3 C	13:3 D ^b	14:3 E ^b	15:3 E	16:3 F
8:4 C	9:4 D	10:4 E	11:4 G ^b	12:4 G	13:4 A ^b	14:4 B ^b	15:4 B	16:4 C
8:5 A ^b	9:5 B ^b	10:5 C	11:5 D	12:5 E ^b	13:5 F	14:5 G ^b	15:5 G	16:5 A ^b
8:6 F	9:6 G	10:6 A	11:6 B ^b	12:6 C	13:6 D ^b	14:6 E ^b	15:6 E	16:6 F
8:7 D	9:7 E	10:7 G ^b	11:7 A ^b	12:7 A	13:7 B	14:7 C	15:7 D ^b	16:7 D
8:8 C	9:8 D	10:8 E	11:8 G ^b	12:8 G	13:8 A ^b	14:8 B ^b	15:8 B	16:8 C
8:9 B ^b	9:9 C	10:9 D	11:9 E ^b	12:9 F	13:9 G ^b	14:9 A ^b	15:9 A	16:9 B ^b
8:10 A ^b	9:10 B ^b	10:10 C	11:10 D	12:10 E ^b	13:10 F	14:10 G ^b	15:10 G	16:10 A ^b
8:11 G ^b	9:11 A	10:11 B ^b	11:11 C	12:11 D ^b	13:11 E ^b	14:11 E	15:11 F	16:11 G ^b
8:12 F	9:12 G	10:12 A	11:12 B ^b	12:12 C	13:12 D ^b	14:12 E ^b	15:12 E	16:12 F
8:13 E	9:13 G ^b	10:13 G	11:13 A	12:13 B	13:13 C	14:13 D ^b	15:13 D	16:13 E
8:14 D	9:14 E	10:14 G ^b	11:14 A ^b	12:14 A	13:14 B	14:14 C	15:14 D ^b	16:14 D
8:15 D ^b	9:15 E ^b	10:15 F	11:15 G	12:15 A ^b	13:15 B ^b	14:15 B	15:15 C	16:15 D ^b
8:16 C	9:16 D	10:16 E	11:16 G ^b	12:16 G	13:16 A ^b	14:16 B ^b	15:16 B	16:16 C
OCTAVE	2ND	3RD	4TH aug- men- ted	5TH	6TH minor	7TH minor	7TH major	OCTAVE

Figure 7B

the "rays" which pass through identical notes. You can generate patterns by numbers, colors, frequencies, or shapes. It is a coding.

I would like more questions, then I will know where you are.

Question: Those octaves you talk about up there, is that anything related to a piano?

Answer: Yes, the difference between a piano and this system is that the tuning of a piano is more or less equidistant between adjacent notes or equal tempered, whereas this Lambdome matrix is based on a harmonic series. With a harmonic series of tones, you get very unequal spaces or intervals between adjacent tones. If any of you play the flute for example, you know that your fingers are not equally spaced. We humans tend to like to make everything orderly, and we don't generally consider the octave leaps of the harmonic musical system in the first stages. Many composers work with overtones. Overtones are harmonics that are heard when a particular note is sounded. Many other sounds are heard at the same time particularly if there is another note struck with it, or a string which is next to it.

Question: Is that resonance?

Barbara: Yes.

Question: On a piano you have a C through C and then it starts again? And then you have another set which starts again at C?

Barbara: Yes, exactly. Let me explain it to you on the diagram. (Figure 1)

This entry at 2:1 would be the C above middle C, multiplying the beginning frequency by 2. Then you move to the next C at 4:1 and you are two octaves above middle C, multiplying the beginning frequency by 4, or doubling twice. This is the octave part of the overtone series.

Question: These are the actual notes that are being played?

Barbara: Yes. They have been generated based on the numerical ratios. They are theoretically self generating, and can actually be generated by a mathematical formula. This is a fascinating concept. This goes back to the philosophical concept "How can one generate many?" This matrix is one of the explanations of that concept. One axis represents increasing frequencies or the higher sounds 2:1 through 16:1 (*by multiplication*), and the other axis represents the lower sounds, of ratios 1:2 through 1:16 (*by division*).

THE SHOWING OF THE SLIDES

As I present them, you can see all of the other ideas that can be inspired from thinking of every fraction, every number as a length, and using these as radii to create circles. (Figure 8)

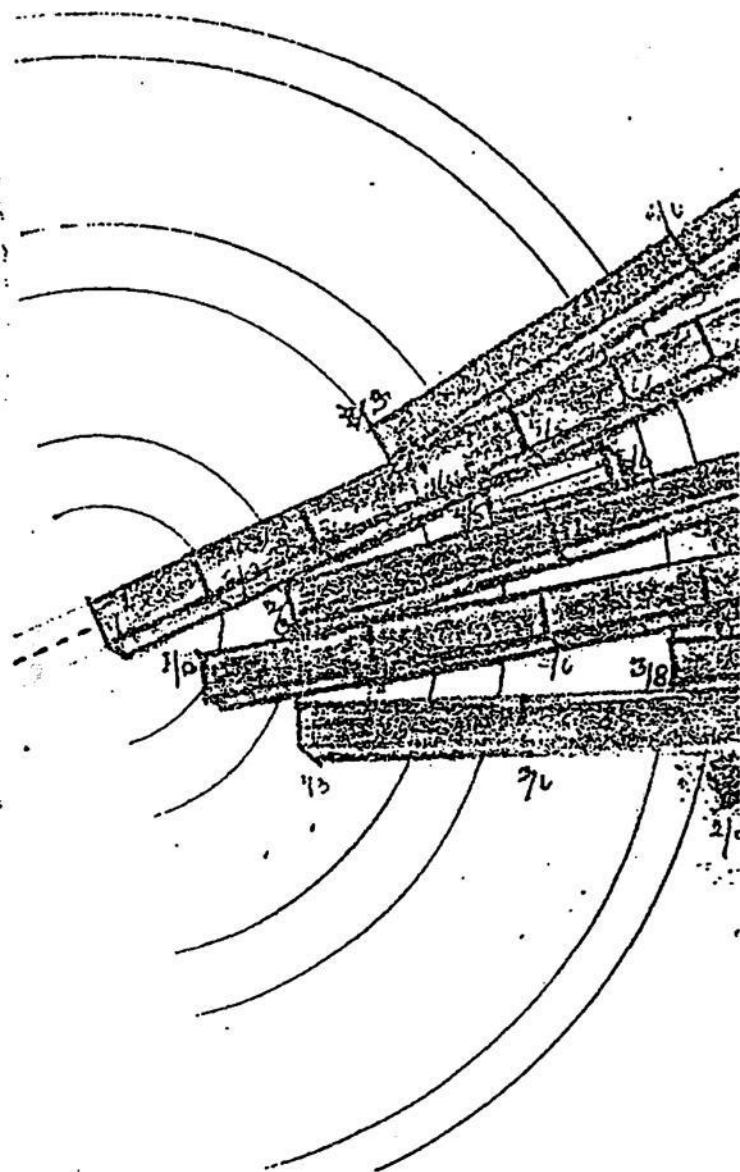
Professor Baer: Is that what is happening here?

Barbara: Yes. And one of the reasons I chose to work with electronics is that I wanted to see whether the shapes generated electronically would look like the visions which I had as a painter using this matrix for inspiration.

I would like to read to you these thoughts about the matrix to give you some background.

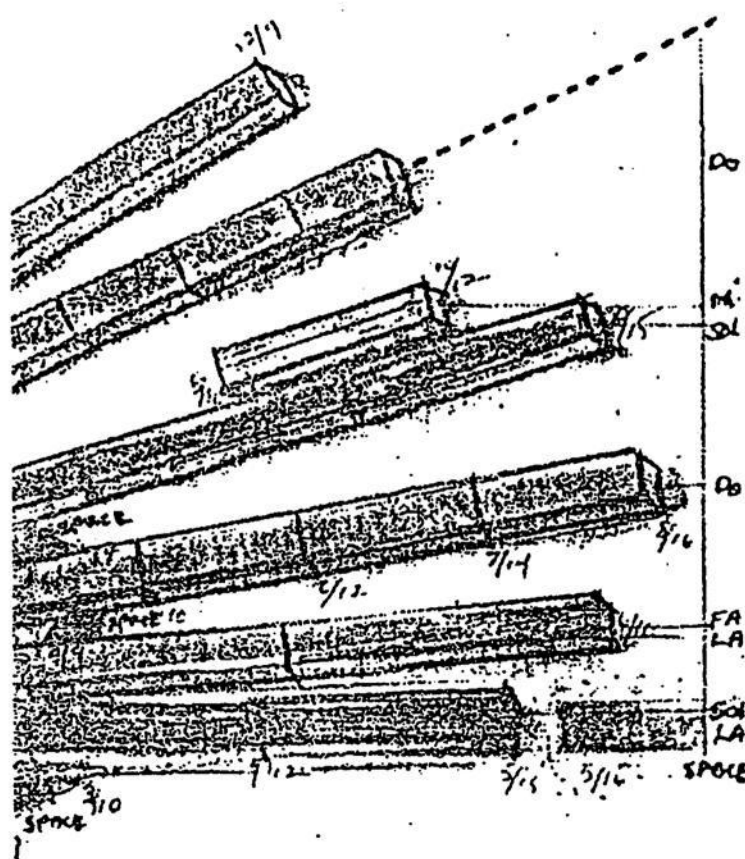
This booklet which I put together in 1976 is called *The Lambdoma*.

"The Lambdoma is a diagram over five hundred years old. It came through Pythagoras, the mathematician, philosopher and astronomer who taught the science of life. Pythagoras left no writings and we have only the works of his students. His community flourished for many years. It is said that he treated the sick by music. He reduced the musical scale to a mathematical science much of which is exemplified in the Lambdoma diagram. Iamblichus, the Neo-Platonist, gave the Lambdoma diagram its name



BARS REPRESENTING EACH TONE PERIODICITY

Figure 8A



Parlo... Her' 75

BARS REPRESENTING EACH TONE PERIODICITY

Figure 8B

because of it's upside down shape of a y, suggesting the letter Lambda (λ), which is the eleventh letter and seventh consonant of the Greek alphabet. (*Iamblichus lived in 200 AD. He was a neo-pagan.*).

It is worth mentioning that that the Lambdoma teased the minds of those living in the middle ages. In Germany, 1868-76, Albert von Thimus wrote a work called "Harmonikale Symbolik des Altherthums" [2]. (*This book is in the Boston Public Library in the Music collection if any of you want to look at fascinating diagrams. It is in German, in two volumes, on just the Lambdoma.*).

To describe the diagram (Figure 1) in non-mathematical terms one would begin by saying that it symbolizes the infinitely small and the infinitely large. Its laws are so strict mathematically and musically that our present-day harmonies are still based on it's principles which in turn are based upon fundamental principles of physics. The Lambdoma is made up of identity rays which radiate from a given point in space. Identity rays call each tone of a musical scale by name. Visually they create different shaped triangles. While, in sound, they create a cacophony of tones all related to one another.

How does one apply this Lambdoma to anything today? Color does have a language. There are only seven to twelve tones in our musical scale. A pattern is bound to emerge. If one has difficulty imagining the overtone series in music abstractly, or a number system abstractly, color can bring out patterns immediately accessible to the eye. Tones of musical overtones so abstract and unable to be visualized by the mind's eye, assume exploding or contracting essences. A two dimensional space becomes an illusionary three dimensional world. (Figures 5 and 6)

And that is what this video and music is showing.

Question: What do the colors signify?

Barbara: Every tone is identified with its own color. I took in this case a beginning color here which is red to signify C. Newton and Pythagoras both assigned the same

colors to each interval on the musical scale. D would be orange, E yellow, F green, G blue, A indigo, B purple, and back to the octave C which is red again. That is how you create these marvelous patterns.

Professor Baer: Has anyone heard of Steve Halpern's "Spectrum Suite"? He portrays all of these things that Barbara is saying. And also I think he related them to the chakras and also for healing.

Barbara: Another thing you can do about translating the tones into numbers, alphabets or fractions, frequencies of cycles per second and colors, you can also translate each one which is a frequency into a wave length by simply dividing by the speed of sound in air, which is approximately 1,130 feet per second. So that what you have is a formula which makes a correspondence with each musical note in frequency to its dimension in feet. Our hearing spans about four octaves down from middle C, where we reach the lower limit of our hearing range, the undertones. The upper limits, the overtones, span a larger field of six or seven octaves from middle C. The longest wavelength of an undertone that we can hear is about fifty feet at about .22 cycles per second, whereas the shortest wavelength, of twenty thousand cycles per second, is only a fraction of an inch. Obviously the range of frequencies extend in both directions and extend way beyond the limits of our hearing. We can apply the principles to the microcosmos and the macrocosmos.

Professor Baer: Has everyone here had Introductory Psychology? It includes the basic psychology of sound and the range of human hearing.

Barbara: This is a slide of a painting done by one of the inmates at Bridgewater Prison while listening to these sounds.* The inmates were trying to portray what the sounds would look like if they could see the sounds.

Professor Baer: There is a term called synesthesia. Has anyone ever heard that term in Psychology, where you can

* Release, to publish the art work of the inmates, is not available.

hear blue? I suspect that some of that is coming through here. It is a mixed mode experience.

This was done in a more literal way. (Figure 9) This is one of my works which was based on cutting the vibrating string in half, and keep dividing it in different ways, including halving.

Question: Is this an inmate's or is this yours?

Barbara: This is mine.

Question: I was going to say what a difference between your's and his.

Barbara: That little area that is in the square is the 16 by 16 dimension. (Figure 10). This is an example of a matrix which includes 300 entries representing the harmonic series on the horizontal section of the grid. This, of course is beyond our hearing.

Question: Is this like an infinite series of a progression?

Barbara: Yes it is. It is an infinite series until it is set at any limit. The interesting thing is, what do you do when you come to the end of the 16th entry? Is there a space or gap between 16 and 17, or does it color code to a red at 16 or an orange at 18? I simply decided that it goes with 16 so that is why I kept coloring the gaps in order to make it visually more attractive.

The cover shows the color coding and the corresponding notes. And if you notice the red diagonal down the middle is a constant tone. Mathematicians are always trying to find constants. And here is a physical constant which doesn't go into any other octave in music except the one it began with.

Professor Baer: I would like to see the musical notes. I wanted to study their letters. I was just wondering, are you talking about that middle diagonal?

Barbara: Yes.

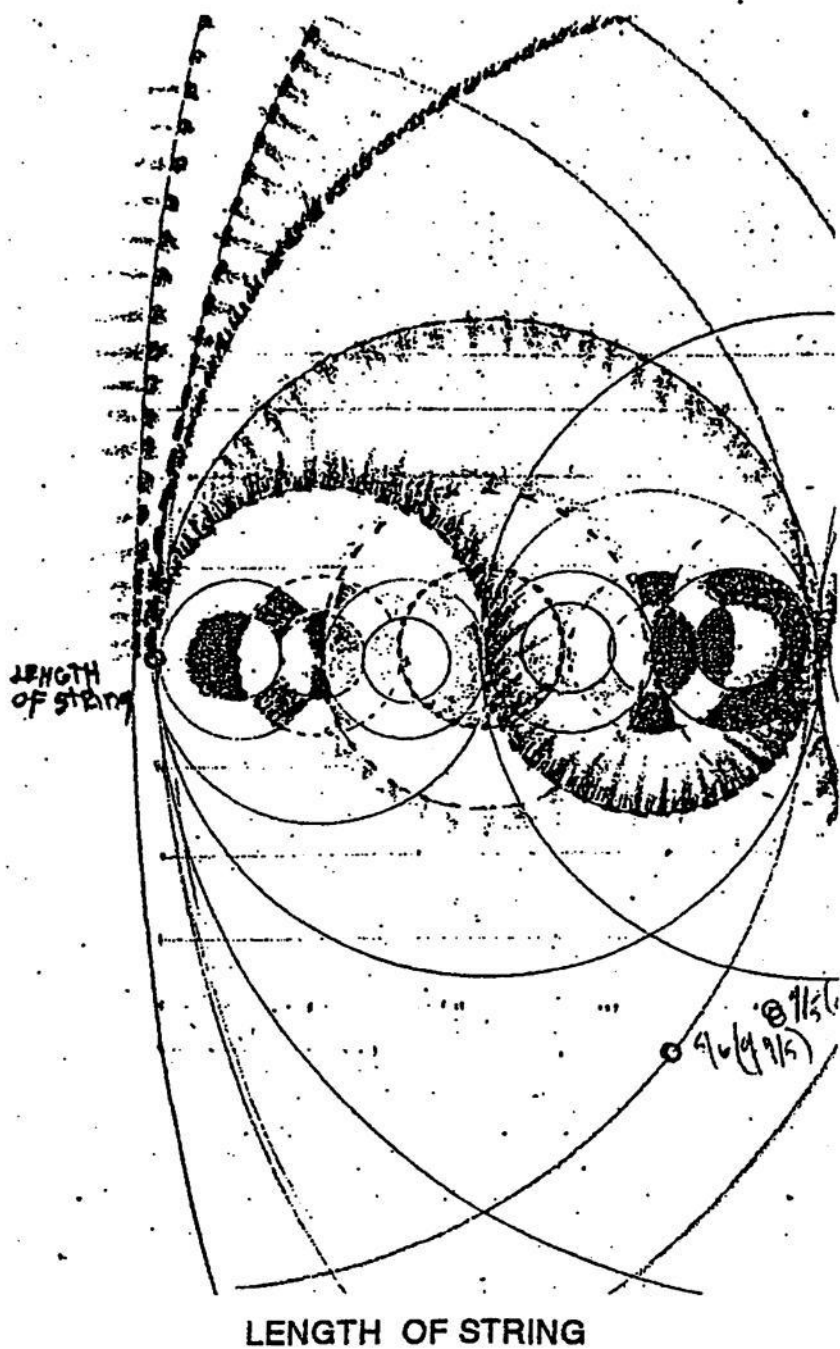
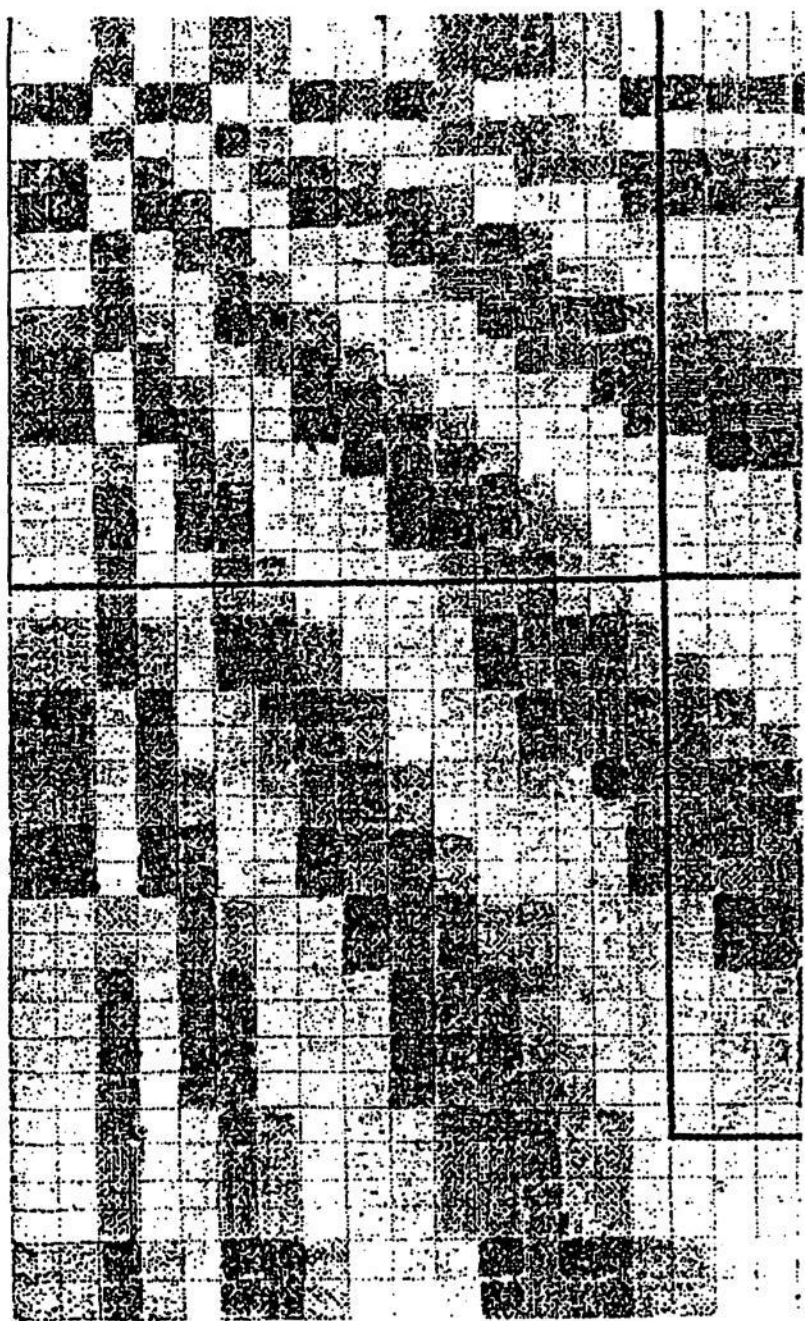
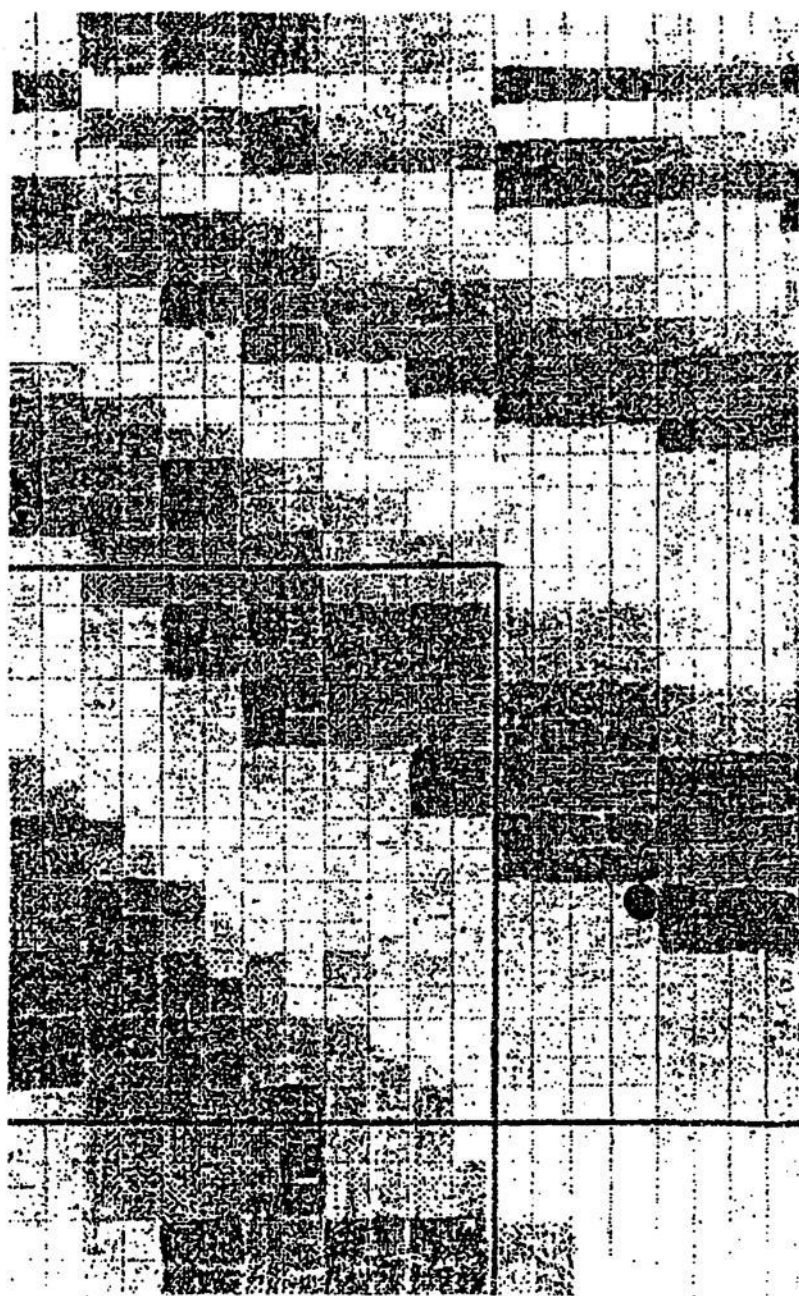


Figure 9



EXTENDED LAMBDOMA

Figure 10A



EXTENDED LAMBDOMA

Figure 10B

Professor Baer: But the notes are changing aren't they?

Barbara: Not in the middle. The interesting thing is that all the rays where you see red, is the beginning note in different octaves. The middle ray is the only one which is the same note in the same octave. It means getting a whole stability of key notes of C in red in a matrix. It represents one generating many. It is a very interesting philosophical problem because you get seven rays within this matrix.

Professor Baer: Oh, that is a magic number, seven rays. In fact I have a book called "Seven Rays" by Madame Blavatsky. In fact I think she was the one who introduced the idea of seven rays.

Barbara: And you see what happens as the colors go from the seven rays in opposite order on each side of the unison ray. The primary colors are yellow, red and blue. Now the corresponding link between music and the primary colors could very easily be what is called the "the circle of fifths" in music. This is because the fifth note G (greenish blue) of the "C" scale is opposite or complementary in color to the first note C (red) of the same scale. Reds (C) are opposite greenish blues (G). And yellows (E) are opposite purples (B). So when you have all the spectrum of colors on each side of a red ray, you have red going towards purple on the upper overtone part, and then you have red going towards yellow on the lower undertone part of each of the seven rays. So you always have this sensation of going back and forth.

Professor Baer: I am thinking of the flowing in of opposites in the Tao idea. Now in psychology we talk of two different kinds of primaries, the red, green and blue, the physical primaries. And the psychological primaries red, green, blue and yellow. There is some distinction there.

Barbara: In art we call secondary colors green, purple, and orange.

Professor Baer: Are you dealing with reflective colors, and transmitted colors?

Barbara: Painters deal with pigments, which is a different approach. There can be six colors and when you add black you have seven. (*There are in fact primary, secondary and tertiary colors, making twelve*). Many people have said that higher notes can be represented visually by lighter tints and lower notes by adding darker tints.

Figure 10 is another way of showing different intervals in music. If you pick a certain note such as E (yellow) or G (blue) and you only color one of those notes in a four quadrant matrix they form their own characteristic pattern. When you lay them all out together in all the colors, none of them conflict. They can't be in the same place at the same time. All of the color coded notes whether they are A, B, C, C, E, F, or G, will never conflict with one another because their patterns are interlocking in their own spaces. This is so no matter which note you pick as a beginning tone. And that is what is so fascinating, the structure is so absolutely perfect. And this is only represented here on two dimensions.

Professor Baer: Barbara what do the Greeks mean when they are talking about the harmony of the spheres? What is your understanding of that?

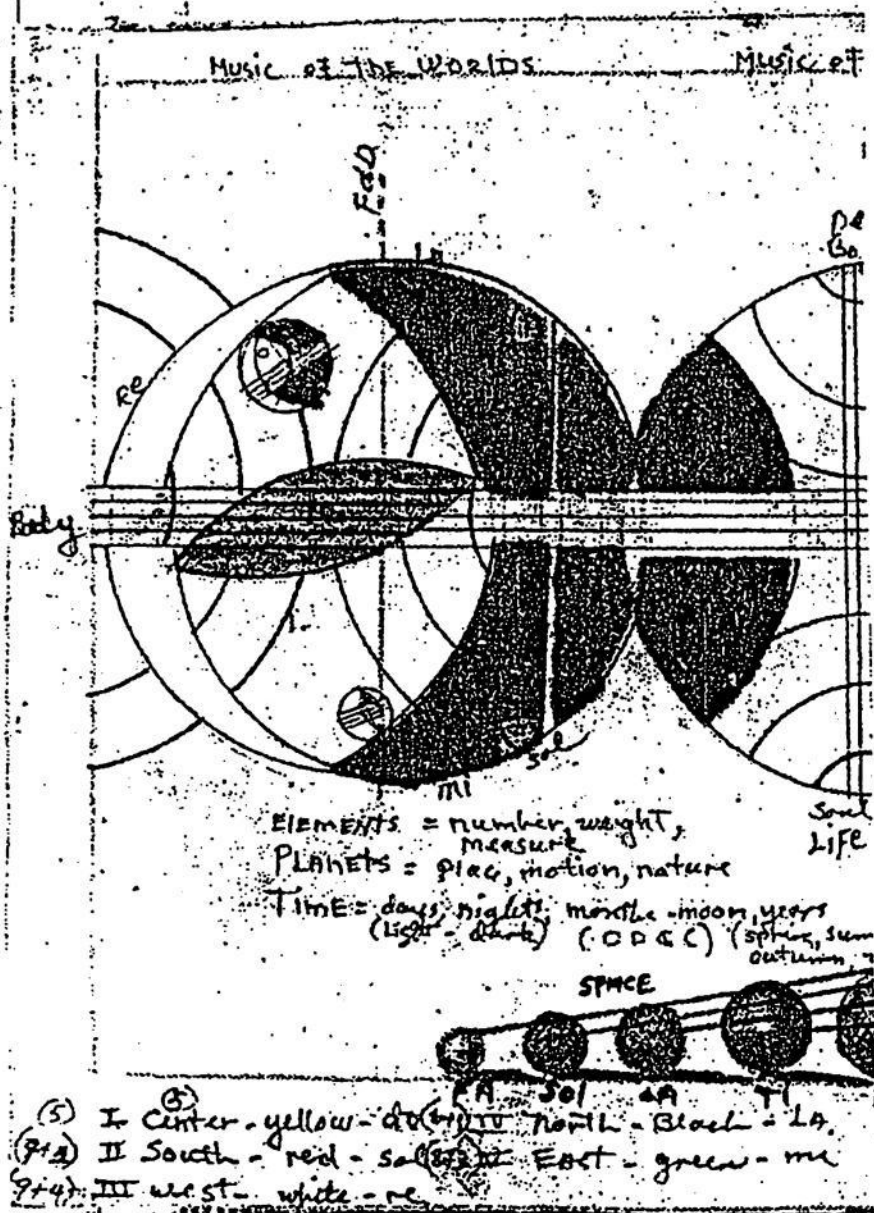
Barbara: Well, I think that what they meant was that there are certain immutable cosmic laws that are unchangeable, and if they were involved with music that is exactly what they would find. I think that anyone who is experimenting with the laws of music realizes that the beauty of it is that it is so crystal clear.

Professor Baer: So these are conforming to the laws of the cosmos in a sense? And what our mind is doing is just tuning in to that and perhaps recognizing it, and in the process of recognizing it you are in touch with the infinite?

Barbara: I think so.

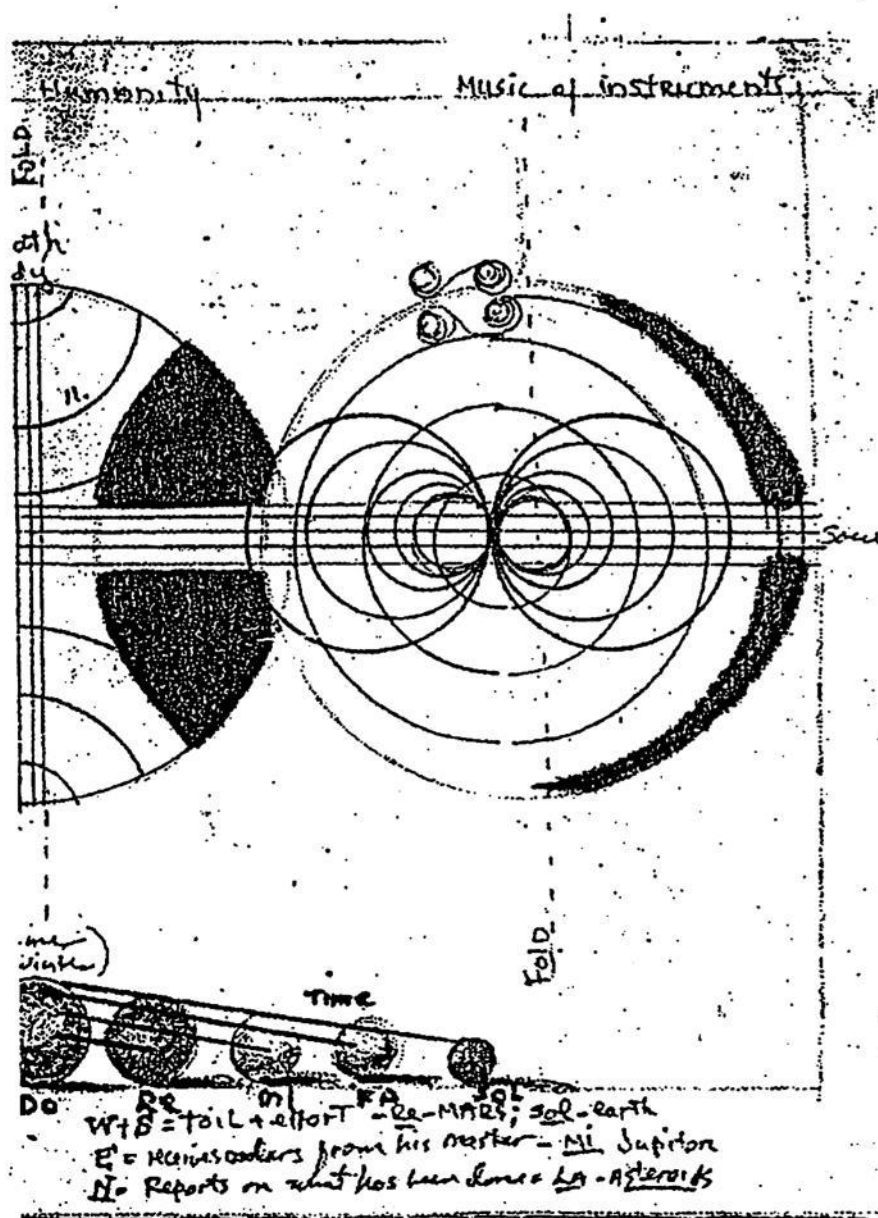
Professor Baer: I did not understand the meaning of that slide. (Figure 11) What was it trying to say?

Barbara: I get many of my ideas from reading. The



MUSIC OF THE SPHERES

Figure 11A



MUSIC OF THE SPHERES

Figure 11B

first circle represents the music of the worlds, the second circle symbolizes the music of humanity, and the third is the music of instruments. And this was just sort of an imaginary way of portraying the concepts in intersecting circles.

Professor Baer: Would you call this sort of an inspirational painting?

Barbara: Yes, that's one thing. You can't always be scientific about every thing.

Professor Baer: You had a pentagon which you passed around.

Barbara: Oh, the pentagon illustrates the Fibonacci series.

Professor Baer: How many know what the Fibonacci series is? It holds the basic ideas of all of our living systems.

Barbara: Music is based on primary numbers like 1, 2, 3, 5, & 7, while the Fibonacci series begins with one and adds one making two, and two and one make three, and three and two make five, and you keep adding the successive numbers to each other infinitely.

Professor Baer: Yes, the two previous numbers you add together to produce the next number in the series. That is the Fibonacci sequence. Those are the Fibonacci numbers. By the way this is the way all plant life displays its leaves on a tree. Now that is a finite discrete array, and you take this into a continuous function and you end up with an elaborate spiral. In a 3-dimensional spiral you get into a double helix and you have the DNA molecule and all sorts of other things.

Barbara: And also the Golden section.

Professor Baer: We are dealing with a project in Egypt right now where we are dealing with this logarithmic spiral. And I think we may find some things in the pyramid, because of just knowing the mathematics of this logarithmic spiral

which is the continuous analogue of the Fibonacci series, which is based on the whole thing of the pyramid and how it is laid out. To really understand the structure of some of these architectural structures in ancient Egypt you have to have an understanding of the mathematics.

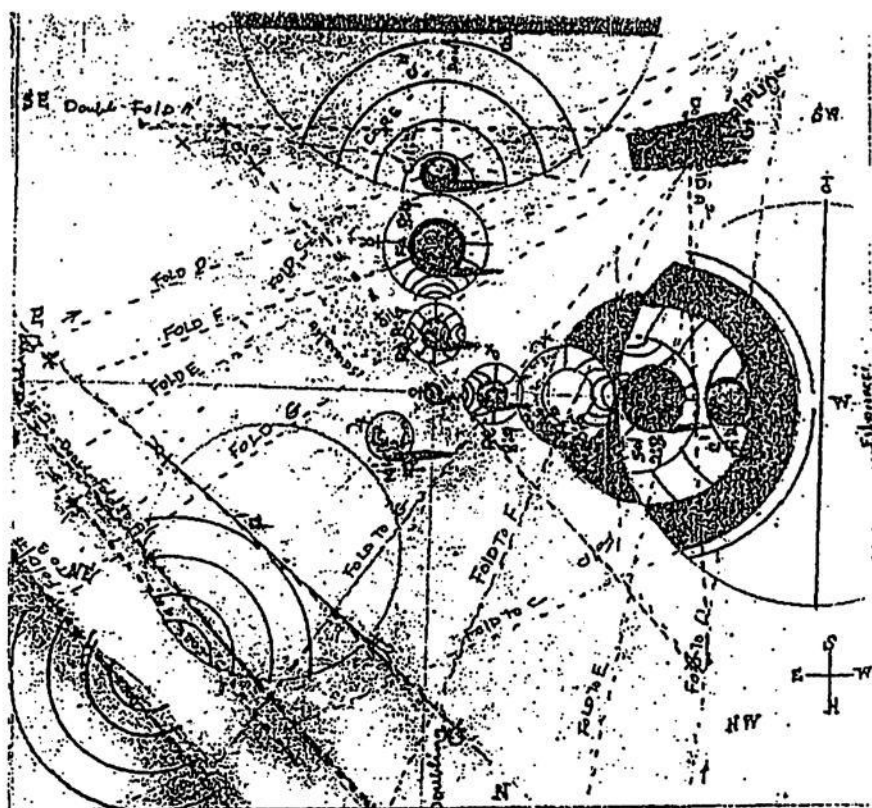
Barbara: Sun flower seeds and galaxies are based on this principle too. I think there is a correlation between that and music also.

Relative pitch and interval mean the same thing. It means that whatever you choose as a beginning frequency, all of those numbers in the matrix are related to one another in those specific proportions. The reciprocal of those frequencies represents the wavelength. In other words, that is another fascinating thing, in cycles per second you have a number such as "n" ($n/1$), then one divided by "n" ($1/n$) would be its inversion. They are both reciprocal of one another, wavelength and frequency, so you have a space / time continuum.

You see what the intervals are called. The beginning is called "the beginning tone", the next are tonic, semi-tone, minor tone, etc. These are in musical terminology. Then underneath is shown the colors related to the notes. In the mid-seventies I was also interested in pairing planets with the notes and numbers. So I had all of that going on at the same time. And I did that based on researching what certain writers had come up with in terms of which of the planets is related to certain musical notes. *(Two or three notes could be related to each of the planets based on their orbits around the sun, their spin, and the orbit of the solar system around its galaxy).*

Figure 12 is another way of trying to work out what things would look like if you doubled and halved and then folded and seeing what happens. This is all a discovery, a search and trying to understand. There is a mathematical basis for sound. I am trying to prove that.

Question: Are you saying that a wave can behave as a particle, or a particle as a wave?



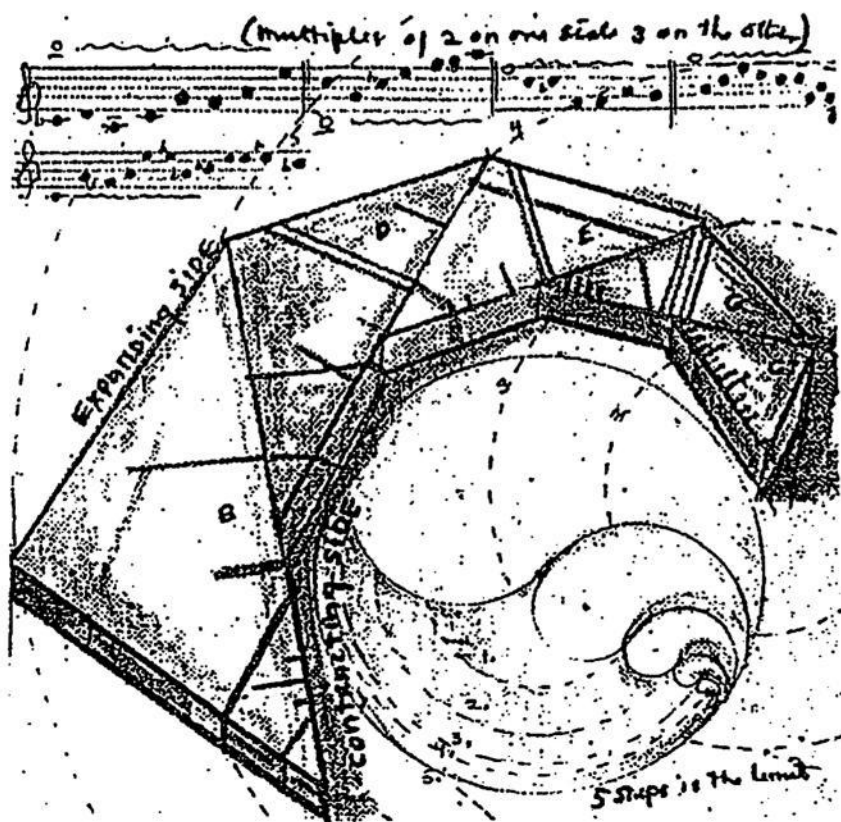
SPACE FOLDS

Figure 12

Barbara: That is something I am not qualified to answer.

Professor Baer: I am going to read you a passage after Barbara is finished today.

Barbara: These are triangles in this slide. (Figure 13) I tried to work out angles. This was in an art exhibition that I had and the Director wanted them explained.



UNIVERSAL LADDER OF SOUND

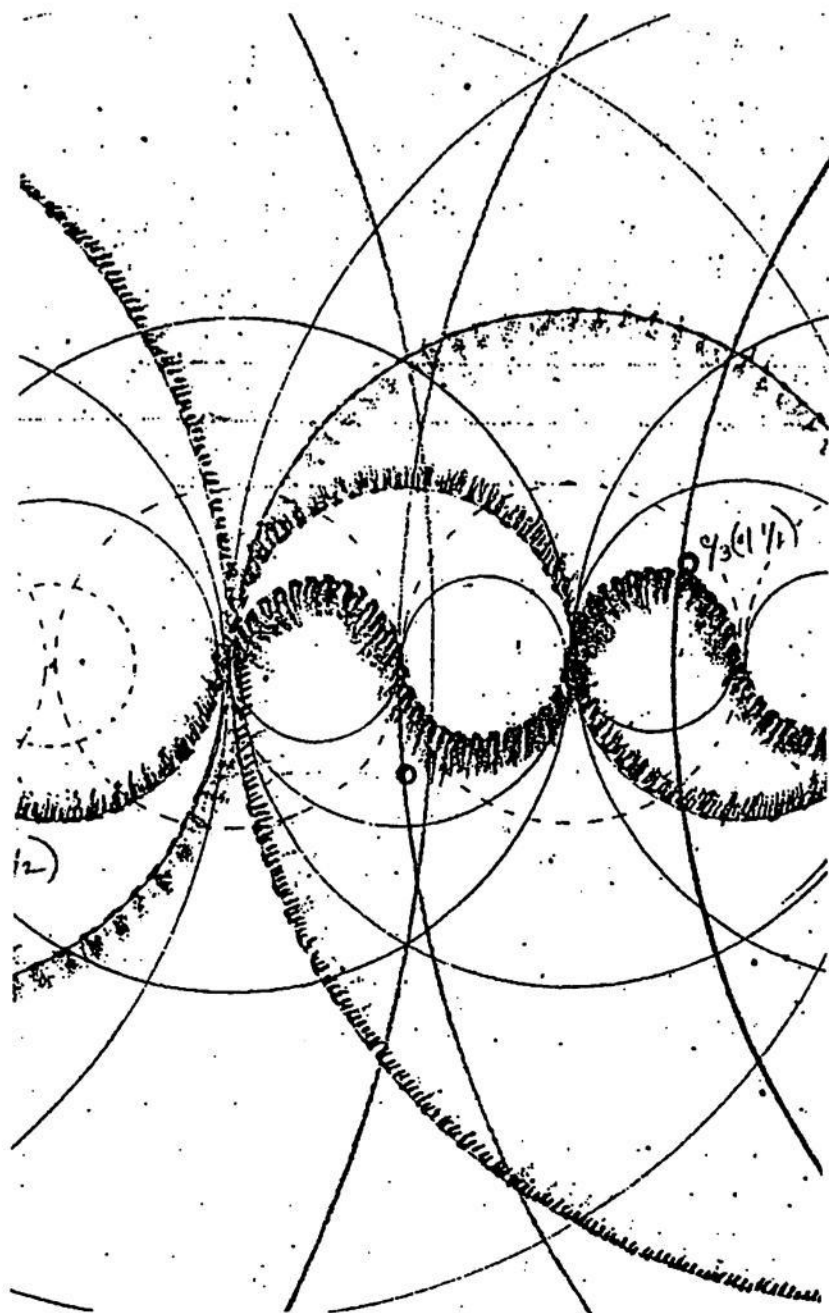
Figure 13

Professor Baer: Can you just pick a few that are some mainstream ideas.

Barbara: Figure 14 presents a way of dividing lengths based on a vibrating string, into different proportions.

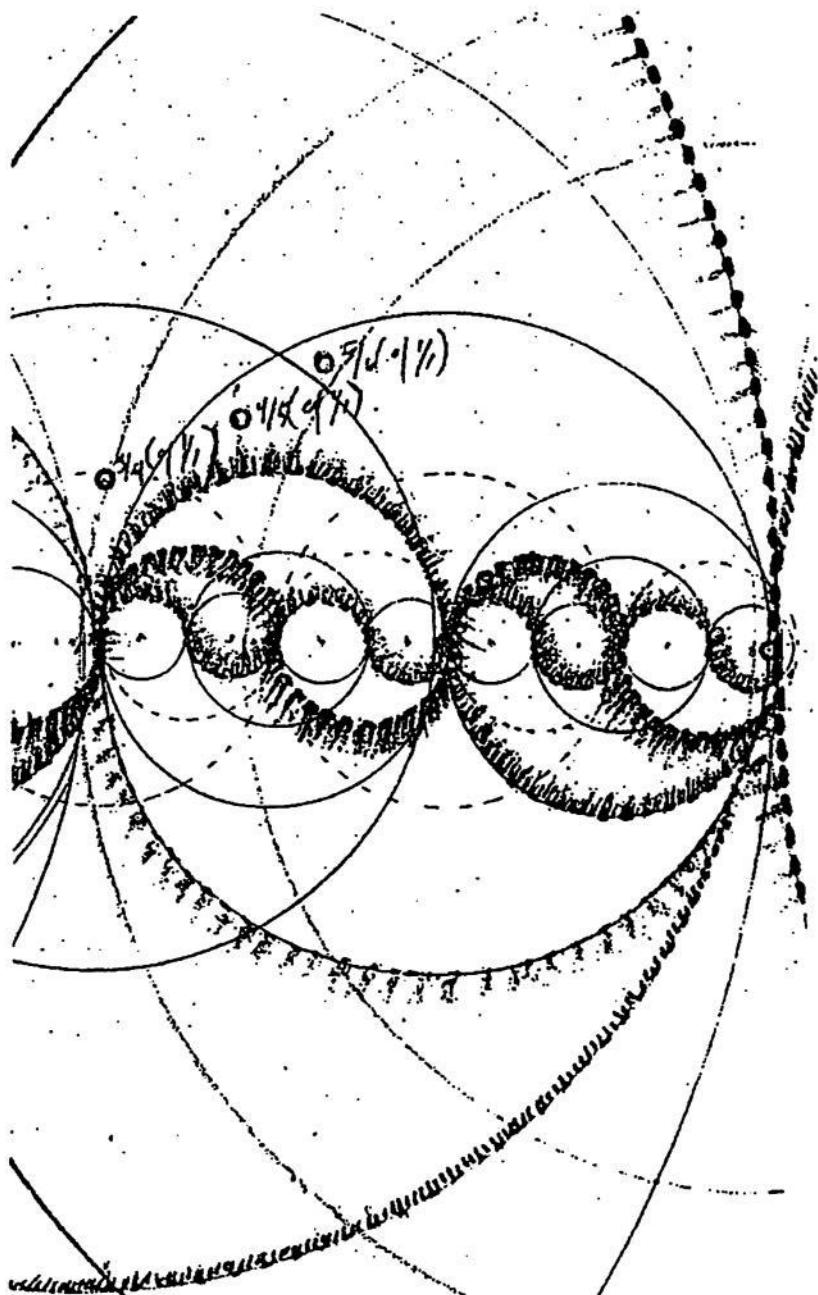
Professor Baer: Just a few more minutes and we will talk about things.

Barbara: Figure 15 is an illustration of taking lengths



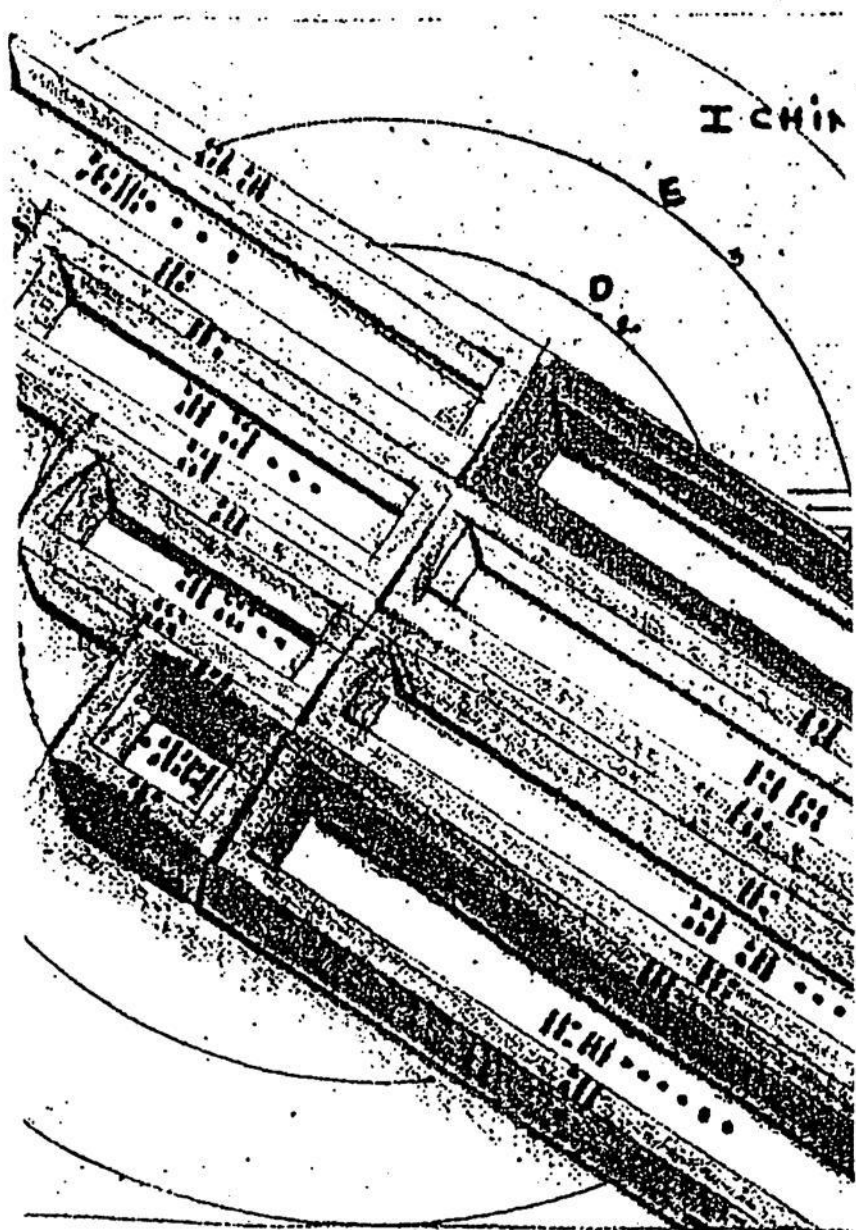
VIBRATING STRINGS

Figure 14A



VIBRATING STRINGS

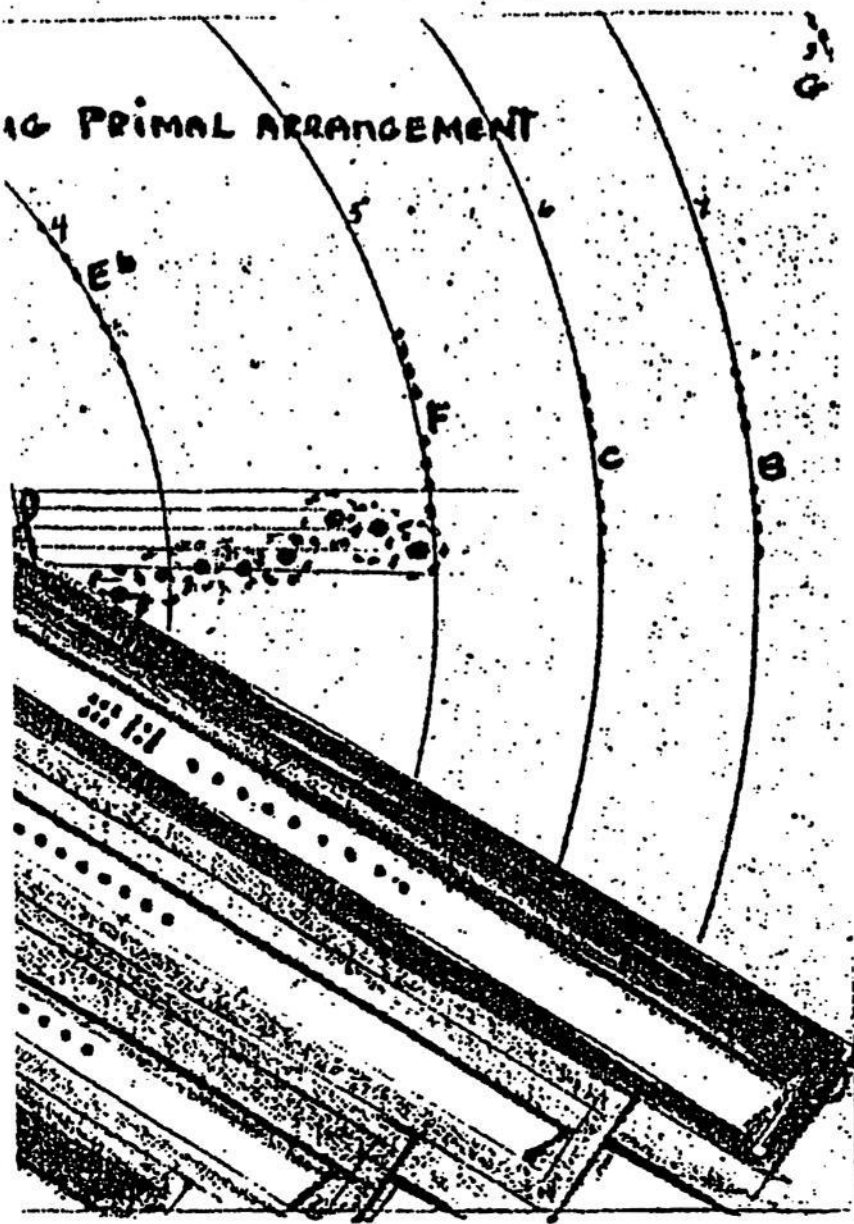
Figure 14B



I CHING PRIMAL ARRANGEMENT

Figure 15A

16 PRIMAL ARRANGEMENT



1 CHING PRIMAL ARRANGEMENT

Figure 15B

and cutting them into their musical proportions. Octave doublings of nine are always a second step of the scale in our music, so would always be the same color, orange, as is true with all other octave doublings of the other notes in the scale. I think this slide based on the "I Ching" shows that there are many roads to the understanding of musical correspondences. The Chinese had a color / note analogy that was almost the exact opposite of our Western one. With Pythagoras C was red. In China C was green. These are complementary colors.

Professor Baer: I would like to talk about some of the books that are listed here and some of the ideas that you are trying to say. I notice that some of the references are yours and some are from other sources. Can you say a few words about why you included "The Divine Proportion" [3], on your list?

Barbara: This book is called a study in mathematical beauty, and here is the Fibonacci spiral we were talking about. This book has so much on this golden section. And the golden section is something that is very related to music. For instance here is the Fibonacci series in fractions $1/2$, $2/3$, $3/5$, $5/8$, $8/13$, and $13/21$. If you generated these tones you would get first a beginning tone then an octave, then a fourth, then a minor third, then a third, and finally a minor third, while their inversions yield a beginning tone, an octave, a fifth, a sixth, a minor sixth and a sixth. The series would continue to get more stable and more finely tuned alternating between thirds and sixths. This is a very good book to tell you more about beauty in mathematics. It explains the golden rectangle as an 8 to 5 ratio. It is a valuable book, it is about beauty and proportion.

This is another book by Ernest McClain, called "The Myth of Invariance" [4], specifically on music and mathematics and comparative music from the Reg Veda, and the origin of the Gods. The person who wrote the introduction, Sigmond Levairie, is the person who wrote the book called "Tone: A Study in Musical Acoustics" [1] where I first found this Lambdome diagram. I think it is the only place where we can find the diagram, except from the Albert von Thimus' book [2]. (*"The Pythagorean Plato"*, by

McClain [5], is another in which the Lambdoma diagram is illustrated) There is obviously a communication between the people who are interested in music theory. These books illustrate all the different ways you can think about music. They even talk about the "Book of the Dead".

Professor Baer: How many have even heard of "The Book of the Dead"? I see that two of you have heard of this book. I want to share a quote, Barbara, which you will probably be fascinated with. I was browsing through a Quest Bookstore yesterday and picked up this. Quest is the Theosophical Society bookstore downtown, 122 Bay State Road. And the lead article is written by a theoretical chemist, who has very eminent credentials. And they are talking about our new understanding of the nature of cosmology, and relating it back to the ancient times, which is a subject we are going to be talking about on Thursday, the Tao of Physics. And there is a beautiful quote here which is relevant to what you have been saying. In 1925 De Broglie . . . how many do we have majoring in science here? Well you have heard of De Broglie I'm sure. And De Broglie in 1935 talked about the particle theory of the structure of nature and the sub-atomic particles, etc. He says De Broglie in about 1925 confirmed in a variety of ways experimentally. It now appears that behavior of the fundamental entities is characterized less by a particle-like and more by a wave-like nature. In other words to talk about the fundamental particles we do not talk about electrons and neutrons, positrons and neutrinos and all the other little particles, but it is much more important to talk about the wave-like nature of them. Here is the pay-off line. He says "And it is the harmonic relationships of these waves which determine the aspect and action of all that the universe contains. In a word, both the universe as a whole and we in particular are not matter, but music."

I think that is exactly what you are saying here. What does mathematics, or what does music have to do with anything we are talking about in this course. This is a very eminent theoretical chemist who seems to know what he is talking about, I think reflecting the modern cosmology of these thinkers saying that the universe is music.

The ancient Greeks, when they talked about the harmony of the spheres, were saying the same idea. How many of you have ever heard of that expression, the harmony of the spheres? It is not uncommon at the time of dying for people to hear the celestial music coming to them. Or, maybe sometimes if you take an LSD trip you might get it too, but that is a whole other story. And where does that sound come from. It is an inner sound, perhaps the way the brain is organized. The networking process within the brain is the key to that. There are two other little quotes here and then we will get back to something you are saying. We are going to be getting into great depth on this shortly. De Broglie is talking about the idea that sub-atomic particles do not exist in definite places. We like to think of the universe as a thing out there. He says there is no such thing as a sub-atomic particle at a definite place. Rather that they show tendencies to exist. In other words the universe shows tendencies to exist. It is not out there. This is a good eye-level physicist. He says these patterns furthermore do not represent probability of things but the probabilities of interconnections.

That is what Teilard de Chardin in his "Phenomenon of Man" was saying, that we are forming networks and that the network is the name of the game. It is not those objects out there but the network. He says sub-atomic physics have no meaning in isolation, or as isolated entities, but can only be understood as interconnections between the preparation of an experiment and its subsequent measurement. So that the only thing that has meaning is the interconnections.

The Rosicrucians have as their fundamental premise, when they are talking about the nature of things, that the universe was made in harmony and numbers. And that is their fundamental assumption of the ways things came about. So that in order to penetrate the meaning of the universe, it is not like tearing things out and looking at it as an anatomist, dissecting a body and saying here are positrons and neutrons and so on. But it is by seeing the potentials of relationships and the harmonics of these potentials that will let us get a glimpse of this. So I think an artist has a greater capacity to penetrate that perhaps than the analytical thinkers, who are trying to structure it in very focused ways.

Now Barbara, you have focused on the mathematics of this thing, were there any other books you would like to comment on before we get into that?

Barbara: There is a wonderful book on "Number, the Language of Science" by Tobias Dantzig [6], which is old, 1930.

Professor Baer: You know what Einstein said about that book, "Number, the Language of Science"? He said "It is the most important book I have every read."

Barbara: It puts the whole history of mathematics in perspective, and in a way you can understand, so you don't go along just picking up little things. You can put it all together.

Professor Baer: We have been talking about the word "number". Does anyone want to know what a number is? Give me a definition of a number. You have been using it all your life, right? What is a number? In the book of Dantzig, they say it is a class of all possible classes. I won't even bother translating that, but you can see the way they begin to talk about those things. I don't want to scare all you people into thinking you have to have a solid background in theoretical physics and all those things. I would call them lay people. They are just explorers in the nature of consciousness, probing very deeply into this, and they are picking up a lot of this without taking all of these formal courses. But I can not conceive of anyone understanding the nature of consciousness without seriously looking at some of the fundamental ideas of mathematics, and modern physics. Do you have any more comments on those books?

Barbara: There isn't very much in art that I know that has been done. There are some articles, the one's I did. I don't know if anyone would perhaps want copies of them? One of them is about the relationship of color and music, (about which I was invited to write a letter to the Editor of the Journal "Leonardo"). Another on Linear and Structural Patterns based on double entry multiplication tables, which referenced one of my articles in the same journal. This

Lambdoma diagram is a double entry multiplication table. This this the first article I wrote on the subject called "Paintings Based on Relative Pitch in Music" [7], an eight page article which covers a lot of ground. And then there is one on Lissajous figures, which is the basis of the video, which shows the array, and the patterns that these form, just in terms of their notes, and intervals and in terms of black squares, in terms of harmonics, the first, third, fifth, and seventh. It is really hard, when one is spanning so much in so many different disciplines, you can get only a feel for it. I hope you are all not hopelessly confused.

Professor Baer: A quote from Ram Das, "In order to understand the universe, you must learn to dance." To dance to music and it is a dancing process. On Thursday we are going to talk about another book called "The Dancing Woo Lee Masters". Has anyone ever heard of it? And it is exactly the same thing. So what Barbara is saying is that perhaps the music is the process in which the universe is formed, and in order to understand the thrust of that music we must learn to dance to that music.

Question: What about the Sufies?

Professor Baer: Oh, yes. Well, you see the Sufies have an understanding of that from a mystical experience. If you have ever watched the Sufies with their . . . in fact alot of the dances are logarithmic spirals. They go into a lot of those winding processes that are exactly a continuous form of the Fibonacci series. So there is that, and they say in some of those ancient civilizations including ancient Egypt they have ritualistic dancing which is sacred dancing. There are three forms of dancing, one is sacred and one is just fooling around sort of dancing. I think the other is spiritual or something. The sacred dancing is a way of penetrating the mysteries of the universe. So start dancing. Just don't sit there. Well, thank you Barbara for coming by today. It was nice of you.

I hope that you will all meditate on this. I am sure there were many problems that we had just communicating today. There are so many . . . just to find a common denominator. Maybe we have set you off balance, so that next few weeks

we can talk about some very heavy things. And some of the things we are going to talk about in the next few weeks are exactly what we have talked about today.

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TEACHING MATHEMATICS BY A CORRELATION OF THE STRUCTURES OF ART AND SOUND

*Paper presented at The Curriculum Theorizing Conference
c 1980*

INTRODUCTION

Mathematics has been one of the subjects to which many students have an admitted aversion. Some of the roots of the problem may be found in the rigid ways in which mathematics has traditionally been taught. The fear of failure can be instilled at an early age by inflexible rules.

The arts and music curricula, on the other hand, have long been considered fun, and especially in the case of the visual arts easy. When experimental use of art materials is encouraged, it leads to a creative play aspect of learning. And the rules are made up along the way by the player.

Because in this technological age we are truly illiterate without a basic understanding of mathematics, why can't mathematics be taught in conjunction with art and music. We will illustrate several ways of implementing this focus. First some basic structures in mathematics are examined and then some correspondences found in music and art.

In mathematics several structures can be analogous to both art and music such as properties of inversion, association, constants, balance, substitution, dependent and independent variables. It might be important for students to realize that most mathematical axioms upon which the foundation rests are unable to be proved. At the base of the

mountain upon which mathematics sits are laws as arbitrary as any musical composition or visual work of art. Once this is realized and illustrated and demonstrated, mathematics can become a creative game.

Some of the ways of linking art, mathematics and music are by the visual and aural principle of the vibrating string, patterns color-coded as to number or ratio, filling combined multiplication/division tables with colors, shapes and sounds.

Exercises using such links could lead to an ability to think not only abstractly, but by analogy. Leaps of analogy are creative, imaginative and fun.

Long ago in our past histories people seem to have had the ability to integrate the arts and sciences as one unifying discipline. We know there was a formula having one-to-one correspondences of the mathematical ratios to specific musical intervals. And before that Pythagoras, known mostly for his theorem of the sum of the squares of the sides of a triangle equaling the square of the hypotenuse, also coded ratios (fractions) into musical notes with their specific colors.

Most probably there was also a correspondence of design in two or three dimensions as well using the mathematics of musical harmonies as the basic structure.

It is my belief that it would be creatively stimulating for students to try to re-discover some of these early formulas. We know that ropes were used and knots tied at various intervals for construction of triangles with specific proportions such as the three, four, and five Pythagorean triangle. Because of these numbers used as ratios 3:4, 4:5, 3:5 or their reciprocals, we already have musical proportions of a musical fifth, sixth and third as steps on a familiar musical scale, with corresponding colors of blue, purple and yellow.

Color coding of whole numbers from one to sixteen and relating these to the harmonics of a vibrating string is an exercise full of discovery.

THE LAMBDOMA DIAGRAM AS A LINK TO NUMERICAL RATIO MUSIC AND COLOR

There is a formula which has resurfaced from the time of Pythagoras to our time known as the LAMBDOMA. [1, 2, 3] The Lambdome is a type of Rosetta stone which is a translation of mathematical ratios to musical intervals, or a translation of musical intervals to mathematical ratios. It is a type of anagram which arrives at the same solution horizontally as well as vertically. The solution is one of either musical interval (relationship of one note to another) in a scale or ratio (relationship of one number to another) in any proportional context. The Lambdome insures that an abstract numerical ratio can be applied to physical realities such as sound, or color or even shape.

The clarity of the structure of the Lambdome allows a student to make analogies of a mathematical or proportional nature with musical intervals of both harmonic and sub-harmonic structures. With a color-coding of this harmonic and sub-harmonic series a visual dimension adds further insights into the nature of what might be called a Law of the Vibration of Sound. [1, 2]

The early Greeks believed in a universal theory of number, almost a Divinity of number, where each number had certain Divine qualities.

The Lambdome diagram, lost for centuries, can help explain why these numerical ratios had different qualities when linked with their musical equivalents. Because we are aware of the emotional impact of music, it would be rewarding to discover that certain whole number ratios would also yield the same emotions when applied to architecture or other phenomena of a physical nature.

For example, taking the analogy further, stable numbers which would represent the note C (as multiples of two) or octaves, would be 1, 2, 4, 8, 16 . . . while varying ascending degrees of unstable numbers might be the numbers 3, 7, 9, 13, or 15. The latter series become increasingly dissonant musically on a harmonic series, whether they are whole

numbers or their reciprocals.

The full Lambdoma diagram is a 16 by 16 matrix, a combination multiplication division table, made up of only whole number ratios, which appear as nothing more than a matrix of familiar fractions. The rows multiply and the columns divide, or *visa versa* depending upon the quadrant used. I often color-code four quadrants in a two dimensional array. When four color-coded quadrants, according to the associated musical intervals, are joined in different ways patterns emerge that are visually as well as philosophically very thought provoking.

The idea of numbers eliciting emotional responses might prove an exciting thought to some students, especially those more geared towards the humanities. For those potentially interested in physics the analogies to quantum leaps of octaves, particle / wave theories, and applications of mathematics to other physical phenomena might be surprising. In any case the creative imagination could soar, as is what happens when working in an unknown territory whether it be a jungle, a new neighborhood, a new thought.

The mathematical properties of these musical intervals are dependent upon ratio alone, the relationship of one number to another by division. We have basically an X, Y axis. The symbol X/Y implies that X divides Y or *visa versa*. The table by its structure is always an odd divided by an even or *visa versa*, or multiples of odd and even numbers which then can be factored to more basic numbers. This factoring of multiples in itself reveals a very visible pattern of similar simple ratios.

We are all very familiar with the multiplication table. But a division table is one with which we are not familiar. The early Greeks assimilated a division table with a multiplication table. When a division table is combined with a multiplication table in the same set the result is a table of fractions, rational numbers which form a series of infinities, which either converge or diverge. What is then possible is that, in order to find a harmonic matrix of whatever scaler value is chosen whether that of sound or light, or distance, or time we then have a chart of all the harmonics (multiples)

and sub-harmonics (divisions) related to that scalar value. For example, we might choose 256 cycles per second to represent the note Middle C on the piano. 256 is the number we enter at the apex of the matrix with ratio 1:1. Then when the matrix is generated by its formula X/Y and its limits are set as a 16 by 16 matrix, then the musical notes of the matrix can be identified or actually sounded by an appropriate computer synthesized music program.

In higher mathematics this very table forms a closed set. That means that whatever is added, subtracted, multiplied or divided is found somewhere else in the table.

There are many more intriguing properties of the diagram waiting to be rediscovered by exploration and creative thinking about numbers.

Tobias Dantzig wrote in his book on the Theory of Numbers [4], a book, incidently, which Einstein mentioned as the greatest book on mathematics which he had read, "It is true that the statement of its problems (number) is so simple that even a child can understand what is at issue". He also wrote that correspondence and succession were the "two principles which permeate all mathematics-nay all realms of exact thought-are woven into into the very fabric of our number system." These two words correspondence and succession can be substituted for the words cardinal and ordinal. This is my example of making analogies. Let me explain, cardinal implies "how many" without any definition of the kind or quality, while ordinal implies the order or sequence of the number.

To make an analogy to music, for example "how many" would be analogous to the musical key of a piece, an A, B, C, D, E, F, G or as the Europeans acknowledge the sol-feggio; Do, Re, Mi, Fa, Sol, La, Si, Do, which makes it clear that Do can be any one of the seven letters or notes of the scale. The number seven is especially pertinent to music with the seven tones of a scale, and the corresponding seven colors of the rainbow. These seven notes and colors may be considered ordinal, a succession of tones linked with a corresponding succession of the colors red, orange, yellow, green blue, indigo and purple.

One of the earliest number systems is the Thimshian language of a British Columbia tribe where there are seven distinct sets of number words. One is for flat objects, one for round objects, one for long objects, one for floating objects, one for measurement, one for counting people, and one for counting not definite objects. Qualities are important in numbers and this is what could be the importance of linking number to musical intervals where qualities differ in such apparent ways.

Another primitive number system used in Africa and Australia is a binary system. [4] The succession of musical tones from Do to Do or C to C constitutes a binary system, a counting by 2. In music an octave is a doubling or halving, signifying an end of a cycle. A doubling signifying an octave overtone cycle, a halving signifying an octave undertone cycle. In musical sound there is always a cyclic system, where no matter how many intervals one puts between an octave, seven or twelve or as many as fifty two in an Indian scale, the cycle always returns with every doubling to its beginning note, higher in pitch in every succeeding octave. By halving the same note it always returns to the same note but lower in pitch in every succeeding octave. Therefore an octave forms a framework for a musical structure by doubling or halving.

We also have simultaneously the steps in a scale (ordinal) identified as the first, second, third up to the twelfth for example. At the eighth step we come to the do an octave higher, so that the ninth is really the second an octave higher, the tenth is really the third an octave higher, the eleventh is the fourth, and the twelfth is the fifth, both of the last two an octave above the original note.

Besides the steps of the scale we also have the sequence of the numerical ratios for each of the intervals found within the octave. * These sequences of ratios are based on

* The overtone sequence occurs in leaps from unison 1:1, to an octave 2:1, to a fifth 3:1, to another octave 4:1, then to a third 5:1, on to a fifth (an octave higher) 6:1, then to a seventh 7:1, and finally back to an octaves 8:1. It is not until this eighth harmonic that a recognizable scale enclosed in only one octave is found, or sounded. The scale then sounds

the principle of the vibrating string. It is believed that Pythagoras used huge ropes to identify the nodes or rest points represented by the successive divisions of the vibrating rope. The nodes are the overtone series. They represent the divisions of the rope into $1/2$, $1/3$, $1/4$, . . . $1/16$. Mathematicians call this the harmonic series. In music it is synonymous with the partials or overtone series. Harmonic = overtone = partials. An inversion of the series is what might be called an undertone series or sub-harmonic series. We think of these overtone numbers as whole number integers, whereas we consider their inversions as fractions. Fractions are synonymous with ratios or proportion. They are sometimes written as $X:Y$ as well as X/Y . This principle of ratio or fraction is one of the most important and perhaps least recognized factors connected with music theory. That this principle has implications that extend far beyond music into physics makes it a challenging subject. Since all matter, as we know it, is vibrating to different frequencies, each of these particular frequencies could be identified with its musical scale equivalent, and a quality of a numerical ratio could be determined by its musical equivalent. For the most part our mathematics has been dealing with the quantity rather than the quality of number. A concept of quality could open many doors to imaginative minds.

Now we might say that a quality of a series of ratios might be considered to consist of an overtone / undertone system, or a harmonic / sub-harmonic as mentioned above. The fact that every time a single sound is sounded a series of harmonics and sub-harmonics is present in its proper sequence. You may have heard these in a flute, or even the harmonics of a human voice.

Because the Lambdoma matrix is based on fractions, it

(If begun in the note C) the following:

C, D, Eb, F#, G, Ab, Bb, B & C.

This is a typical Lambdoma scale, very similar to the harmonic minor or Hungarian minor scale in the key of C:

C, D, Eb, F#, G, Ab, B & C.

provides an incentive to better understand the concept of fractions. Fractions have almost been eliminated from the curriculum in lower school mathematics classes and are on the *endangered species* list. This is a disadvantage when so much can be learned by identifying fractions of a certain kind with intervals in music of a specific frequency. Adding and subtracting, multiplying and dividing of these musical intervals in frequencies of cycles per second as the 1:1 entry yields surprising musical interval answers.

It was in the 1880's when the mathematician George Cantor caused a revolution in mathematics because of his bold attempt to classify the infinite series. One of his matrices on transfinite numbers is no less than the Lambdoma matrix without any of the equivalent one to one musical intervals notated. It has been years since his theories exploded on the scene, and the furor has not really died down yet. But there are more and more references to his work in the recent mathematics journals. Many mathematical methods of proof do not hold when applied to his matrix, and his matrix is the Lambdoma. It is a matrix which does not include the concept of zero.

THE CONCEPT OF ZERO

Dantzig wrote, about the concept of zero, "In the history of culture the discovery of zero will always stand out as one of the greatest single achievements of the human race. A great discovery! Yes, but, like so many other early discoveries which have profoundly affected the life of the race, not the reward of painstaking research, but a gift from blind chance".

Zero became a symbol for an empty column or row. Zero in the Lambdoma diagram is not a column but a point. It is not even a part of the matrix, but is the point at which the seven rays meet outside of the matrix. In the columns and rows there is no zero. There is no zero in music. The piano keyboard is an example of this. A note C on the piano keyboard goes up one step for a second, and down one step for a seventh. It goes up two steps for a third and down two steps for a sixth. It goes up four steps for a fourth and down

four steps to a fifth. These are known as inversions in music.

PROPERTIES OF INVERSION IN MATHEMATICS AND MUSIC

In mathematics inversions or reciprocals are likened to a number proportional to another or inversely proportional to another.

$$X = Y \text{ (Proportional)}$$

$$X = 1 / Y \text{ (Inversely Proportional)}$$

In music the mathematical ratio 2:3 is an inversion of 3:2, where 2:3 is a musical fourth and 3:2 is a musical fifth.

PROPERTIES OF CONSTANTS IN MATHEMATICS AND MUSIC

In mathematics a constant is a ratio or integer such as pi which retains the same value.

In music a constant is the same note of ratio 1:1, such as 256 cycles per second representing the unison of two notes (C) sounded together.

In the Lambdoma diagram this principle is illustrated by the ratios 1:1, 2:2, 3:3, . . . n:n. The constant in the case of the Lambdoma diagram becomes the hypotenuse of the square matrix, incidently at a degree of 45.

PROPERTIES OF BALANCE IN MATHEMATICS AND MUSIC

In mathematics an equation is a balance of number relationships.

One adds or subtracts or multiplies or divides, on each side, in order to solve the equation.

In musical sound, balance is a harmonious relationship of each sound to another. The overtone and undertone series represented by the Lambdoma is a harmonious balance of sounds in relationship to each other. When taking two sounds measured in numerical vibrations of cycles per second, they can be added, subtracted, multiplied or divided. The first two are called additive and subtractive synthesis in music. The results of these operations always yield a musical sound within the framework of the Lambdoma matrix of sounds.

PROPERTIES OF SUBSTITUTION IN MATHEMATICS AND MUSIC

In mathematics one can substitute one symbol representing a numerical value for another in order to solve an equation.

In music any note on the scale of any frequency can be substituted for another note on the scale, and the relationships of one note to the other will always be maintained, but in a different proportional order when using the Lambdoma matrix.

DOUBLING AND HALVING AS THE MATHEMATICS OF OCTAVES IN MUSIC

The Egyptians in ancient times multiplied and divided by doubling and halving. Even in the fifteenth century a process called *Duplation* used doubling for multiplication. Dantzig asks "Why did not classical Greece create an algebra?" [4]

The answer might be; "Wasn't the algebra of Musical symbolism inherent in the Pythagorean Lambdoma, which Pythagoras brought from the Egyptian temples?" The algebra of the Lambdoma deals exclusively with fractions or ratios. Our present day mathematics teaching seems to have focused on whole numbers rather than on the ratios of whole numbers. The process of derivation and integration in calculus is more of a mathematics of ratios.

One, two, four, eight and sixteen are doublings which

indicate the keynote of a matrix, and reveal jumps of four octaves within the matrix. Doublings of three, six and twelve indicate three octave jumps of the fifth step in the musical scale. Doublings of five, and ten indicate two octave jumps of the third step in the musical scale. While doublings of seven and fourteen indicate a jump of one octave in the musical scale. Eight, nine, ten, eleven, twelve, thirteen, fourteen and fifteen then form a musical scale within one octave only. This scale is what forms a Lambdoma scale which begins at the eighth harmonic. The same pattern of octave jumps is revealed in the halvings with the difference that the steps of the musical scale are in inverse order and descend rather than ascend. This is easy to see with a piano keyboard where C is the beginning note, as was described earlier.

PRIME NUMBERS IN MATHEMATICS AND IN MUSIC

Prime numbers have fascinated human kind, numbers that can only be divided by the number one and themselves. The prime numbers two, three, five, seven, eleven, and thirteen are all used in music. Nine and fifteen which are not prime numbers are also present in the Lambdoma matrix but they are the most dissonant intervals since they are too close to the beginning keynote, representing a whole step (nine) and a half step (fifteen). In the scale of C they represent a D (second) and a B (seventh). Prime numbers fall between the multiples of even numbers in an ever increasing scarcity. But even prime numbers would have a musical sound when generated audibly.

Pythagoras used only the integers two and three and their multiples, to create the scale that is usually attributed to him.

THE CONCEPT OF INFINITY IN MATHEMATICS AND MUSIC

The concept of infinity is a mathematical necessity. [4] However, one must set limits within the vast field of the infinitely large and the infinitely small. We must set a fixed

dimensional limit or scale for each property with which we are concerned. For example the scale we would use for a chemical or a biological dimension, would be vastly smaller than one used for an astronomical dimension.

In music, the limits would be set at our range of hearing. In cycles per second this would fall roughly within the range from 20 cycles per second to 20,000 cycles per second. The piano keyboard has a limit of 20 cycles per second to 5,000 cycles per second.

Also in music the overtone series which becomes increasingly higher and higher in frequency of pitch until it goes beyond the upper range of our hearing, would be considered to be going toward the infinitely small in wavelength, (a note of A of wavelength one inch would equal a frequency of 13,560 cycles per second). The undertone series, on the other hand, would become increasingly lower and lower in frequency of pitch until it goes toward the infinitely great in wavelength, (a note of A of wavelength of four thousand feet would equal a frequency of 0.2825 cycles per second).

THE CONCEPT OF SYMBOLS

The symbols used in Greek thought were the alphabet. The alphabet and number were linked and as we see from the Lambdoma matrix so was the musical interval linked to the number and alphabet. In higher mathematics the Greek alphabet is still used. In music the first seven letters of the alphabet are used to identify each note on a musical scale.

THE CONCEPT OF QUADRANTS

"The perpendicular axes separating a plane into four quadrants took three thousand years to discover, as the principle of position in numeration took five thousand years to discover", wrote Tobias Dantzig. [4] I would like to substitute the word rediscover for discover. The Pythagorean Lambdoma has a coordinate system probably adapted by Pythagoras from his sojourn in Egypt. As for position in

numeration, what could be more crystalline clear than a series of overtones (harmonics) in perfect harmony, or a cascading infinite series with every entry identified by its exact and specific and ordinal numerical ratio. Dantzig wrote that the coordinate principle is inherent in ancient fairy tales in terms of where to find the treasure. The treasure we and our children can find is inherent in the lambdoma diagram.

THE STRUCTURE OF VISUAL ART

One finds the structure of visual art, as one finds the structure of anything by breaking it into its constituent parts.

Color

Lets start with color. There are three basic colors made up of the primary colors red, blue and yellow, in pigment. The secondary colors are purple, green and orange. These are all made from the mixture of the primary colors with each other. There are also two colors which are independent magenta and aqua, and there is black and white. Black could be called indigo, a bluish black. Both Pythagoras and Isaac Newton color coded musical intervals with the same set of colors, red for C, orange for D, yellow for E, green for F, blue for G, indigo for A and purple for B. Therefor the primary and secondary colors and black (indigo) were used for the color coding.

Line

A line can be straight, as in a number line, or curved as in a circle. A line can be open or closed making an object or form. A line can be used as a radius for a circle, or for different parts of a triangle, rectangle, parallelogram or polygon. If a line is measured according to the proportions of harmonic musical interval relationships the proportions of every line segment would be harmonious, with respect to each other line. Thus can the laws of sound be expressed visually.

Dimension

In order to classify as a work of visual art an art object must have dimension. A matrix such as the Lambdoma has two dimensions just as a sheet of paper has two dimensions. The illusion of three dimensions depends on parallel lines and angles, shadings and an imaginary light source, varying sizes and a method of perspective.

Because the Lambdoma has two dimensions, any interval representing a musical note can be color coded or even the entire matrix can be color coded using the Pythagorean and Newton color code system. A child can do it. It means a child could assign any color to an interval and color each note on the matrix. This is an exercise in abstract reasoning and substitution, and might be a good practice exercise, but only if a student were interested in doing it.

Space

Space is another ingredient of art. When one puts a dot on a piece of paper one has created an illusion of object versus space. A color splash with another color perhaps complimentary or opposite on the color wheel also creates an illusion of figure ground. A closed line also can create the illusion of space enclosed, and it depends on the shading whether the line is a object or a hole in an object.

Infinity

How would one represent the idea of infinity in art? A repetition of pattern, or tessellation of tiling of object versus space such as the work of Escher suggests this illusion of the infinite. Now we discovered that the infinite series in the mathematics of the Lambdoma matrix is symbolized by the overtone / undertone series made up of multiplications and divisions. When this matrix is color-coded in four separate quadrants the repetitive patterns become an illusion of imploding or exploding space or forms.

Making own Rules, Breaking own Rules, Playing with Color, Line, Pattern and Space.

In the arts there is almost unlimited freedom to play with the separate elements making up art. One sets up one's own problems, solves them in ways which are unique and which no one else has done, and daydreams at the same time. No wonder it is fun, creating one's own structure. So lets play with mathematics.

CONCLUSION

It seems time that our children, in their schools, should enjoy the challenge of a *Rosetta Stone* of mathematics which equates fractions, to the wonderful sounds of an overtone and of an undertone series with all of their philosophical implications.

This is an exciting area for young minds to experience. The fact that it is coming not from traditional mathematics education as we know it but from our most ancient past, going back untold ages, adds a challenge, a sense of history. It is not beyond the reach of minds anxious to explore an unknown and forgotten territory. This creative exploratory aspect of the study of math could be used as a supplement to existing mathematics curricula, which might add a creative stimulus to those students who feel that they cannot handle the types of structures of a more traditional mathematical mode. And if these students are told that this matrix of relationships is from our most ancient past, they might try to understand some of the origins of this ancient system, and try to make analogies, rediscoveries, and apply the system to problems of multiplication, division, adding of integers in frequencies and rational numbers. This creative, exploratory approach to math might stimulate very original ideas. Not only by this system could they strive to understand the past, but they could also take any vibratory structure of the universe, from atoms to stars, and by a very simple process of octave expansion or reduction determine the sound of every known phenomena in the universe. This could include the sound from each planet revolving around the sun to the sound of the room in which they are working or playing.

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ABINATIO

*Presentation given as part of a three-day workshop in
Davenport, Iowa in December of 1984. **

I wish you to know, from this weekend, that we have access to everything we wish to know, not only by books or lectures or workshops but by meditation and channeling.

Channeling is "active meditation" rather than "passive meditation". When we go into meditation, it is just a quieting of our being. Sometimes, while in this state, we can see colors or we can hear high pitched sounds. For example, if we see an emerald green we are channeling from the heart center. If we hear a high pitched tone, and if we can identify this tone with a specific pitch we would know which of the seven centers we are operating from at that particular time.

The colors we see in meditation are much brighter and different than those we see with our eyes, and the sounds we hear are much higher in pitch than the sounds from a flute or violin.

So we become aware that sounds and colors are on many different planes ranging from the physical to the etheric. When we realize that we have access to etheric and other realms even while we are in our physical bodies, the revelation is awe inspiring.

It might help us to know that all of humanity now is in a process of transformation, a transformation of conscious-

* Sponsored by Bugsy Williams, founder of the "Abinatio" group.

ness. It is as though we are caterpillars becoming butterflies, after centuries of evolution.

I am here to share with you some methods by which you may become more aware of your abilities to go to the source, the center of being, through your clairvoyance, remembrance and the recognition of your oneness with all humanity and with the Creator.

Sound and color give us a good place to begin because these use two of the senses of which we are quite aware, on this level. But what is sound, really, and what is color and what is the difference between them? The difference is only our own tools of measurement, limited as they are.

Sound and color are like our bodies, sound is vibration which our physical sense picks up as a small window of 20 to 30,000 beats per second. If we defined sound by wavelength instead of frequency we would have a lower limit of 50 feet and an upper limit of a fraction of an inch. But the vibration we call sound in its sub-audible or lower limit is unknown to us. Just as the lower limit of light seems to be chemicals or heat, we can't perceive it with our limited senses until it falls within the range of our physical sight. The rods and cones in our eyes are our sensors or receivers. And the shell like form of the ear with its tiny hairs is another receiver. These are both only tiny windows to the spectrum which stretches from the infinitely small to the infinitely large. When we think of the other three senses, touch, taste and smell, these are only other windows to a vast universe without.

Some people are able to identify by touch different colors. Can you taste a color? Is a smell a color? There are seven sounds we recognize throughout the history of music, and seven colors we identify. Are there seven tastes, and seven smells and seven textures as well?

Philosophically, all of these might be to the mind of

God one continuum. In the greater reality we are not limited to just our five senses. We can travel from one end of the universe to the other in thought, and we can do this faster than the declared speed of light of 186,000 miles per second.

Sound can be measured in frequency or wavelength and is most usually measured in frequency. While color can be measured in frequency or wavelength but is most usually measured in wavelength.

There is a formula in physics:

$$v = f w$$

where: v = the speed of light (a constant)

f = frequency

w = wavelength.

But frequency and wavelength are inversely related, so that as one gets bigger the other gets smaller and vice versa.

We know that light travels fastest in a vacuum, while sound doesn't travel at all in a vacuum. Sound appears to travel faster through dense materials, and fastest of all in copper. Interesting, isn't it that we conduct electricity through copper? Is electricity sound by another name? Electricity is generated in this country at 60 cycles per second, this causes a 60 cycles per second hum which we all recognize as the buzzing sound coming from our refrigerators, computers, and other appliances.

Musically this hum is a B flat. It also happens to be one of the frequencies in the King's Chamber in the Great Pyramid at Giza in Egypt. The width of this chamber is just over 17 feet. Now this dimension can be translated into cycles per second by the formula:

$$v = f w$$

where v = the velocity of sound in air, at room temperature and is roughly 1,130 feet per second.

We are the only country in the world which generates current at this particular frequency. In Europe, and the mid-eastern countries it is generated at 50 cps which translates as the note G sharp (or A flat).

We will play some sounds recorded in the King's Chamber in March of this year, which will induce you into a meditative state. It is no accident that our country is resonating to this ancient sound. We are the new Atlantis, or the new Jerusalem. It is not by accident that we have incarnated here, in this country, at this time. We are all old souls, with just a little nudge needed to awaken us to our sacred memories of past lives. This is done especially through sound, and to a lesser extent through visual patterns.

Perhaps you will remember these sounds as if from a distant past, and you may recognize some of the patterns you will see. Therefore, just flow with these sounds and colors and patterns. I might point out a few things for you to remember.

We have access to etheric and other realms even while we are in our physical bodies and this revelation is awe inspiring.

It might help us to know that all of humanity now is in a process of transformation, a transformation of consciousness. It is as though we are caterpillars becoming butterflies, after centuries of evolution.

I am here to share with you some methods by which you may become more aware of your abilities to go to the source, the center of being, through your clairvoyance.

Since we began the slides with Pythagoras, and since all of the work I have done since the 1970's is based on one of

the diagrams attributed to him, which is called the Lambdoma Diagram, it would be beneficial to plunge deeper into his philosophies and theories.

This summer, when I was at Mount Shasta, California, Peter Caddy, one of the founders of Findhorn in Scotland, and Sir George Trevelyan, the father of new age education in Great Britain, both informed me that they believed that our present age is the age to which Pythagoras' philosophies were aimed. It is our age, it is we who can apply Pythagoras' teachings today.

Who was Pythagoras? He was an exceptional being, an initiate of the mystery school tradition, as was Jesus Christ, six hundred years later. The Delphic Oracle in Greece predicted to Pythagoras' mother that she would bear a child who would excel in grace and wisdom.

He was held in esteem as one who had come to earth to enlighten humankind. He believed that each individual has within, certain qualities which make it possible to become a divine being.

He began each day in silent meditation as it placed him in contact with constructive unseen forces. He believed that each of us must attain integration of soul, and he taught a way of life in keeping with our divine birthright. He taught that we must have a depth of commitment, insight, understanding and application of divine principles.

He taught the science of his time, of which the mathematics is still used in our pure and applied mathematics of today, known as the Pythagorean theorem, where for a right triangle the sum of the squares of the sides is equal to the square of the hypotenuse. He believed that religious insights need to be deepened, feelings need to be mastered, and souls need to be purified. He used symbols to instruct knowledge. He taught that true wisdom is discovered by looking inward, not outward.

He played the lyre to attune and maintain harmony within his body, as by music the negative passions were modified to produce health. He taught that one may become a part of the creative principles by relating to them with one's inner being. He recognized the constant interchange between the universe and the human.

About mathematics, he believed that mathematics was capable of abstracting the soul from the senses, and preparing it for intellectual and emotional ascension, and intuiting that which is inherent in Divine Mind. He claimed that the soul has it's own number and harmony.

He demonstrated these truths by numbers to which he gave certain qualities.

At tomorrow's workshop these principles, relating number to harmonies, will be discussed and demonstrated.

In order to give you a glimpse of this the following is a sample:

NUMBER	QUALITY	HARMONY
1. ODD	limited division	undertone
2. EVEN	unlimited multiplication	overtone
3. ONE & MANY	primes & factors	
4. LEFT & RIGHT	< 1 & > 1	lower & upper
5. MASCULINE & FEMININE	opposites	inverse relations x & $1/x$

6. REST & MOTION	stability & energy	octaves & 5ths
7. STRAIGHT & CROOKED	symmetry & asymmetry	2, 4, 6, 8 & 1, 3, 5, 7
8. LIGHT & DARK	high & low	> 1 & < 1
9. GOOD & EVIL	unity & duality	within matrix & without matrix
10. SQUARE & OBLONG	ratios	Lambdoma lissajous figures

Pythagoras taught that the essence of musical structure is that opposites are held together in harmony.

Therefore, tomorrow we will explore together Pythagoras' Lambdoma diagram, knowing that it can generate many from one, that it symbolizes the energy of the universe and that it generates seven rays.

We will show a method for finding a note and a color, through means of a calculator and meditation. So bring a calculator if you can.

We will explore the chakra, color, musical note, smell, taste, and touch correspondence.

We will test your reactions to sounds.

You will see the shapes of your own sounds, determine the frequency and the color.

Your tools will be an understanding of ratios, for an appreciation of proportion which can even be applied to forms

or dwellings and a harmonizing of your environment.

We will listen to the sounds made in the King's Chamber of the Great Pyramid in Giza, Egypt to re-awaken ancient memories.

"WHAT ONE OF US CAN DO EACH OF US CAN DO"
(Pythagoras)

PYTHAGORAS & NEWTON

AQUARIAN AGE

NOTE COLOR

NOTE	COLOR
A	PURPLE
B	INDIGO
C	RED
D	ORANGE
E	YELLOW
F	GREEN
G	BLUE

NOTE COLOR

NOTE	COLOR
A	ORANGE
B	YELLOW
C	GREEN
D	GREEN-BLUE
E	BLUE
F	PURPLE
G	MAGENTA

AQUARIAN AGE

RATIO	FREQ	COLOR	NOTE	CHAKRA	SMELL
1/1	440	Orange	A	Base	Burnt
2/1	880	Orange	A		
3/1	1320	Blue	E		
4/1	1760	Orange	A		
5/1	2200	Green	C#	Heart	Mint
6/1	2640	Blue	E		
7/1	3080	Magenta	G		
8/1	3520	Orange	A		
9/1	3960	Yellow	B	Sol-Plx	Lemon
10/1	4400	Green	C		
11/1	4840	Blue-Green	D	Throat	Fresh
12/1	5280	Blue	E		
13/1	5720	Purple	F	Pineal	
14/1	6160	Magenta	G	Crown	Lotus
15/1	6600	Red-Mag	G#		

WORKSHOP OUTLINE

COLOR AND SOUND

1. EXPLORE THE RELATIONSHIPS BETWEEN COLOR AND SOUND:

- A. The Window of Color
- B. The Window of Sound
- C. Limits of Our Senses
- D. Vibratory Nature of Matter
- E. How Sound is Measured and How Color is

Measured.

2. PATTERNS OF SOUND, AS TRANSLATED INTO VISUAL IMAGES:

A. Lambdoma Pattern

- 1) Ratios
- 2) Color-Coded (Color-Sound Correspondence)
- 3) Lissajous Shapes of Ratios as Demonstrated

by Laser

- 4) Generates Seven Rays
- 5) Three Dimensional Lambdoma
- 6) Egyptian Origin (Aprons?)
- 7) Lambdoma as Invisible Force on Differing

Forms

- 8) Lambdoma as Light in One Octave
- 9) Generates Many From One
- 10) Holds Opposites Together

3. HOW SOUND CAN HEAL:

- A. Sound Creates Shape
- B. Sound Has Energy
- C. Sound Heals on Emotional or Spiritual Level:
 - 1) Verification Through Prison Art Project and

Drug Rehabilitation Residents

D. Sound Heals on the Physical Level Through Changing the Structure of Matter.

4. PYTHAGORAS, HIS PHILOSOPHIES AND THEORIES:

- A. The New Pythagorean Age.
- B. Numbers, Music and Abstraction:
 - 1) Qualities of Numbers
 - 2) Numbers Directly Related to Music
 - 3) Music Directly Related to Ratio.
- C. The Soul, And Divinity Of Humans.

WORKSHOP SCHEDULE

10:00

MEDITATION (5 Minutes)

10:05

1. GET ACQUAINTED:

- A. "What do you hope to get out of the workshop?"
- B. "What is your expertise?" Share it with us
- C. "Any electronic buffs here?"

10:44

2. DEMONSTRATION OF SOUNDS THAT EFFECT US:

- A. Sounds that energize. (M.I.T. Experimental Music Studio)
- B. Sounds that make us feel like moving. (drums from "Sanctuary")
- C. Healing Sounds. (Iamblichus)
- D. Sounds that have a stretching feeling of micro-tonalities, 45 steps to the octave. (M.I.T. Second Set)
- E. A Water Wheel at an oasis in El Fayoum, Egypt
- F. Sounds from a pulsar (radio astronomy) like a heart beat.

11:30

**3. ANCIENT SOUND STRUCTURES BASED ON THE
MATHEMATICS OF PYTHAGORAS OR THE
LAMBDOMA:**

- A. Overhead projector; transparencies selection.

12:15 - 1:30

LUNCH

1:30

4. KING'S CHAMBER MUSIC:

- A. Write reactions, draw shapes, ask self, "what do the sounds look like?"

2:00

**5. DEMONSTRATE SHAPES WITH LASER AT SAME
TIME AS MUSIC IS PLAYING.**

3:00

6. FINDING ONE'S OWN SOUND:

- A. Discuss favorite colors
B. See if color is same or a complementary color.

4:00

7. WIND UP:

- A. What have they experienced, share it with others
B. Healing Circle
C. "Oum", the importance of the human voice.

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The Philosophical Research Society, Los Angeles,
California, 1970.

DISCOVERING YOUR OWN KEYNOTE AND ATTUNING THE CHAKRAS WITH SOUND

*Presented at the 1987 Conference of the
United States Psychotronics Association
with technical support by Robert Miller Foulkrod.*

We will tell you something of the history of how one can discover one's own keynote and possible ways of attuning the chakras by sound. The chakras represent different energy centers of the body which are generally acknowledged to have their own color as well as their own sound. We have been experimenting in various workshops throughout the country by having a person hum a note most comfortable to the person's voice. Then we identified that note by first having a signal generator and then a frequency counter which indicates the cycles per second of the note the person is humming. We have had people pick their favorite color and then see if the color matches the tone they sung. We then found that we could eliminate the signal generator and frequency counter and use a Casio keyboard set at a flute setting. The sound of a flute yields overtones or harmonics of a note better than a piano keyboard. We then used the laser / scanner projection system, that had been a part of our electronic gear, to produce the clear visual Lissajous figures characteristic of each interval in the musical scale. Because we have also worked with the notes which activate the chakra system, we could then identify the chakra by the note sung. It is the mathematical relationship of each of the notes to the fundamental note that create the perfect Lissajous figures which we could then identify.

Two years ago we were fortunate to have Dr. Steven Proskauer, a psychiatrist who was also a musician and a clear channel, live in our farm community. One day he

asked me if I knew the sounds of the specific chakras? I said if you know the colors you would also know the notes or intervals. So we worked with the colors red for the base of the spine where the kundalini energy lies, and we found that when we used the Law of Octaves by taking the frequency of 512 cycles per second and multiplying by two (n) number of times we reached the color green, a compliment of red, and a frequency measurement, not a wavelength measurement. From this I realized that color can be emitted (transmitted) or absorbed, and the colors then become complimentary and follow a system known as The Circle of Fifths in music. (See Table 1)

CIRCLE OF FIFTHS

C 1	D 2	E 3	F 4	G 5
Color, Absorbed: Red	Orange	Yellow	Green	Blue
Color, Transmitted: Green	Aqua	Blue	Violet	Magenta
G 1	A 2	B 3	C 4	D 5
Color; Absorbed: Blue	Indigo	Violet	Red	Orange
Color, Transmitted: Magenta	Orange	Yellow	Green	Aqua

Table 1

We concluded that colors and sounds can be both absorbing and transmitting and that since we knew the ratios or frequencies for the musical notes according to Pythagoras' Lambdoma Diagram we could then know the chakras identified with each of the sounds and colors.

Now the process by which we translate from sound to color or color to sound is known as the Law of Octaves. The Law of Octaves has been described by Ouspenski in "The Search for the Miraculous". Also what seems to be a description of the Lambdoma Diagram is also found in that work. Ouspenski was a disciple of Gurdjieff.

We will try to answer the following questions:

What is the Law of Octaves?

Where did the law come from?

Is it tied into some of the frequencies which determine the chakras?

How can we use this law?

The Law of Octaves is: Multiplying any frequency in cycles per second by 2 in order to reach its equivalent frequency in chemicals, heat or light; or dividing any of these frequencies by 2 in order to reach a frequency tending toward gravity.

Where did the Law of Octaves come from? The Russian philosopher Gurdjieff wrote about this law, and his student Ouspensky quoted Gurdjieff in his book called "A Search for the Miraculous". The following quotes are from that book.

Gurdjieff:

"In order better to understand the significance of the law of octaves it is necessary to have a clear idea of another property of vibrations, namely the so-called 'inner vibrations'. This means that within vibrations other vibrations proceed, and that every octave can be resolved into a great number of inner octaves". [This reflects the Lambdoma diagram where one triangular matrix includes the higher frequencies of smaller wavelengths (inner octaves) and the other triangular matrix includes the lower frequencies of longer wavelengths (outer octaves)].

"Each note of any octave can be regarded as an octave on another plane".

"If we study the manifestation of the Law of Octaves in vibrations of other kinds the laws are everywhere the same, and that light, heat, chemical, magnetic and other vibrations are subject to the same laws as sound vibrations."

"The laws which govern the retardation or the deflection of vibrations from their primary direction were known to ancient science. These laws were duly incorporated into a particular formula or diagram which has been preserved up to our times ... in the guise of this formula ideas of the octave have been handed down. ... in very remote times one of these (mystery) schools found that it was possible to apply this formula to music." [This formula describes the Lambdoma diagram when it was applied to music. Also acceleration versus retardation/deflection can be determined by adding frequencies in cycles/second when applied to the Lambdoma diagram when the ratios are coded in frequencies.]

"Between mi and fa the increase is retarded, between si and do the increase is retarded". [On the do, re, mi, fa, sol, la, si, do scale there is one half-tone between mi and fa and between si and do, whereas all of the others are whole tones.]

On the idea of "the increase is retarded", we substituted the concept of retardation and acceleration.

I decided to make an application of Gurdjieff's theory, of acceleration, retardation and stabilization, combined with whatever chakra frequencies were indicated, in the form of a table.

For example, when the frequency of the Base chakra is combined with the frequency of the Throat chakra does one feel vibrations in the Solar Plexus chakra? We have slides showing the visual mandalas created by this combination.

We will sing these two notes together to experience the result, and do the same for some other combinations such as the Throat and Solar Plexus. Do we feel the vibrations in the Heart chakra? Again the Base and the Solar Plexus

together might activate the Third Eye. The Throat and the Third Eye together might activate the recently discovered Psychic Center, which is an eighth chakra which we discovered because of a gap of 64 cycles per second in the frequencies between the Throat and the Crown chakras.

Because we used a recursive technique of adding each frequency to another and taking the result of the first and the second entry to establish the next frequency, we were able to establish whether the frequencies accelerated or retarded or stabilized, another one of Gurdjieff's theories. We also used the Law of Octaves for these calculations by putting each frequency in the range of the octave between middle C of 256 cps and the next higher C of 512 cps in order to see if the resultant frequency divided by two was either higher or lower than the first entry. If it was higher we determined that acceleration was taking place, if lower retardation, and less than 1 cycle per second difference would indicate stabilization.

Table 2 is an interpretation of Gurdjieff's words in the form of a chart.

Table 3 describes the frequencies of the chakras in cycles per second, the musical note, the transmitted colors, the reflected colors, the wavelength in inches and the possible shapes and ratios based on some of the ratios involved from the Lambdoma Diagram.

It would be interesting to check the connections between the chakras based upon an analogy to the colors transmitted versus reflected. The base chakra color green might be related to the reflected color green of the heart chakra.

The Lambdoma matrix is a large matrix of 16 x 16 columns and rows of whole number ratios. If one listens to a series of sound intervals, following row after row of such a Lambdoma matrix, it would send many frequencies into the body which would all be harmonically balanced because of the family of harmonic overtones involved.

ACCELERATION-RETARDATION-STABILIZATION OF SOME OF THE FREQUENCIES USED IN MUSIC, COMBINED WITH SOME OF THE CHAKRA FREQUENCIES

The laws of sum, difference, product and quotient do not hold but new laws are created.

RECURSIVE

MUSICAL FIFTHS TEND TOWARD MUSICAL THIRDS AND MUSICAL FOURTHS

The resultant acceleration or deceleration is relative to the first note of any pair.

BASE + THROAT -----> SOLAR PLEXUS

C 256 + G 384 = 640 > 640/2 = Eb 320 = acceleration (Eb is above C).

Note: The resultant of addition is found in all cases by octave reduction, that is by dividing by 2.

If one played these two frequencies together, would one feel it in the solar plexus chakra?

THROAT + SOLAR PLEXUS -----> HEART

G 384 + Eb 320 = 704 > 704/2 = F# 352 = retardation (F# is below G).

If one played these two frequencies together, would one feel it in the heart chakra?

Eb 320 + F# 352 = 672 > 672/2 = E+ 336 = acceleration (E+ is above Eb).

Range of Musical Fourths or Heart Chakra

F# 352 + E+ 336 = 688 > 688/2 = F+ 344 = retardation (F+ is below F#).

E+ 336 + F+ 344 = 680 > 680/2 = F 340 = acceleration (F is above E+).

F+ 344 + F 340 = 684 > 684/2 = F+ 342 = retardation (F+ is below F+).

F 340 + F+ 342 = 682 > 682/2 = F 341 = acceleration (341 is above 340).

F+ 342 + F 341 = 683 > 683/2 = F 341.5 = retardation (F is below F+).

Would the resultant frequencies in the range from 352 to 341.5 be part of the heart chakra? (Musicians often use 341.5 as F)

	Fund.	Musical	Musical	Musical	Musical		Musical	Musical
Note:	C	2nd	3rd	4th	5th		6th	7th
Chakra:	Base	Polarity	Solar	Heart	Throat	Psychic	3rd=Eye	Crown
Frequency:	256	288	230	352	384	416	448	480

Table 2A

THIRDS TEND TOWARD SECONDS

BASE + SOLAR PLEXUS -----> POLARITY

C 256 + Eb 320 = 576 ---> $576/2 = D\ 288$ = acceleration

If one played these two notes together, would one feel it in the polarity chakra?

Eb 320 + D 288 = 608 ---> $608/2 = D + 304$ = retardationD 288 + D + 304 = 592 ---> $592/2 = D + 296$ = accelerationD + 304 + D + 296 = 600 ---> $600/2 = D + 300$ = retardation

Would 288 to 300 be the musical range of the polarity chakra?

OCTAVES TEND TOWARD MINOR SIXTHS

C 256 + C 512 = 768 ---> $768/2 = G\ 386$ = acceleration

BASE + THROAT -----> THIRD EYE

C 512 + G 384 = 896 ---> $896/2 = A + 448$ = retardation

If one played these two frequencies together, would one feel it in the third eye chakra?

THROAT + THIRD EYE -----> PSYCHIC CENTER

G 384 + A + 448 = 832 ---> $832/2 = Ab\ 416$ = acceleration

If one played these two frequencies together, would one feel it in the psychic center chakra?

A 448 + Ab 416 = 864 ---> $864/2 = A - 432$ = retardationAb 416 + A - 432 = 848 ---> $848/2 = Ab\ 424$ = accelerationA 432 + Ab 424 = 856 ---> $856/2 = Ab\ 428$ = retardationA 424 + Ab 428 = 852 ---> $852/2 = Ab\ 426$ = accelerationAb 428 + Ab 426 = 854 ---> $854/2 = Ab\ 427$ = retardationAb 426 + Ab 427 = 853 ---> $853/2 = Ab\ 426.5$ = acceleration

Where:

- b indicates a flatted note
- indicates a slightly flatted note
- # indicates a sharped note
- + indicates a slightly sharped note

Note: The Lambdoma scale that we use is: C = 256, D = 288, E = 320, F = 352, G = 384, Ab = 416, A = 448 and B = 480 in cycles/second or Hertz.

Table 2B

Chakra	Frequency	Note	Color	Color (Transmitted)	Wavelength (Reflected)	Shape	Ratio
Base	512	C	Green	Red	26"~27" *	Circle	1/1
Lower Abdomin	576	D	Green-Blue	Orange	23"~24"	Square	9/8
Solar Plexus	640	E	Blue-Violet	Yellow	21"~22"	Circle~Square	5/4
Heart	704	F	Purple-Indigo	Green	19"~20"	Square	11/8
Throat	768	G	Magenta-Red	Blue	17"~18"	Butterfly	3/2
Psychic Center	832	Ab~A	Red-Orange	Green-Blue	16"~17"	Square	13/8
Third Eye	896	A~Bb	Red-Orange	Purple	15"~16"	Square	7/4
Crown	960	Bb~B	Orange-Yellow	Indigo	14"~15"	Square	15/8

SUBTLE BODIES

First	1024	B~C	Yellow-Green	Pink	13"~14"
Second	1152	D~Eb	Green-Blue	Peach	11"~12"
Third	1280	E	Blue-Violet	Pale-Yellow	10"~11"
Fourth	1408	F~G	Pale-Magenta~ Violet	Green-Blue	9"~10"
Fifth	1536	G~A	Peach~ Pale-Magenta	Green-Blue	8"~9"

Table 3

ON ALPHA, BETA, THETA, AND DELTA WAVES AND THE CHAKRA SYSTEM

We take the frequencies from C = 256cps to C = 512cps which we have established as to optimum frequencies representing the eight musical intervals on a Lambdoma musical scale. The ratios are 1:1 for 64cps, 9:8 for 288cps, 10:8 for 320cps, 11:8 for 352cps, 12:8 for 384cps, 13:8 for 416cps, 14:8 for 448cps, and 15:8 for 480cps. These represent the musical notes C, D, E-, F+, G, Ab, A+ & B. They also represent the lower octaves of the eight chakra system.

Another chart (Table 4) using the Law Of Octaves takes the chakra system and compares the frequencies to the

* Read 26"~27" as *between* 26 and 27 inches and Ab~A as *between* Ab and A.

Alpha, Beta, Theta and Delta waves. The results of this chart show that within the Alpha waves (8 - 13cps) representing the edge of sleep, creativity and relaxation, we found all the chakras represented except the Crown chakra. The Theta waves (4 - 7cps) show no Crown, Polarity, or Heart chakras. The deep sleeping or Delta waves (.16 - .5) would seem to represent ratios or fractions which fit in well with the Lambdoma theory.

ALPHA WAVES: 8 - 13 CYCLES PER SECOND

Alpha waves represent the edge of sleep, creativity, and relaxation. By taking these cycles and raising them to the middle C octave we find that we have the following intervals included:

Number of Cycles	Chakra & Frequency	Musical Note	Colors Reflected	Colors Transmitted
	BASE			
8	256	C	Red	Green
	POLARITY			
9	288	D	Orange	Blue-Green
	SOLAR PLEXUS			
10	320	Eb	Yellow	Blue
	HEART			
11	352	F#	Green-Blue	Lavendar
	THROAT			
12	384	Gb	Blue	Magenta
	PSYCHIC CENTER			
13	416	Ab	Indigo	Orange

Note: there is no B musical note in this series from 8 to 13 cps, and there is no Crown Chakra in this series.

THETA WAVES: 4 - 7 CYCLES PER SECOND

	BASE			
4	256	C	Red	Green
	SOLAR PLEXUS			
5	320	Eb	Yellow-Orange	Green-Blue
	THROAT			
6	384	G	Blue	Magenta
	THIRD EYE			
7	448	A	Purple	Orange-Yellow

Note: there is no B, D or F musical note in this series. There is no Crown, Polarity, or Heart in this series from 4 to 7 cps.

Table 4A

DELTA WAVES: DEEP SLEEPING: 0.5 - 1.5 CYCLES PER SECOND

	BASE			
0.5	256	C	Red	Green
0.6	307.2	D#	Orange-Yellow	Blue
0.7	358.4	F#	Green-Blue	Magenta
0.8	409.6	G#	Green-Blue	Lavendar
0.9	460.8	A#	Purple	Yellow
1.0	512	C	Red	Green
1.1	563	D	Orange	Green-Blue
1.2	614.4	D#	Yellow-Orange	Green-Blue
1.3	665.6	E	Yellow	Blue
1.4	716.8	F+	Blue-Green	Magenta-Violet
1.5	768	G	Blue	Magenta
1.6	819.2	G#	Blue-Lavendar	Peach

BETA WAVES: 14 - 30 CYCLES PER SECOND

THIRD EYE				
14	448	A	Purple	Yellow
CROWN				
15	480	B	Blue-Purple	Yellow-Orange
BASE				
16	256	C	Red	Green
17	272	Db	Red-Orange	Green-Blue
POLARITY				
18	288	D	Orange	Green-Blue
19	304	D#	Orange-Yellow	Blue
SOLAR PLEXUS				
20	320	Eb	Yellow	Blue
21	336	E~F	Yellow-Green	Lavendar
HEART				
22	352	F#	Green	Lavendar
23	368	Gb	Green-Blue	Magenta
THROAT				
24	384	Gg	Blue	Magenta-Violet
25	400	G#	Blue-Violet	Peach
PSYCHIC CENTER				
26	416	Ab	Blue-Violet	Orange-Magenta
27	432	A-	Violet	Orange-Peach
THIRD EYE				
28	448	A+	Indigo	Yellow-Orange
29	464	Bb	Purple	Yellow-Orange
CROWN				
30	480	B	Purple	Yellow

Note: there are sixteen intervals within this octave, and all of the eight Chakras are in this series from 14 to 29 cps.

Table 4B

For example .5 or $1/2$ represents the Base chakra at C, and .16 represents $8/5$ or a Fibonacci ratio, and a musical note of G#/Ab. The Beta waves (14 - 30) which are the waves we use to read or do mental work have all of the chakras included in this series. We might conclude that all of the chakras must be functioning in order to do mental work.

Finally we made a chart (Table 5) showing some simple algebraic formulas for intervals in music. We included their shape, color (both transmitted and reflected or absorbed), their frequency in cps, their wavelength in feet, some mathematical insights such as the Base chakra is red or green, it is a harmonic mean, and a parabola or an infinity symbol. The Throat chakra is an arithmetic mean, and a circle in a square, and a rose and blue green color. The Third Eye is roughly a Fibonacci ratio of $5/3$. The Polarity chakra is a square of color blue green or peach. The Throat chakra is also a diamond shape with two pyramids on each side with a color of peach blossom and sky blue.

In music an interval between 1 and 2 comprises an entire octave. This means that we are dealing with ratios of whole numbers.

2:1 is an octave above the fundamental and 1:2 is an octave below the fundamental.

Therefore let us let: $a = 1$ and $b = 2$

Where a = the beginning of the musical number line of the first octave.

Where b = the end of the musical number line of the first octave.

We have shown how the chakra system can be linked to musical intervals by the Law of Octaves and that the chakra system is automatically linked to color, both absorbed and reflected. We have shown that the circle of fifths in music is linked to complementary colors. We have experimented with Gurdjieff's theories of acceleration and retardation by using a mathematical recursive technique to

MUSICAL OCTAVE NUMBER LINE

PART ONE

Formula	2a-b	a/b	ab/2b-a	4ab/(a+b) ²	a/b ² +ab/3b-a	2ab/a+b	
Ratio	0	1/2	2/3	8/9	1/1	6/5	4/3
Interval *		C	F	B	C	E	F
Shape †		figure eight	fish	square network	circle	folded arms	heart
Color (transmitted)		green	indigo	yellow	green	blue	indigo
Color (reflected)		red	green	violet	red	yellow	green
Frequency (cps)		128	171	228	256	307	341
Wavelength ‡		8.8ft	6.6ft	4ft-10in	4ft-4in	3ft-7in	3ft-4in
Mathematical Insights							Harmonic Mean
Chakras					Base		

PART TWO

Formula	$\sqrt{ab}$	$a+b/2a$	$2b+a/a+b$	b	$(a+b)^2/4ab$
Ratio	1.4 or 7/5	3/2	5/3	2/1	9/8
Interval	Gb	G	A	C	D
Shape	Square	Circle in Square	Square	Parabolla	Square
Color (transmitted)	Magenta Violet	Rose	Peach	Light- Green	Blue- Green

Table 5A

* Musical interval related to octave of Middle C.

† See Lissajous Lambdoma chart (Figure 3, on pages 42 and 43).

‡ Based on the speed of sound in air (1129 feet per second).

Color (reflected)	Green-Blue	Blue-Green	Violet	Rose	Peach
Frequency (cps)	358	384	427	512	288
Wavelength	3.2	2.9	2.7	2.2	3.9
Mathematical Insights	Geometric Mean	Arithmetic Mean (Fibonacci Ratio)	Golden Mean		
Chakras		Throat		Base	Polarity

PART THREE

Formula	$2b-a$	b^2/a	$ab/2a-b$
Ratio	3/1	4/1	2/0 (Infinity)
Interval	G	C	There is no note. It is outside of the Lambdoma matrix.
Shape	Diamond with two pyramids on each side	W (a letter of the alphabet)	There is no shape.
Color (transmitted)	Peach Blossom	Pale Green	White or Black
Color (reflected)	Sky Blue	Pale Rose	Black or White
Frequency	768cps	1024cps	Zero or Infinite
Wavelength	1.5ft	1.1ft	Infinite or Zero
Chakras	Throat	Base	

Table 5b

find a correspondence of how two chakras might relate to a third chakra, as well as finding a range of notes which might apply to a designated note on a musical scale. We experientially examined how sounds, which theoretically accelerate or retard, feel to an audience when played. We also studied a chart relating musical notes to particular organs of the body as well as materials with which we surround ourselves. We also related these to the chakra system. We played notes which represent the alpha, theta, delta, and beta systems, and related these notes to the chakra system as well. Finally we cited some mathematical insights to the music of the chakras. In short it is in having the exact mathematical ratios, and/or frequencies which enable us to make correspondences all because of the Law of Octaves combined with our long study of the Lambdoma Matrix which makes it all possible.

In conclusion, by having a framework of exact frequency, or ratio, or color, or musical note, we can relate such things as a chakra system and make analogies which might be helpful in the understanding of our oneness with all things.

DRUG FREE ART

Presentation given at the 1986 conference of the United States Psychotronics Association.

INTRODUCTION

We will depict how residents in a drug rehabilitation community have a "space" to relax and try out their creative ideas via art. We will present a theory of how sounds can create this atmosphere of creativity. The application of the theory is illustrated by the art work and by the written expression of the residents feelings about themselves and their art work, and how the sounds affected their responses. We will discuss the nature of the drug community, its philosophy, the origin of its name, its benefits to the individual and to the community, and the methods of teaching in the Art Workshop. We will present speculations on why the emotional responses are unlocked by our methods. We will show how the philosophy in the poem, representing the philosophy of The Third Nail drug rehabilitation community, is reflected in the art work of its residents and in the comments they write about their own work. These comments deal with change, energy, being, knowing self, ending fears, spirit growing, mind growing, body growing, loving self and sharing this love.

We will present some personal theories about how the sounds produce their effects of achieving transpersonal (cosmic) states, and how the results relieve depression, and how they release both negative and positive reactions.

A DRUG REHABILITATION THERAPEUTIC COMMUNITY

The Third Nail is a drug rehabilitation therapeutic community. The program's purpose is to help men and women become and remain drug free. Our family / community is based on mutual aid and the concept of self help and of helping others to help themselves. Our residential and out patient services are located in Jamaica Plain in the Boston area. People seeking help come directly to our door or call a 24 hour help line.

OUR PHILOSOPHY: A POEM

I believe in change at last,
From my scornful, self-destructive past,
To energy flowing and feeling free,
To being the person I can be,
To knowing myself and how I feel,
To end my fears of becoming real.

Living here, I learn, I grow.
I feel my spirit, mind and body flow.
I love myself and the freedom it brings,
I share this love with all human beings.

THE NAME: "THE THIRD NAIL"

The name has several meanings. It is analogous to the third nail in Christ's crucifixion in that the junkie nails himself to his own cross with a hypodermic needle. When most people come to The Third Nail, it looks to them like the end of the line. What they find here is a rebirth, a "resurrection", not necessarily religious, but one whose primary values are honesty, responsibility, respect, and sharing values which lead many people to new lives.

In addition, The Third Nail was the third drug program in Roxbury. Some people say that the first nail is drugs, the second nail is police, courts and other forms of trouble, and

The Third Nail is the first "nail" to give them a real chance.

Another interpretation is that the "third" part of any equation is the meaningful one, signified by triangles, trinities, and triads in cultures throughout the world.

HARD WORK

The program is housed in an old school building. It is home for the residents and they are family to each other. Their task is to manage their home with pride and quality. Cardinal rules of the house are: "No drugs or alcohol, no violence or threats of violence, and no sexual activity." Violation of the Cardinal rules can result in expulsion.

The four phases of the residential program (orientation, treatment, transition, and re-entry) include group counseling, individual counseling, marathons, and a work program which teaches skills and responsible work habits through a system of earned privileges. An education program prepares residents, who have not completed high school, for their G.E.D. exam. Before leaving the program, usually after nine months to a year, residents must have secured a job and / or enrolled in school, located housing, opened a savings account, and begun developing a positive social network.

BENEFITS TO THE INDIVIDUAL

Residents continue with our Aftercare Unit which includes weekly groups, counseling and urine screens for four months. Following this, they are eligible for graduation. Successful completion of treatment and aftercare enables residents to become and remain drug free. Through the program, they are also able to resolve drug related problems including family issues, legal entanglements, education and vocation limitations.

BENEFITS TO THE COMMUNITY

Treatment not only supports individual recovery but ac-

tually stops crime. The average drug addict needs about \$100.00 a day to buy drugs, so is likely to commit two crimes per day. With 30 people in treatment, the program prevents some 60 crimes per day, a saving of \$6,000 in criminal gain daily. Of those who complete treatment and become drug free, many dedicate themselves to the struggle to end drug abuse.

STAFF

The Third Nail staff includes both professionals and recovered drug addicts. Several are graduates of the Third Nail. There is a treatment staff, a Court Liaison, a Vocational / Educational specialist, a Family Specialist, a Psychological Consultant, and an Art Therapist.

I have been a member of the staff for six years, holding a two-hour workshop once each week. This workshop is designed mostly for residents in the first phase of the program, the Orientation phase. Often a new resident has been there only hours before the Art Workshop. Needless to say he or she may be quite disoriented, often suffering withdrawal symptoms which are physically painful. In these cases, the resident often prefers to just sit and not actively participate in the workshop. Often, however, when seeing the others absorbed in their drawings the new resident may decide to "Give it a try".

THE PHYSICAL SPACE

The physical "space" where the Art Workshop is held is in the house's dining room. It is a large room approximately 60 by 30 feet with high ceilings. The walls are covered with the work of the residents, three or four drawings high. Each week I also draw sketches of the residents in profile, with a brown pastel stick, and then ask each one, "What specific rainbow color of aura surrounds you today?" The colors they choose vary from yellows, greens, blues, purples, reds, oranges, to grey, white and black, and sometimes multi-colored. Then I color the space around each profile. Often when they finish their drawings they will walk around the room looking at the work others have produced, as well as

those "thumbnail" sketches on the walls.

The dining room has good "vibrations". It is a place to eat, to smoke, to talk and to relax. The configuration of the tables and the chairs changes periodically. Sometimes they are broken up into a table with four or five chairs in different parts of the room similar to a restaurant seating arrangement. At present the tables and chairs are in the shape of an open ended square, with the residents seated on both sides of the tables. The number of residents varies from week to week. A full art workshop can number as many as 18 persons, or as few as two or three.

PSYCHOLOGICAL SPACE

The psychological "space" that is created at the art workshop adds the other dimension to the harmonically related sounds that are played. The room itself acts almost as an acoustic chamber. It is this added dimension of sound which seems to act as a catalytic agent which helps release the emotions and the creativity on a subconscious level. The residents seem to attune themselves to their inner being. They are still, and they are concentrating, trying to draw, "What they think the sounds might look like." I exert very little authority, with the exception of asking the new residents to fill out a form releasing the use of the photographs of their art and their comments, and asking them to choose three or four colors and take a sheet of paper. I then simply walk around, doing the sketches and sometimes offering encouragement as to the progress of the work, but often not even that.

Since my function is to lead an art workshop, I do not deal with any of the issues a counselor might have to face. For example, I do not know the crimes or reasons for the residents being in the program. I deal with each one basically as an individual who might benefit from an art workshop in terms of getting feeling out on paper in symbols or in words, and providing a space of freedom from pressure and a feeling of relaxation.

The most usual comment of a new resident is, "I can't

draw." I point in the direction of the walls and say, "That is what they all say when they first come here."

METHOD OF TEACHING

Often the residents have not experienced any art in school, in which case they seem to need to progress through a kindergarten style, which they do in about 10 minutes. Then I say, "Try another." The next is usually more sophisticated so I can say, "You see, you have progressed from kindergarten to third grade in a few minutes."

I usually encourage the new residents to use pastel instead of magic markers and explain that they can create almost instant art in a short period of two hours with this medium. Later they may like to use thin markers with templates which are either circular or square, and enable them to create designs in a "constructivist" style.

If the resident has had little or no art in school, the result is often stick figures, and a primitive style. Often the last work of the day exhibits a sophisticated, abstract art style.

Another thing I explain is that I take photographic slides of the best art work for either exhibition purposes, or for lectures on "Drug Free Art". The original art work is photographically reduced and when it is enlarged in a color xerographic print, all the imperfections are minimized, and the style looks more professional. The ideas are accentuated, and the colors and compositions stand out in a polished perfected style.

THE NATURE OF THE SOUNDS USED

The sounds used vary from works created on a Moog and Minimoog Synthesizer from Robert Ceely's BEEP Studio, to a cellist and flutist and voices in the King's Chamber in the Great Pyramid at Giza in Egypt, to computerized synthesized music from an algorithm done at the Massachusetts Institute of Technology in 1981 and to

sounds created by sine wave generators based on mathematically derived intervals in musical sounds. There is even one tape of sounds from the astronomical observatory at Greenbank, West Virginia which was edited with a "sound-on-sound" technique had a descending Pythagorean scale cascading down over the sound of a pulsar called "Vela X".

These sounds are unlike any that the residents have ever experienced for the most part. They are not based on our familiar Western scale but are rather a scale of what might be termed "natural" harmonics based upon the principle of overtones and undertones. [1 & 2]

The latter sounds were generated by two sine wave generators, or a computer and all were based on a mathematical formula in the form of a matrix, which was attributed to Pythagoras (600 BC). These natural harmonics are mathematically derived in each case. They consist of cassettes of sounds which date from 1976 to the present. The matrix of sounds is called the Lambdoid, or Lambdoma Diagram. [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 & 12]

THE COMPLETED DRAWINGS

When each resident has finished a drawing and written their feelings on the back, I then hold the drawing up to the class and read the comments on the back. I also ask them, "Why does this drawing work?" I then explain the harmonious use of color, the composition of shapes, the originality of the concept or style, and usually point out that they are each going through the whole history of modern art in styles varying from primitive, expressionistic, abstract expressionism, impressionism, surrealism and realism and fantasy. Sometimes the group claps for the artist or jokes. What is usually the first image is drug paraphernalia, then fantasy, images of mountains, lakes, stars, faces, horses, explosions, and abstractions of all styles varying from cave-like drawings to constructivist type techniques.

After holding up a resident's art work, I find a place on the wall to hang it. Often this means taking down the work of a previous resident. If this is necessary, I try to make sure

that it is the art work of someone who has already left the program, or who, having graduated, has left the residence and who is not a resident who has just moved on to another stage in the program.

The words which the residents write on the backs of their drawings are emotional releases, it seems, of pent up thoughts. The words even become poetry in many cases. It seems that a key has unlocked emotions, and visual imagery and symbols. That key appears to be sound, and in particular the sound of the Pythagorean matrix called the Lambdoma Diagram.

PHOTOGRAPHING THE ART WORK

Periodically, I bring in a camera to photograph the best work. In this case I try to photograph a sample from each of the residents in the program. If someone has outstanding work, I photograph two or three of their works of art. If I take a photograph of the residents at work, I always ask them if they will give permission to be photographed. If they don't give permission, I photograph only the group which has assented. By the following week, I have either a contact sheet, made from the slides or have an eight and one-half by 11 inch color xerographic copy made, if an exhibition is planned. For exhibitions, the color, xerographic print is mounted on a foam-core backing with a card which includes the comments, title and name or initials of the resident. When the resident sees the color reproduction of the work which he or she might have regarded as of no artistic merit, it is as though the individual is looking at the art from an art book. The reduction from the 14 inch by 17 inch, or larger, original smooths out many of what the resident might consider defects in the original work. This method of reproduction makes the residents feel that their work is important. It gives the residents a great boost upward from their usually negative self image. As a corollary to this, an exhibit is an even further boost to this positive image which The Third Nail is trying to create for each of its residents. Incidentally, I make only positive comments on any work. In short, the residents experience what might be called positive affirmations. The results, of the art work as well as of

the comments they make in getting in touch with deeper feelings, prove the success of the method.

RESULTS

In the past five years there has been only one public exhibit. It was at the Boston City Hall in 1982. We had originally been assigned a space prominent and effective, but were finally given a corner by the information desk with a kiosk and a corner wall. The residents helped hang the show. We had approximately 65 works, all mounted with cards attached with comments about the work, in several rows on the walls. People coming in and out of the building did stop to look. The attendance at the opening exhibit was mainly composed of the resident's families and the staff from The Third Nail. One community newspaper wrote about the show, and then came to The Third Nail to interview the resident artists, and watch the art workshop in progress.

The article quotes me as saying, "The perfect natural harmonics help induce a tranquil meditative state. Often I say to everyone, "Draw what you hear". This method releases them from the fear of not knowing what to draw. The article then goes on to say, "Many in the workshop that day used the sounds as an aid." (A few residents, who had drawings in the show, said that from start to finish they did no more than draw what they heard.)

SPECULATIONS ON WHY THE SOUNDS UNLOCK EMOTIONAL RESPONSES

There are many studies on right and left brain differences. One of the most recent studies, by Phyllis Saltzman, on "Creative Problem Solving in the Classroom" in the *Journal of Curriculum Theorizing*, Vol. 5:1, 1984. My conjectures are that when the logical part of the brain is "entrained" by a logical mathematical system clothed in sound, perhaps the intuitive and creative parts of the brain are left free to pour out images, and words in an almost automatic way. One student told me that it was almost as if he were doing automatic

drawing as he listened to the sounds. The visual images themselves exhibit this property of automatic drawing as is evident from the examples of the slides. In the process of teaching the art workshop in the past six years, I have photographed over 300 of the works of the residents. It has only been in the last three years that I have worked exclusively with sound, as other teachers worked with the still life or the landscape as a model in previous times.

THE INTENT OF THE REHABILITATION COMMUNITY AS A FACTOR OF SUCCESS WITH RESPECT TO THE ART WORK PRODUCED

It is assumed that "intent" is one of the most important factors in many areas of successful endeavors. The entire "intent" of the Drug Program and of the residents themselves is to be well. They come into the program at the lowest point of their lives, having in many cases been referred by the courts as an alternative to prison, or "awaiting" trial. They are at a virtual "turning point" in their lives. Therefore the motivation is high for a change in their life patterns.

CHANGE OF PATTERNS IN LIFE

The art workshop is a change, or something new to the residents. As drawing a single line or series of lines or dots on a piece of paper is accomplished, it marks the first step on a long journey of changing life patterns. This is observed when analyzing the writings of many of the residents. The phrases which they have written on the backs of the sheets of drawings, express positive feelings of "making" it, and reflect verbally the drawings. This contrasts to the early weeks in the program where both images and verbal messages are negative. The original self-image of the drug addict is usually very negative. That is a pattern that must be changed. When the pattern is seen changing in the drawings, it reflects the change in the person. It is a small step, but an important one, for the counselors, and psychologists and educators as well as the individual all work together for the same intent of health, in the individual.

HOW THE ART REFLECTS THE POEM ENTITLED "OUR PHILOSOPHY"

Not only the visual images, but the comments about the visual images verbally reflect the philosophy of the Third Nail Poem.

**"I believe in change at last,
From my scornful, self-destructive past,"**

Slide numbered Title

#149	Coldest Day
#157	Prison Wall
#172	Flaming Cross
#176	Changing My Life
#114	Gloom and Sadness
#110	Feeling Discouraged
# 28	In Flight
# 29	Trying
#311	Balls of Confusion

"To energy flowing and feeling free,"

Slide numbered Title

#314	Felt Free
#177	Thoughts and Feelings Changed
#188	All Kinds of Feelings
#189	All kinds of Feelings
#190	Mixed Feelings
#196	I Felt Relaxed and Free
# 55	The Flowing
#223	A Bright but Dark Day in Space
# 77	Feelings
# 83	Flowing Shapes

"To being the person I can be,"

Slide numbered Title

#143	Jona and the Whale
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#126	Light Side / Dark Side
#132	Felt Good, Thinking about an Indian
#315	Peace of Mind
#305	Butterfly

"To knowing myself and how I feel,"

Slide numbered Title

#307	Butterfly
# 42	How I Feel
# 46	Flower
#161	I Feel Tranquil and at Peace with Myself
#164	I Am Feeling Unique, Special-like, the
Only One, I Feel Apart, Higher than Most	

"To end my fears of becoming real."

Slide numbered Title

#179	Fear and Anticipation
#180	That face and What It Sees
# 58	Good Spirits
#222	Coldest Day of My Life
# 41	Nervous Breakdown

"Living here, I learn, I grow."

Slide numbered Title

# 50	Living Here I Learn, I Grow
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"I feel my spirit, mind and body flow."

Slide numbered Title

# 16	Geometry
# 10	Shell
#212	3-D Cylinder
#225	Life is as Pretty as You Make it
#218	Things Appear Clearer on the Outside
#167	Tree and Gentle Flower
#168	Mandala

#107	Erratic Video Game
# 71	I Was in Real Good Spirits
# 70	God of the Birds
# 82	Wizard and Warrior

**"I love myself and the freedom it brings,
I share this love with all human beings."**

Slide numbered Title

#158	Rose-Life
#155	Tree and Butterfly
#239	Lighthouse and Sun
#165	Hands Raised
#169	A Real Tight Peace
#170	Gaiety
#171	A New Space for Growth
#174	Ribbon Candy
# 30	Dove on Branch
#175	Finding a Way
#163	Grandmother
#109	Butterfly
#108	Elated Feeling
# 85	Again I Quit
# 84	Stairway to Truth

**COMMENTS WHICH REFLECT THE FEELINGS
AFTER DRAWING WHILE LISTENING TO THE
SOUNDS**

I have found that the sounds entitled "King's Chamber" are very effective in releasing imagery and feelings. These sounds were recorded in the so-called "King's Chamber" at the Great Pyramid in Egypt, in March of 1984. The comments of the residents follow.

The comments of the residents about their feelings while drawing are indicative of their state of being, as is revealed by the following:

#312 "I'm numb from the jumble of the world. I must find order in which to find myself".

#304 "I felt that this is an image of all the obstacles in life and you cannot avoid anything, you have to hit it head on".

"Because of being in this program we are constantly moving, never stopping during the day to just enjoy ourselves or enjoy others company. During art workshop we sit together, talk together . . . We enjoy the music as it relaxes our minds from speeding. We just sit and enjoy life." (Subject matter is two ducks)

"Art class is a place to let go of some emotions, refreshing self, and recognize how you feel. It makes it a lot easier to deal with them feelings. Also it gives the residents to share about-selves with others. It's a time for relaxing, having peace with self." (Comment without any drawing)

"Representing the burning force of life that burns within me, hanging over the water because if I fall in my struggle I will no longer illuminate for the world to see. The recording made in the Kings Chamber caused me to think of Al Ma'mun sleeping overnight in the Pyramids."

#322 "Walking through a hot dry place with nothing but heat and lots of time. Nothing is there that I can see but there is something that is watching me."

"The feeling is very peaceful as if all the pressure has been lifted and all parts of me are floating freely, not in different direction, not in confusion, but toward my goal. I can see it now. I see it as attainable. I am in no hurry though. I don't race to it. Rather I drift slowly to it. When the time is right I will reach it".

The following was the comment of an invited resident who experienced the program for a week:

"Feelings while doing it, great joy. Being with people who have all done negative stuff but who at this moment are being released and feeling naturally high on the music and art work".

FOLLOWING THE ART WORK AND COMMENTS OF ONE RESIDENT

A human hand and a skeleton hand were the subject matter of his first day at The Nail. He said he couldn't draw. His comment on the work was:

"If I could get help, I will, no matter how long it takes."
(Music was "Crystal")

His second drawing was of a woman pulling a man by the hair. The woman represents death, the man is holding "life" in one hand. His comment was:

"Not right to go."

The following week he drew a man with tattoos. His comment was:

"I feel strange becuze of all the goings on around me. They say to keep cool and don't be a fool. But when you don't know who to turn to or who to talk to, one can't help but come out mixed up, in a house of pain." (Music was Commodore computer, and Hubble Flute)

The next was the last drawing he made, a unicorn very well drawn. He presented it to me with this poem:

UNICORN

"You made me see things I never thought could be seen.
You gave me true feelings of being honest with myself
and others.

I will miss you like a two floor house without a stair-
way.

And I would like you to know that I will go on being a
man of art, music and a loving human being.

This picture is of a unicorn, a horse that never was
But is loved and beautiful to look at."

After five months, five residents are still in the program,

out of a house with a maximum of 30 residents, some of whom are very transient.

WHAT ARE THE CHARACTERISTICS OF THOSE WHO ARE DRUG FREE?

I would like to point out that in all cases the work of the residents is original, and in many cases extremely good. The residents are not trying to become artists, but are just expressing their innermost feelings visually and verbally. It is this factor that makes the art workshop therapeutic. They are not trying to compete with one another in terms of technique or technical expertise, and they enjoy seeing each other's work and praising each other's work and also listening with attention to the feelings expressed and written on the other side of the drawings.

The one person who decided to go to art school, was provided with a separate studio where he worked to prepare a portfolio. This individual was accepted into two highly regarded art schools in the Boston area, and made his choice of one. He is currently there earning his degree.

QUESTIONS TO BE FURTHER INVESTIGATED

There are many ideas to be further investigated about the use of sound as therapy. Some of these are:

- A. How specific sounds produce their effects
- B. How specific sounds help achieve transpersonal (cosmic) states
- C. How specific sounds can be used to relieve depression
- D. How specific sounds release negative and positive emotions.

I would like to propose some theories about each of these.

- A. How specific sounds produce their effects.

Sound is basically a mathematical construct. It is based on a physics of vibration involving harmonics and sub-harmonics. Musically, these are defined as overtones and undertones. If a matrix of harmonics and sub-harmonics is generated through the mathematics of the principles of a vibrating string, for example, every frequency and its corresponding wavelength would resonate every part of our physical body. The effect would be a harmonious remembrance of each cell in our body to all harmonics contained in the sound, or matrix of sound. Therefor, a bath of these harmonics would cause not only our physical, but also our mental, emotional and spiritual bodies to be refreshed.

I have used sounds based on a Pythagorean matrix, and have found that the best results seem to come from a matrix with a beginning frequency of 352 cycles per second or a musical note of F. I have repeatedly used this in the art workshop with good results. 352 cycles per second has a factor of 11 and the frequencies used in the music of the King's Chamber, of 66 cycles per second as the fundamental frequency, also have a factor of 11. The lowest note of the cello is a C at a frequency of 66 cycles per second. When this frequency was sounded in the King's Chamber, attuning the dimensions of the room to the corresponding frequencies, the voices and the flute kept this frequency as the key sound around which other sounds, harmonious to it, are heard.

B. How specific sounds help achieve transpersonal (cosmic) states.

The cosmos resonates to harmonic frequencies. We know from the work of Hans Jenny that sound creates forms resembling cell growth and development. If a sound could represent the energy of the cosmos, from the microcosmos to the macrocosmos, a transpersonal state might be the result, especially if all of the harmonics and sub-harmonics were resonating to some frequency which falls between the middle C and high C notes of the piano, as that is a good median point between the micro and macrocosmic levels.

C. How specific sounds can be used to relieve depression.

A matrix of sounds based on the Pythagorean Lambdoma Diagram can be generated by computer, which by the fact that every frequency and wavelength is generated within a specified limit can elevate the emotional body so that "depression" is released. I have found that if the group at The Third Nail seems lethargic, I can play a portion of this matrix, based on 352 cycles per second as a constant, and the group is immediately energized. This takes place within a few minutes.

D. How specific sounds release emotions.

The same reasoning applies to a release of emotions as to the above three entries. A harmonically balanced matrix when heard audibly seems to release emotions. The only proof of this is the work done at the drug rehabilitation program and occasionally elsewhere. Something is happening, we know that, but much experimenting, studies with control groups, analyzing and testing remains to be done.

TRYING THE SAME SOUNDS ON OTHER GROUPS

Because of the encouraging results of using sound based on Pythagorean harmonics with the drug rehabilitation group, I applied these same sounds and methods with other groups. One was in Akron, Ohio in 1982, and others in 1984 on a lecture tour in Oregon and in Phoenix, and Albuquerque, New Mexico where a trance-like state of being seemed to infuse many so-called creative and intellectual members of our society. Some of the comments, which were the result of the suggestion, "Draw what the sounds might suggest visually.", follows:

"... sort of like the pleasure of doing an enjoyable thing with no pressure on me."

"Circles becoming triangles, becoming pentagons BEFORE becoming squares."

"The bubbles find something to hang on to and ... to

explore."

"Feeling that I'll just keep drawing and only step back to see what it is when the time ends."

"Thinking: no visible cooperation here. I wonder if there is cooperation at another level: Think must darken the green (go over it) so others can SEE it."

REACTIONS OF PARTICIPANTS IN WORKSHOP IN SAN LEANDRO, CALIFORNIA TO SOUNDS MADE IN THE KING'S CHAMBER IN THE GREAT PYRAMID IN EGYPT

The contrast between the reactions to the King's Chamber music, by the drug rehabilitation group and the reactions by eight individuals in a workshop entitled "Healing with Sound", are highlighted next.

The participants in the workshop were two chiropractors, a student interested in music (with a background in mathematics), a medical secretary, an artist, two involved with esthetics and healing, and one still searching for peace, control, and meditation.

Five of these people filled out the questionnaire which asked for reactions from a physical, emotional and mental standpoint. The following phrases express the verbal responses of this group:

MEDICAL SECRETARY:

"Physical reactions: vibrates, ears rebel, high notes bother."

"Emotional reactions: love it, somber, sadness, loneliness, delighted, excited, begging, plaintive."

"Mental reactions: uplifting, calming, confused, questioning."

STUDENT:

"Physical reactions: left foot tingles, whole body vibrates, right ear, right groin, pain in right upper chest, heat on the soles of the feet, resonances of crown chakra."

"Emotional reactions: heart expansiveness, melancholy, desire to see beyond, feeling of hiddenness, great depth, response both of strength and of danger, the forgotten cry."

"Mental reactions: the reality of unseen forces, the imprisoned soul, island in the ocean, water against rock, shimmering lattices of light, light sources pulsating."

HEALER:

"Physical reactions: well being, relaxed, reflex right leg, digestion, diaphragm, transverse colon, sacroiliac."

"Emotional reactions: weary, clearing, calm."

"Mental reactions: light, peaceful, trance state, sign "Whites Only" absurdity."

PARTICIPANT:

"Physical reactions: vibrations in feet and lower extremity."

"Emotional reactions: ambiguity, disturbing, death, strangeness, impurity."

"Mental reactions: visual, large space, concrete floor in vacant building, cello playing itself with spirit voices, woman moving around, space here and there with foggy wisps to strings of color, monastery feeling, darkness, interesting in certain sense but do not like. (note: a woman did dance while the solo flute was playing, the space was large, the floor was stone, and it was dark)"

SOUND HEALER:

"Physical reaction: some tenseness, constriction of chest."

"Emotional reaction: alternating range, serene, threatening, sadness."

"Mental reaction: stimulating, intensity, heavy / light. He wrote, "About the second half I just let myself go and did not record my reactions."

We can ask ourselves the question, "Why do these sounds in the Great Pyramid have such physical, emotional and mental effects on all groups and individuals so far exposed to them?" We can only answer, that, within this particular space of the King's Chamber (dimensions; height 19.17 feet, width 17.17 feet, and length 34.33 feet), a resonance was set up of frequencies vibrating between 60 and 66 cycles per second. These frequencies are within the range of the lowest note of the cello, a note "C" two octaves below middle C.

We might ask, "What does the King's Chamber music have to do with Pythagorean theories?" Aside from the legend that Pythagoras spent 20 years studying the mysteries of Egypt, his mathematical theories of sound were based on wavelength. Therefor we translated wavelength, derived from the dimensions of the chamber into frequencies present in the Pythagorean table. This could be done because of the properties of inversion inherent in the diagram.

We applied a well known formula from present day physics:

$$f = v / w$$

Where: f = frequency (cycles per second) (cps)
 v = speed of sound in air at room temperature
 (1,130 feet per second)
 w = wavelength (feet).

The fundamental resonant frequency in a room is

defined by one half of the wavelength of that frequency. Substituting, twice the chamber length of 34.33 feet, into this formula gives:

$$f = 1,130 / 2 \times 34.33 = 16.46 \text{ cps}$$

Multiplying this first harmonic by four brings it up to the pitch of the lowest note of the cello or 65.8 cycles per second.

CONCLUSION

I feel that sound is a key to our understanding ourselves and others, and unleashing the creative talents within us. I feel that the ancients represented by Pythagoras knew more than we know today of the integration of all Being. And I feel that art, science, mathematics, and emotions are all part of our Soul Growth, and perhaps sound is a key to our recognition of our Soul Being. This is the Being that transcends death and is the divine spark within us all.

I believe that it is the sounds that help The Third Nail residents to release their feelings in a visual, symbolic and verbal fashion. And more particularly, I feel that it is the more ordered harmonically constructed sounds which are the most effective catalyst. That is the reason that I use the Pythagorean intervals which are the harmonic intervals found in the physics of a vibrating string. Perhaps these principles of physics, when applied through music, entrain the logical part of our brains, thus releasing the creative, feeling and intuitive part of the brain. It has taken almost ten years to re-create these sounds, first using synthesizers, then sine wave generators, then computer generated sounds from a mathematical algorithm. The details of that method were presented in a paper given at the Curriculum Theorizing Conference four years ago in 1982. The theories related to the Pythagorean Table called the Lambdoma Diagram are listed in the references.

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HEALING WITH SOUND

First written in August of 1981

Revised in January of 1991

**"There is geometry in the humming of the strings.
There is music in the spacings of the spheres."**

(Pythagoras, 500 BC)

Sound is vibration. The vibratory range of our hearing normally extends from 20 Hertz to 30,000 Hertz (cycles per second) where Hertz is the rate of revolution in a circle or vibration of a string in a sine wave. The universe is like a gigantic string stretched from the infinitely small to the infinitely large. The only difference between the vibrations of sound and the vibrations of light is the rate of vibration, but not the proportional differences between the seven notes on a scale or the seven colors of a rainbow. Our windows to light are our eyes, our windows to sound are our ears. All vibrations between light and sound are invisible or inaudible. All vibrations below 20 Hertz or everything above 30,000 Hertz is inaudible.

Sound is a pushing and pulling of the air. A pushing and pulling, according to the sciences, is a force or energy. If one could generate sound vibrations to cause multiple energies all harmonically equivalent to one another, an entire restructuring of energies could result in the balancing of the energies of a person. This is precisely what a computer-generated Lambdoma matrix has the potential of accomplishing.

This is a way that healing by sound could affect an individual. We are bombarded by sounds, most of them disharmonious. Listen to the motor of your car or of your refrigerator. These motors are vibrating at a low enough rate

to give a humming sound which if raised to a frequency in the middle C range of music could be identified as a certain particular note. Our electric current is generated at a 60 Hertz rate or vibration. This frequency when raised to a recognizable note means we are bombarded by the sound of B^b. B^b is acknowledged by some researchers as the sound of the Crown Chakra. In Europe the generators are running at a frequency of 50 Hertz which relates, by doubling, to the note A when raised in frequency. A is considered to be the Third Eye Chakra by esoterics.

Sounds can annoy, please, destroy or heal, as is evidenced by some of the researches into the effects of sounds on particular people. I am not talking about decibels, or loudness, as much as about the relationships of the intervals between two or more notes. These intervals have very different qualities from each other and are very distinguishable in their balance to one another. This is evidenced by the shapes of the intervals with relation to a fundamental note, where each interval has its own signature or particular configuration.

If in mathematics these musical numerical qualities were to be recognized, as "qualities" rather than just "quantities" very interesting results might follow. What is the particular quality of any two notes sounded together, an interval of the first note and the fifth note of a scale for example? The notes of this interval have a ratio of frequencies of three to two, which creates a pleasing sound. Ratio is the key word here. For without a ratio of one note beating at its numbers of cycles per second to another beating at its own cycles per second there could not be an interval between them.

Not only that but the most harmonious ratios are the simplest ratios, where the numerator and denominator are found to be in the range from one to sixteen. This is Pythagorean tuning. One problem with our musical scale based upon the 12th root of two is that it is not based upon whole number ratios. I propose that it is this whole-number-ratio, natural, harmonic scale with its inherent different quality intervals that will create the healing modalities needed. In our age of computers it becomes easy to generate this type of scale, through simple algorithms. Each person

could have their own "keynote" scale generated by computer.

What must be understood about sound is that it matters what particular "keynote" one begins with. For example, let us take the note of F as a beginning note. F is a very good example for in the writings of Ouspensky, as well as others, the note F is the sound of the universe. I have reason to believe that the note of F is the beginning sound of our consciousness, and that by working towards this sound as our goal, all of the sounds related harmonically to this one note should restructure our energies to be in tune with the universe. If one takes an oscilloscope set to a polar coordinate system, or takes a laser / scanner system and plays combinations of harmonics to the note of F, the lissajous figures which result are beautifully structured linear diagrams of the sounds heard. One can do this by attaching an amplifier, speaker and microphones, or tape recorder to the oscilloscope or laser / scanner in the proper manner.

Notes that are not harmonious when sounded with the note F include the notes B, E, and G. The reason for this is that both of the notes E and G are so close to one another stepwise in the scale. Also the vibrations clash because the note G is in a proportion of nine to eight to the note F and the note E is in a proportion of sixteen to fifteen to the note F and the note B is in a proportion of eleven to eight to the note F.

The most harmonious blend of sounds are in proportions of two to three, or three to four, or four to five or their reciprocals.

Now, the Lambdoma matrix goes back to ancient times, certainly to Pythagoras, but most probably to Ancient Egypt and before that Atlantis and Lemuria. It is believed by many that these ancient peoples understood better than we do today the components of light and sound, and made use of this understanding to heal and benefit humankind of those ages.

We have been left the Lambdoma matrix diagram, but not the uses of it. Up to now this diagram has been used for

musical theory purposes only. I believe that the correct use of it could provide a key to unlock many unsolved mysteries not only of healing, but of the nature of the construction of the pyramids for example, and perhaps even the nature of mass and energy, which as a completion of the circle might disclose another key to the components of healing energies. Computerized sounds are now being utilized with this purpose in mind, forming a matrix of sounds which are indeed mathematically precise. They bear a slight relation to our Western musical scale, but are harmonically much more exact.

If we think of the origins of our Western scales, we find that even in Greek times, there were many modes which expressed different states of mind and emotion. We chose the major and the minor modes through which to express our music, only two modes out of many. In India there are ragas for every time of day and season. It was only recently that the twelve-tone scale became an extension of the major minor modes. The limitation of a scale of twelve artificial equal steps within an octave is evident, when we consider the unequal steps or divisions of a natural overtone system. Norbert Weiner discussed this problem years ago in his works on cybernetics. Has our musical scale become a crippling device and not a healing device for us and our present civilization?

Have we taken music to the highest pitch above hearing or to the lowest pitch below hearing? We are beginning to do this with the advent of computer generated sounds. Have you ever heard sounds that are so high that they seem to ring inside your head, or so low that the floor under your feet is vibrating and sounds like low thunder or an earthquake? The computer generated sounds are beginning to search this realm.

If a sound is to heal, the energy of that sound, or those sounds would have to restructure the mass of whatever was to be healed. If the healing were to be on the physical plane the different chakras would have to be opened. The endocrine system would respond to each interval on the harmonic scale. If each of our organs vibrates at a certain specific frequency, and we find the resonant frequency of

the particular organ, it will resonate to the sound.

Most of our physical organs are within a range of inches, or meters or feet in dimension. Sounds near 1,000 Hertz are high and would influence organs of dimensions of one foot at the sound we call Db. At 3,000 Hertz, about four inch wavelength, we would hear the sound A. While at 5,000 Hertz, a two-inch wavelength roughly, an F would be heard. Sounds which are audible are in the wavelengths from less than one inch to about 56 feet at 20 Hertz, the note of E.

The King's Chamber in the Great Pyramid at Giza resonates to a frequency between the notes B and C, which is the lowest note of the cello, which has a wavelength of 17 feet and is a B^b. The ceiling height is 19 feet which resonates with a note of D^b. The coffer in the King's Chamber is 41.4 inches by 90 inches by 39 inches. This coffer fits the dimensions of most humans and is thought in some circles that it's function was to restore the human bodily functions. If so, the harmonic chord which might particularly effect healing would be E^b, E, and F.

Now with each note there is a corresponding color. Just as with the chakras from the base of the spine to the top of the head there is a whole spectrum of colors from red, orange, yellow, green, blue, indigo and violet. These are the absorbing or reflecting colors. The transmitting colors are the complementary colors: green, blue green, blue, violet, magenta, orange and gold. Try to visualize the color of a particular sound in your mind. Hear the sound, then visualize the color. Pair the two in your mind. Thought too is a vibration attached to both sound and light. Thought can be as fast or faster than the speed of light, and slower than the speed of sound. It is the merging of thought with the heard sound that can effect a healing. We can raise the vibrations of sound or light by thought, and this is how we reach meditation and tuning in to the inner planes of consciousness.

Visually and abstractly, light comes very close to sound. If we take the frequency of any specific note and double this frequency enough times, we will eventually reach the light

spectrum in frequency.

It has been predicted in the new age, the Aquarian age, that the thrust of healing will be towards sound and light. Sound and light Centers will dot the planet's face. People will group themselves according to their compatible rays. There are seven colors, seven sounds and seven rays. Different color lights can heal as can different sounds. A sound can be heard and more precisely identified than a color, where each increment of color blends into its neighbor. That is why it is important to develop a visualization of color and know what color can do in the mind's eye. If red affects the lowest chakra, then C is the corresponding note. If orange is the color of the lower abdomen, then D is the note. If yellow is the kidney, then E is the note. If green represents the heart, then F is the note. If blue is the throat, G is the note. If indigo is the brow, then A is the note. If violet is the crown of the head, then B is the note. These are the absorbing colors which would be best it seems for healing since one would want to absorb healing colors and frequencies into the physical body. For a healer it would be transmitting the complementary colors to the physical organs perhaps unconsciously by thought alone.

We exist on this physical plane level in just one of our many consciousnesses. The inner planes are peopled with dream, mental, and spiritual levels. In order to restructure our physical and inner plane bodies, we can create implosions of sound which act like a vacuum cleaner that will suck up negativities functioning as holes in our auras. It is in the etheric planes that diseases commence. By sweeping auras with light and sound, our physical and inner plane bodies are restructured without "holes," without negativities.

The new age brings an awakening awareness of the inner plane consciousness. This is a consciousness that is within us, not outside of us. By meditation, one can raise one's vibrations high enough to communicate on inner plane levels with all that exists on those other planes. Instruments like computers and other electronic devices are like crutches, now. We will eventually learn to do without them by tuning in to our inner plane electromagnetic currents. We are like wet cell batteries, and as such we operate in either a recharg-

ing or discharging way. Ideally we must be like battery charges to others, so that they will feel refreshed and whole after being in the presence of those who are discharging energy to them.

At this particular point in time, sound and light can play an important role in balancing the electric charges, the way in which it is thought to have been done in ancient times in the temples and pyramids of Egypt and elsewhere.

We will have to rediscover vibration and mass. While vibration is frequency in cycles per second, mass could be likened more to wavelength. Mass and energy are inversely related, just as frequency and wavelength are inversely related. The higher the frequency, the shorter the wavelength. The lower the frequency the longer the wavelength. 33 Hertz creates a wavelength of 34 feet. That is almost a balance of frequency to wavelength and the note is Db four octaves below middle C.

As we discover more and more about our universe, we also discover more and more the means whereby the harmony may be brought about and work to heal the energies of ourselves and the planet we inhabit.

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THE IAMBlichus ARRAY AS A TRANSFORMATION OF MAPPING FROM RATIOS ONTO MUSICAL INTERVALS

1984

ORIGIN OF THE LAMBDOMA

The history of the Lambdoma diagram is clouded in mystery. It is believed to have originated in Egypt or perhaps earlier in ancient history. We know that Pythagoras, the Greek mathematician, spent 20 years in Egypt before founding his school in Greece. And it is assumed that he brought this diagram from Egypt. It was used as a double entry multiplication and division table by the ancient Greeks. It seems that in our present age we use only one half of the diagram. It is known as our multiplication table. The Lambdoma is a multiplication and division table combined. It is this property which makes it so significant, because it encompasses both the infinitely large as well as the infinitely small. Below is a representation of this first indication of the Lambdoma diagram which was called the "Lambdoid".

		1/1		
		1/2	2/1	
	1/3	.	3/1	
	1/4	.	4/1	
	1/5	.	5/1	
1/6		6/6		6/1
1/7		.		7/1
1/8		8/8		8/1

Table 1

The first mathematical indication of this diagram is found in the writings of Nichomachus (100 AD) in a work entitled "Introduction to Arithmetic". [1] Iamblichus a neo-Pythagorean, who lived in 200 AD translated this volume.

This early diagram of the Lambdoma clearly shows the properties of the inverses of the integers $1/1, 2/1, 3/1, \dots n$, to $1/1, 1/2, 1/3, \dots m$. It also shows the isometric placing of the diagram so that it forms a triangle. It also shows that the base becomes a hypotenuse, and if the base were considered to be a vibrating string each harmonic would sound along the base of the triangle. The center of the triangle would then have the constant function n/n , or in musical terms whatever frequency would be used to multiply the ratios in the table.

It is possible, almost in the realm of science fiction, that the Lambdoma diagram originated in another galactic star system. Perhaps it originated in the star system Sirius, about which the Dogon tribe in Africa have apparently known for centuries. This is a double-star system which was only recently discovered in modern times by our scientists. In Ouspensky's "Search for the Miraculous", a diagram is described which has been lost, but which is still to be found, which seems to be a description of the Lambdoma diagram. Ouspensky was a disciple of the Russian metaphysician Gurdjieff, author of "All and Everything".

When one thinks about the two main sources of the Lambdoma Diagram, Iamblichus (200 AD) and Georg Cantor (1856 - 1918), both of whose works have been almost totally destroyed, one wonders if the world was ready to receive this sort of information at those times. Of the many volumes which Iamblichus wrote only two seem to have survived. One, Nichomachus's "Introduction to Arithmetic", and "Mysteries of Egypt". In the work "Introduction to Arithmetic" there are diagrams, which are similar to a "double race course". That is there are two overlapping courses, with numbers as low as 12 and as high as 20,736.

When the above limits were translated into frequencies they included all frequencies with the exception of C, or 256 and its multiples. Twelve multiplied by two until it is expanded to a recognizable audible frequency of 384 and

beyond is possibly the beginning frequency since it is the lowest frequency. A Lambdoma table with 384 as the beginning frequency, or constant, might show the other entries as fitting into this matrix. This too is something to be investigated.

DOUBLE RACE COURSE

The "double race course" is apparently an Atlantean construct according to Plato. Plato of course postulated musical / mathematical methods, which few scholars have pursued with the exception of Ernest McClain and Robert Brumbaugh. In his book, "The Pythagorean Plato: Prelude to the Song Itself", Ernest McClain includes a Figure 57 entitled "The Canals in the Atlantean Plain". [2] The canals in this figure bear a very strong resemblance to the rays that others know as the Lambdoma and which McClain includes as Figure 47 entitled "The Pythagorean Table of von Thimus". There are 34 rays depicted in one quadrant of the figure. Each one of these could be given a musical interval, and sounded, when multiplied by a specific frequency. The diagonal is the beginning or constant note. Below the diagonal the intervals fall in descending order, while above the diagonal they ascend. This means that there are 17 intervals ascending and 17 intervals descending from this scale. Doubling these numbers makes 68 intervals in the plain, 34 ascending and 34 descending. McClain claims that every line is a geometric progression or ray, while every intersection is a number.

The quadrant grid is a dimension of 15 by 20, or 30 by 20 (doubled horizontally), or a 3:2 ratio which we know as a musical fifth. The Lambdoma grid could be constructed as a 15 by 20 matrix. Each ray when color-coded would have a specific angle. If we took the arctangent of each square, we would then have an angle in degrees which would mathematically determine the slope. Through this method we would then use the slope of the angle as the rate of change, or derivative using principles of calculus. This slope would then always be the hypotenuse of the angle and we could then apply Pythagoras' formula of the square of the hypotenuse equals the sum of the squares of the two

sides, or: $H^2 = A^2 + B^2$. By this method we would know the rate of change of each ray, which would change depending upon which variable of frequency was chosen as the base frequency. But no matter which frequency was chosen the relationship of each interval in the scale would be of exactly the same proportion.

IMPORTANCE OF THE LAMBDOMA

Implicit in the Lambdoma diagram are theories and applications yet to be discovered. If mathematicians examined Georg Cantor's nineteenth century theories especially with regard to his array of transfinite ratios, and made the corresponding link with the phenomenon of musical sound, an application of mathematics to a physical reality might result.

The importance of this coupling of mathematics with musical intervals cannot be stressed enough. One could examine the structure of crystals to see if a Lambdoma pattern were to be found in them. Or we could examine the planetary and star systems to find similar correlatives, perhaps even to find a point of origin of our own universe.

A CLOSER LOOK AT THE LAMBDOMA - WAVELENGTH OR FREQUENCY?

A closer look at the complete Lambdoma diagram follows. It is important to know that this table is introduced as a table of "string" lengths. And as we know, "string" lengths are in inverse relation to frequency, for "string" length is interpreted as "wavelength".

The formula for frequency and wavelength follows, and this formula applies to all matter including sound since all matter is in vibration:

$$v = f w$$

Where: v = velocity of sound through different materials
at a certain temperature

f = frequency
and w = wavelength

This formula the ancients might have read as:

$$w = v / f.$$

The ancient Greeks and also the ancient Chinese measured the musical intervals by length. In other words an application of music theory before the advent of electronic means was in wavelength rather than frequency. Organ pipes are good examples of music produced by different wavelengths.

In this age, since we can readily measure frequency, our formulas read $f = v / w$. Therefore, the Lambdoma diagram can be interpreted as a frequency / wavelength table, or a mass / energy table, or a space / time table, or a heat / cold table, or gravity / anti-gravity table. Any phenomenon which have inverse properties can be read into the table for the x or y axis. Perhaps we could even consider the z axis as velocity v.

THE LAMBDOMA DIAGRAM

Adapted from Ernest McClain's "The Pythagorean Plato: Prelude to the Song Itself".

	D/D >>>-----HARMONIC PROGRESSION----->								
Ratio	1/1	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9
Note	D	D	G	D	B-	G	E	D	C
Freq.	288	144	96	72	58	48	41	36	32
R.	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8	2/9
N.	D	D	G	D	B-	G	E	D	C
F.	576	288	192	144	116	96	82	72	64
R.	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8	3/9
N.	A-	A-	D	A-	F	D	B	A-	G
F.	864	432	288	216	173	144	123	108	96
R.	4/1	4/2	4/3	4/4	4/5	4/6	4/7	4/8	4/9
N.	D	D	G	D	B-	G	E	D	C
F.	1152	576	384	288	230	192	165	144	128

R.	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9
N.	F#	F#	B-	F#	D	B-	G#	F#	E-
F.	1440	720	480	360	288	240	206	180	160
R.	6/1	6/2	6/3	6/4	6/5	6/6	6/7	6/8	6/9
N.	A-	A-	D	A-	F	D	B-	A-	G
F.	1728	864	576	432	346	288	267	216	192
R.	7/1	7/2	7/3	7/4	7/5	7/6	7/7	7/8	7/9
N.	B+	B+	E+	B+	A-	E+	D	B+	A+
F.	2016	1008	672	504	403	336	288	252	224
R.	8/1	8/2	8/3	8/4	8/5	8/6	8/7	8/8	8/9
N.	D	D	G	D	B-	G	E	D	C
F.	2304	1152	768	576	461	384	329	288	256
R.	9/1	9/2	9/3	9/4	9/5	9/6	9/7	9/8	9/9
N.	E-	E-	A-	E-	C	A-	F#	E-	D
F.	2592	1296	864	648	518	432	370	324	88

Table 2

THE FREQUENCY TABLE

The above Lambdoma table differs from others found in the references because the frequencies, in cycles per second, are given beneath the ratios and the musical notes. The difference lies in the fact that the table is constructed according to frequencies rather than wavelength. And as we have pointed out the differences lie in the inverse properties of frequency to wavelength. To the best of my knowledge the Lambdoma has never been used in this way, by multiplying a given frequency by the ratios found in the table.

PROPERTIES OF THE LAMBDOMA TABLE

One interesting property of the table is that zero (0) does not exist within the table. The 0/0 ratio is found outside of the table itself, and was considered a point, not a geometric figure.

Another interesting point is that the x axis was considered a harmonic progression, 1/1, 1/2, 1/3, . . . 1/n,

while the y axis was considered an arithmetic progression, $1/1, 2/1, 3/1, \dots n/1$. The functions of the different intervals are found within the table in a certain pattern, as well as in a specific sequence.

THE ALGORITHM WHICH GENERATES THE MATRIX AND THE LIMITS

The algorithm or formula which generates this matrix is a simple one. Basically it is a division of the x axis by the y axis, establishing the limits of each by a reasonable number. The Lambdoma matrix, which we have shown above, has a limit of 9, on both axis. This makes a matrix of 81 entries. This matrix ends at the ninth harmonic. It is preferable to establish a matrix with dimensions of 16 by 16 rather than of 9 by 9. Then, a scale is formed, based on the ninth to the 16th harmonic. This scale can be called a pure Pythagorean scale, based on the overtone and undertone series. Unfortunately, the undertone series has not yet been acknowledged completely. Yet it seems to be in essence a sub-harmonic which is recognized. We may recall that the "fifth" in music, which is a ratio 3:2, is called the "dominant", while the "fourth", which is a ratio 2:3, is termed the "sub-dominant" in music theory.

Perhaps an even broader base of a matrix of 20 by 20 or even 26 by 26, might be significant to use. At the Massachusetts Institute of Technology's Experimental Music Studio, in 1981, we used a matrix of 20 by 20, making a matrix with 400 entries.

It took thirty seconds for the matrix to sound all of its separate harmonics and subharmonics in a range of octaves that extended to eight doubling. Since we used the beginning frequency of F at 352 cps the range was 7040 to 17.6. The latter is below the hearing range for most people, and would be a music note of D^b, while the former is a musical note of A.

MAPPINGS

a, b, c, d, e, f & g = musical intervals

x, y, z, w, v, u & t = ratios

	RATIOS	INTERVALS	MAPS TO
Example: Where	x = 1:1	(1st = c)	c-----x
	y = 9:8	(2nd = d)	d-----y
	z = 6:5	(3rd = e)	e-----z
	w = 2:3	(4th = f)	f-----w
	v = 3:2	(5th = g)	g-----v
	u = 5:6	(6th = a)	a-----u
	t = 8:9	(7th = b)	b-----t

Let A = (c, d, e, f, g, a & b)

Let B = (x, y, z, w, v, u & t)

Therefore:	f(c) = x	Inverses	-1
	f(d) = y		y = t
	f(e) = z		
	f(f) = w		-1
	f(g) = v		z = u
	f(a) = u		
	f(b) = t		-1
			w = v

The above mapping is an abstract analysis of the properties of inversion found in the Lambdoma diagram. This is one of the most important properties of the Lambdoma diagram.

FUNCTIONS OF MUSICAL INTERVALS

To carry the vibrating string concept even further, imagine a string of a given length stretched and fixed at each end. Suppose we divide this string into four parts. We would number the string 0, 1, 2, 3 & 4. Since 0 cannot be a quantity or number, and three and four would be superfluous in terms of music analogies of an octave, we would use only the numbers one and two, which we will call m and n. Now within this octave range are to be found functions for each of the ratios found in the Lambdoma table. The limits of the Lambdoma are $0 < 1 < 2$. We are now able to find functions

for each of the multiple entries in the Lambdoma matrix, including the harmonic mean, geometric mean, and arithmetic mean.

$$\text{Arithmetic mean} = (m + n) / 2$$

$$\text{Geometric mean} = \sqrt{(m)(n)}$$

$$\text{Harmonic mean} = 2(m)(n) / (m + n)$$

Below is the number line of functions, ratios and musical intervals adapted from Hans Kayser, "Lehrbuch der Harmonik". [3]

Given: $m = 1$ and $n = 2$

Where $m = \text{unison}$

and $n = \text{octave}$

Formula:	$2m-n$	m/n	$n/(2n-m)$	$4mn/(m+n)^2$	m	$3mn/(3n-m)$
Ratio:	0	1/2	2/3	8/9	1/1	6/5
Note:	-	C	F	B	C	E ^b

Formula:	$2mn/(m+n)$	$\sqrt{mn}$	$(m+n)/2$	$(3n-m)/(n^2+mn)$	n
Ratio:	4/3	-	3/2	5/6	2/1
Note:	F	F#	G	A	C
Means:	Harmonic	Geometric	Arithmetic		

Formula:	$(m+n)^2/4mn$	$2n-m$	n^2/m	$mn/(2m-n)$
Ratio:	9/8	3/1	4/1	Infinity
Note:	D	G	C	-

IMPLICATIONS OF FUNCTIONS OF MUSICAL INTERVALS

The implications of having functions related to the ratios enables an assignment of quality to each ratio. When one analyses the qualities of the musical intervals with respect to the fundamental or beginning frequency or length, other properties seem to be inherent within the framework of the integers one and two. In the case of length, the measurements are fixed, proportionately to the given unit measurement.

KAYSER'S THEORY

If our number system only needs a limit of zero to four, as Kayser's music, ratio and function line implies, then it would change the face of our present day number system. The binary system of zero and one, seems a step in this direction. However, specific integers, based on the harmonic intervals used in music in ratio form, might be the key which could unlock the aspect of quality in our number system.

For instance, octaves would be the framework of the system. Octaves are multiples of two or one half. Fifths might exhibit qualities of most force, or most energy, as fifths are the most universally accurate intervals in all cultures, and all of the known centuries, in Chinese, Indian and Western music as mentioned by Alain Daniélou in his essay "Sémantique musical". [4] Octaves and fifths seem to be the only intervals which have this universal acceptance in these cultures. The ratio associated with the octave is 2:1 or 1:2, and the ratio associated with the fifth is 3:2.

KAYSER'S FORMULAS

A cadence in music is the seventh harmonic. This harmonic has a ratio of 8:9, and a formula of $4(m)(n) / (m + n)(m + n)$. Its sequence on the number line is just before 1:1, or "home".

In music theory the "sixth" step of the scale, is one upon which modulation to another musical key can take place. It's ratio is 5:6 and its formula is $(3n-m)/(n^2+mn)$, where $m = 1$ and $n = 2$. A chord of C, E and G is a chord of the first = 1:1, the third = 6:5 with the formula: $(n^2+mn)/(3n-m)$.

EFFECT OF LAMBDOMA ON LISTENERS

If the frequencies are generated by computer, the Lambdoma Diagram (Table 2) would have descending scales at every row, which would ascend in pitch at each column. Musically a descending series becomes a depressant factor for those listening. I have watched the faces in an audience in a workshop in Akron, Ohio. The entire audience had very discouraged looking faces when this sequence was played, coupled with a descending row. While the opposite effect is observed when the series is ascending. Because of this effect, a descending series might be used as a "downer" for overly excited individuals. For building energy in the listener the ascending series is very effective, as has been established in the drug rehabilitation program, in Boston, Massachusetts, known as "The Third Nail".

This matrix when generated by the computer and played to different groups has marked effects on raising the energy level of every group that has been exposed to the sounds. It makes one wonder how this matrix was used in Pythagorean times when computers were not available. But as we mentioned before, the wavelengths were most probably the key to this application. Musical instruments built according to the specifications of length, might well be the answer to this riddle.

APPLICATIONS

By substituting frequencies in cycles per second or Hertz into these ratios, an application can be made of these formulas in music. By substituting wavelength (the inverse of frequency) into these equations an application may be made in architectural or geometric structures. Other ratios

to complete either a scale or a modular length could also be substituted.

Applications of the Lambdome diagram which have not yet been investigated include making matrices of the velocities of sound through different materials like air, water, muscles, bone, blood, soft tissue, liver and kidneys.

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101 WAYS TO USE THE SECRETS OF THE LAMBDOMA

Circa 1990

HOW I DISCOVERED HOW TO MAKE LAMBDOMA CHAKRA MEDITATION NECKLACES

One day I met the son of a famous actor who after seeing my studio, with drawings and weavings brought me the book by Hermann Hess called "Magister Ludi: The Glass Bead Game". The setting of the book was in the future and an esoteric society had created the Glass Bead Game which reflected certain aspects of the universe. I immediately thought of the game as being similar to the Lambdoma Diagram on which I had been working for almost 20 years. So I thought to myself, "Why not see if I can put the Lambdoma theory into a string of beads." I had already color coded the original diagram, and linked each color with a musical note.

The date was November 1987. I was driving with a friend to Eden New York for a thanksgiving get together with colleagues, where I was to present a demonstration of the shapes of sounds based on the sequence of notes in the harmonic series. On the way back a few days later we stopped in Herkimer, New York to see if we could find some glass beads.

What I found were some wooden beads in the colors I needed, reds, oranges, yellows, greens, blue greens, purples, and magentas. I purchased these with some wire. In two days we were back home in Maine.

I made some necklaces with the wooden beads and gave them to family and friends. I followed the sequence of color

coded notes of the Lambdoma diagram for each keynote which corresponded with a specific chakra.

There are basically seven energy centers in our physical bodies. These energy centers are known as chakras. Each chakra is represented by the color of the beads contained within the necklace. On one side the overtone series in music is represented, an uplifting energy. On the other side the undertone series in music is represented, a grounding.

The necklace represents an application of a music theory based upon the ancient mathematical diagram attributed to Pythagoras (600 BC) called the Lambdoma diagram, a formula which reveals some universal laws.

Each bead was put on during a meditative state which brings love and healing energies to whoever wears the necklace.

HOW TO MAKE YOUR LAMBDOMA CHAKRA MEDITATION NECKLACE

Question: What is a Lambdoma?

Answer: It is an ancient multiplication / division table or matrix of whole-number ratios based upon a mathematical theory which defines harmonious musical intervals.

Question: How are music and mathematics related?

Answer: You cannot have one without the other. The relationship of one note to another is based entirely on the mathematics of vibrations per second.

Question: Who discovered all this?

Answer: It is thought that Pythagoras handed down this knowledge of harmonics, in 600 BC.

Question: What exactly does harmonics mean?

Answer: One part of harmonics is based on a sequence of tones which musicians call overtones or partials which follow a fixed number pattern which is essentially multiplication. These sounds are in an ascending scale going

higher and higher in frequency.

Question: Do harmonics go lower and lower in frequency also?

Answer: Yes a descending scale can be described as sub-harmonics or undertones where the tones become lower in frequency.

Question: How do you make a necklace based upon this idea?

Answer: Pythagoras also assigned a specific color to each specific note in a scale. He taught that the note C is red, D is orange, E is yellow, F is green, G is blue, A is indigo and B is violet. You put the colors, such as beads, on a string in a particular sequence which represent the harmonics we talked about.

Question: Just what is the sequence of color / notes in which you string the beads?

Answer: First is the keynote with which you start. Then you lay out the bead which is the keynote's color on a bead tray. I like to lay out seven beads of the same color to represent the seven days of the week. Then I start counting from the fifth bead one, two, . . . One and two are the same color for mathematically they represent the same note an octave apart. Number three is a musical fifth note of the scale, and it is always a complementary color to the keynote. Number four is the same color as the keynote, but number five becomes a third note of the scale. Find the third note of your scale and that is the colored bead which you choose. The next number is six, which is a multiple of three so it is the same color as the one you chose for three. Number seven is the seventh note of the scale and has its own unique color. Eight is the same as one, two and four so that is easy. From nine which is the ninth harmonic the colored beads become like a rainbow, because in music the notes become a musical scale. Then one continues to count up the scale. Nine, which is the second note of your scale "re" (do, re, mi, fa, sol, la, si, do) has its own color, "mi" is the same as the fifth harmonic (two times five is ten), "fa" is the eleventh harmonic, "sol" is the twelfth harmonic (double the sixth harmonic), "la" is the thirteenth harmonic and has its own unique color. Fourteen is two times seven so it is the same

as the seventh harmonic and is "si". Fifteen has its own color and becomes a slightly different "si" note. But from the ninth harmonic all the colors follow the rainbow, and all the notes follow a scale. Then sixteen is a multiple of two times eight so we have completed a Lambdoma matrix in the harmonic series and can then separate each bead with seven smaller beads and make the necklace as long as we like.

Question: That is only half of a necklace what about the sub-harmonics that you mentioned or undertones?

Answer: You are right. We now start counting backwards. You must imagine having a keyboard in front of you and starting say at middle C. Now count off one and two from the second side of the necklace. These are both the same notes C. Now count five notes down the keyboard from middle C to the note F. This is the sub-harmonic. Notice that it is one down from the harmonic series which would be a G counting up. Now this is the third sub-harmonic. The fourth sub-harmonic is another C. The fifth sub-harmonic is found by counting down three notes on the keyboard. Now the sixth sub-harmonic is a doubling of the third sub-harmonic so count down to five again. The seventh sub-harmonic is found by counting down seven to arrive at the second note of your scale. The eighth sub-harmonic becomes another C and the ninth sub-harmonic then becomes a seventh on the harmonic scale we used on the first side of the necklace.

Then we do the same thing counting down for all the other notes until we arrive at the sixteenth sub-harmonic. This completes the second half of the matrix. From then on all you do is create the rainbow pattern in the opposite direction from the harmonic series.

Question: What if you start at another note instead of C.

Answer: Just follow the same procedure of counting forward for the harmonic series and backwards for the sub-harmonic series.

Question: Now, how does all of this fit into the Chakra System, and just what is the Chakra System?

Answer: The Chakras represent the etheric energy centers of a person. There are basically seven major

chakras, and this seems to fit into the seven basic colors, and seven basic notes of a musical scale. Most people have described the chakras as following a specific color pattern, the base chakra at the base of the spine is considered to be red. The polarity chakra at the lower abdomen has been seen as orange, the solar plexus at the abdomen is considered yellow, the heart is green, the throat blue, the third eye in the middle of the forehead indigo, and finally the crown at the top of the head is considered to be violet.

Question: So if the Chakras have been assigned these colors all we have to do is substitute musical notes for the colors and have the sounds of the chakras as well as the colors.

Answer: Exactly.

ABSORBING COLORS

<u>NOTE</u>	<u>COLOR</u>	<u>CHAKRA</u>	<u>GEMSTONES</u>
C	RED / PINK	BASE	ROSE QUARTZ GARNET TOURMALINE
D	ORANGE	POLARITY	CARNELIAN
E	YELLOW	SOLAR PLEXUS	CITRINE YELLOW JADE
F	GREEN	HEART	PERIDOT AQUAMARINE TOURQUOISE TOURMALINE
G	BLUE	THROAT	CELESTITE MALACHITE
A	INDIGO	3RD EYE	LAPIS SODALITE
B	LAVENDER	CROWN	AMETHYST

TRANSMITTING COLORS

NOTE -----	COLOR -----	CHAKRA -----	GEMSTONES -----
C	GREEN	BASE	PERIDOT GARNET TOURMALINE
D	BLUE GREEN	POLARITY	AQUAMARINE TOURQUOISE
E	BLUE	SOLAR PLEXUS	CELESTITE
F	LAVENDER	HEART	AMETHYST
G	MAGENTA	THROAT	GARNET TOURMALINE ROSE QUARTZ
A	ORANGE	3RD EYE	CARNELIAN
B	GOLD	CROWN	CITRINE YELLOW JADE

Table 1

There have been a few modifications since that time or "fine tuning" so that the necklaces followed more closely the Lambdoma pattern of musical overtones and undertones.

I have given two workshops, on how to make these necklaces, at the Maine Healing Arts Festivals of 1988 and 1989. Some of the participants are now giving workshops on stringing Lambdoma Chakra Meditation necklaces as well as selling their own versions of the necklaces. I am now in the process of writing a booklet on this to be in a kit so that people can make their own without my having to give so many workshops.

CASSETTE TAPES OF LAMBDOMA HARMONICS

Three years ago Robert Foulkrod, Steven Proskauer and I developed an audio tape of musical intervals based upon the ratios of frequencies defined by the Lambdoma diagram. We titled our tape, "Lambdoma Chakra Meditation." With this tape one heard 256 separate musical intervals for each chakra and visualized the color connected with this chakra. We received many testimonials as to the effectiveness of these tapes on the listeners. These tapes are presently being distributed to hospitals and therapists across the country by an organization doing brain research in North Carolina.

WEAVINGS

About seven years ago I wanted to try to weave the Lambdoma pattern into cloth. I made several scarves through the teaching of my friend Wendy Shaw. Then a few years later developed a pattern representing musical Octaves, Fifths, Thirds, and Sevenths, with the help of Robert Foulkrod. These also represented the chakras, and were found to be very energizing by people who touched them. They were used as a cloth for crystals in some cases. I was asked to write an article on the weavings by an editor of "Woman of Power." The article was not published because it was deemed to be too technical.

MUSIC

It was in the early 1970's that I first came across the Lambdoma diagram. I had been studying music for about eight years, in the Extension Division of the New England Conservatory of Music. I had studied piano when I was five years old, and then intermittently until I was 12.

Twenty three years later I decided to restudy music. I enrolled in the Conservatory to relearn the piano. After that I studied music theory and composition, and learned to play the violin a bit with my three children; David, aged three, Michelle, aged six and Barbara Ann, aged nine. My oldest son Alfred, aged twelve was also learning music on the

piano and violin. It was after these studies that I began reading about music theory on my own. For my own use I carefully translated a book from French, titled "The Semantics of Music" by Alain Danielou, a physicist / musicologist, into English so that I could work with the visual aspects of music through drawing and painting.

DRAWING AND PAINTING

I used curved axis, and radii which represented the ratios used in musical harmonics. I published an article reflecting some of this in the Journal "Leonardo" called "Paintings Based on Relative Pitch in Music".

As I went deeper into music theory I made more drawings based upon musical harmonics. These drawings were a sense of excitement to me, as I kept finding more and more connections with physics, the periodic table and ancient calendar systems. The key to my studies was always the ratios coded into color and note.

PYTHAGORAS AND COLOR CODING OF MUSICAL NOTES

It was Pythagoras (600 BC) who defined a relationship between musical notes and colors. Isaac Newton later used the same color system for coding the musical notes. As I read other authors and scholars I found that the color coding of the notes was markedly different in China for example where the note C became green, instead of the Pythagorean red.

COLOR

More recently I came up with the insight that colors and chakras both emit and absorb. And that these qualities are roughly in a complementary relationship to each other.

Complementary colors are colors located opposite each other on a color wheel, while complementary musical notes are known as musical fifths which means that they are in a

ratio of 3 to 2 to each other in frequency.

SYNTHESIZERS

In the mid-seventies after I had completed an art-plus-text manuscript on some of my discoveries about the Lambdoma diagram, I had the thought of making music based on these theories. I enrolled in a course at Robert Ceely's BEEP Studio where for two or three hours a night we learned about electronic music. At the end of the course each of us was allowed some individual time in his studio. I decided to compose short musical compositions for each of my drawings from two sections of my manuscript. One was called "Start, Stop and Think" and the other was called "The Other Side of Art". The entire four part manuscript was entitled "Eyes + Bars = Ideas".

I wrote a score for each drawing having numbered the drawings with musical notes, and in some cases short musical scores. We rehearsed each drawing / score, then played each on a Moog and Mini-Moog Synthesizer in Robert Ceely's studio. I made a cassette of these sounds which is called "The Other Side of Art" and "Start Stop and Think".

Robert Ceely had an oscilloscope in his studio, which depicted the shapes of the waveforms being played.

OSCILLOSCOPES AND SINE-WAVE GENERATORS

Because of this I bought my own oscilloscope and hooked it up to a Sharp reel-to-reel audio tape recorder with it's own amplifier and speaker system. I also purchased a sine wave generator. I had decided that I could not use a traditional tempered keyboard which was always fixed to a factor of the twelfth root of two. What I needed was a tone generator which would give me more exact harmonic frequencies based upon simple multiplications. I would set the sine-wave generator to a particular frequency which was dialed, and then record that sound for a certain number of seconds. Then I would mix two tones by using a "sound-with-sound" setting on the reel-to-reel tape recorder. It was

this method by which I produced more tapes and would then watch the wave forms on the oscilloscope. It was a trial and error method, by which I would then re-record the sounds which had the most beautiful shapes.

LASER PATTERNS

About the same time as I was experimenting with the shapes I was invited to see a demonstration with a laser-scanner system in the apartment of a friend of Robert Ceely's. The laser projected the shapes of the sounds played. I decided to try to find a way of doing this myself, as I had the table of ratios which created the most significant shapes in the form of the Lambdoma Diagram. I went to The Center for Advanced Visual Studies at M.I.T. where I spent some time talking to Paul Earls. He told me where to purchase a laser and where to order the scanners. This is all described in the article in Leonardo called "Laser Lissajous Figures and the Lambdoma Diagram" which I wrote in the mid-seventies.

MATHEMATICS

By this time I decided I must learn more about mathematics in order to understand the finer workings and structure of the Lambdoma Matrix. There was a course being given at Boston University in the summer called "Art, Math and Music". I enrolled in it. We were told we each were going to write our own course based upon our particular disciplines. It was a course given by the Math Education Department. I decided then to apply for a Master's Degree in Math Education. I was accepted in the program that fall. It took me four years to complete a two year's master's program. I had to relearn math from elementary school math to high school math and finally college and graduate school math. I was able to take courses in Calculus, Linear Algebra, Numerical Analysis, and Computer Science. Those were my favorites. It was while taking a course in Abstract Algebra that I learned that the Lambdoma Diagram was in effect a Matrix known as the Cantor Array and that it did not fit into the known axioms. The Cantor Array did not have

any musical intervals attached as did the Lambdome.

This freed me to realize that I was free to interpret the Lambdome diagram in the art and music ways that I intuited. As a result of studying mathematics, I wrote a draft of a pre-calculus level course on the subject of some of the "Mathematics of the Lambdome Matrix." This draft has not yet been published.

THE EXPERIMENTAL MUSIC STUDIO AT M.I.T.

I applied for a summer course at M.I.T. in Computer Music Synthesis and was accepted. It was there that the matrix I had translated into musical frequencies while studying Computer Science at Boston University, was translated into a software program for generating the actual musical frequencies of the harmonic series of the Lambdome Diagram. Twenty minutes of sounds were created by this matrix, which at that time was in a dimension of a 20 by 20 array. (I have since been using a 16 by 16 array) I tried to create a matrix using the 14th power of the frequencies to simulate octaves of light. The program went well but of course no sound came out of the speakers.

I wrote a short article for the Leonardo Journal on Computerized Synthesized Sound which was not published.

THERAPEUTIC USES IN DRUG REHABILITATION UNITS USING LAMBDOMA SOUNDS

For seven years I worked as an art therapist at a residential drug center using my Lambdome generated sounds and asking the participants to "draw what they thought the sounds might look like visually". The results were very encouraging. One of my theories about the success of this method was the ability of the perfect mathematical structure of the music to "entrain" the logical mind and thus free the intuitive or creative mind of the participants. Two art shows were given from the results of these workshops one at the Boston City Hall, and the other at the Cambridge Center For The Arts. The press review of the first was good. At the

same time I was a visiting artist for the Prison Art Project under contract for six months. I used the same method in the prison when I went once a week. I was able to use pre-recorded sound only three times for security reasons. The inmates of all the prisons in the area also had a showing at the Federal Reserve Building in Boston. The teaching artists also exhibited at the same time with no way of knowing who was a teacher and who was a student. It was at that exhibit that I showed paintings and also my video called "Seeing Sound" showing the shapes of sounds by means of a laser / scanner system. I wrote another article for the Journal Leonardo called "Drawings Based on Laser Lissajous Figures and the Lambdome Diagram" which was published in 1978. I presented a paper to the United States Psychotronics Association describing the success of my use of music in my art therapy program in the drug rehabilitation program at the Third Nail. (See chapter: "Drug Free Art")

PRISON, EGYPT AND THE LAMBDOMA

It was while I taught Mondays at the Prison that I was aware of the Egyptian motifs which the inmates drew. Just the week before I started the program I had heard a lecture given by Professor Dan Baer of Boston College describing a trip to Egypt scheduled for the following spring. When Dan Baer showed a slide of the Pyramids and said that no one knew how the Pyramids were constructed, I jumped up from my seat and words came out of my mouth saying, "I think I know how it was done." I had had an image of the mathematics of the Lambdome having a role in the construction of the Great Pyramid. I decided then to sign up for the two week journey. The price was \$1,600.- for two weeks. My six month contract at the prison became \$1,600.- which paid for the trip. The week after I started teaching I broke my foot walking into a hole on the lawn of my youngest son's school. For the next six weeks I was on crutches in a pink, jump suit which was the only thing I could put on over the cast. Each Monday I would go to the prison with my assistant to conduct the day long workshops. I also continued to teach one day at the Third Nail Drug Rehabilitation Program. This was my initiation in preparation for Egypt. I had essentially finished my Master's of Math Education pro-

gram, with the exception of an independent studies program in which I made my first videotape of the images generated by the sounds projected through a laser / scanner system.

In Egypt, on the second day of the tour, groups of us entered the Great Pyramid. Since there were 200 in our group, just a few of us could enter at one time. It was while entering the Grand Gallery of the Great Pyramid that I felt this uncontrollable sobbing which was as if something was sobbing through me. I felt a familiarity with the place and a recognition of it in each cell of my body. It was because of this reaction that I decided several years later to study the dimensions of this gallery which is 157 feet long and about 25 feet high. In the process of analyzing this space, based upon it's wavelength, it was possible to determine the resonant frequency of the Gallery. The Grand Gallery was like a huge musical instrument to me. The courses of it's narrowing height became a Lambdome scale starting with the note E and ending with the same note one octave higher. I subsequently have written a paper on this which I delivered in 1988 to the United States Psychotronics Association (USPA) but which has not yet been published. (See chapter: "Music From the Grand Gallery") There are video and audio tapes of this presentation available from the USPA. This led to my working with finding the musical harmonies in architecture.

ARCHITECTURE AND THE LAMBDOMA

In March 1989 I presented a three day workshop to a Boston area group called Timeless Architecture. I described the possibilities of working with ratios, colors and wavelengths of sounds for the purpose of constructing or identifying the musical consonances or dissonances of room dimensions.

A group of us made a tape in the King's Chamber of the Great Pyramid in 1984. I often play this tape to audiences so that they can feel the effect of the chamber reproduced for them by the sounds alone. In one workshop one of the participants actually visualized a dark chamber with a woman dancing (which is what had happened while we performed in

the chamber in 1984). Many individuals are very moved by the sounds. A cello, flutes and women's voices were the musical instruments as well as a small sine wave generator. I used a portable, frequency counter to tune the cello to its lowest note which was at 60 cycle per second and resonant to the natural frequency of the chamber. I have found, from a sample testing of about 100 people to certain notes on our musical scale, that the note C is a very irritating, awakening sort of sound. That is one of the resonant notes in the King's Chamber whose height is over 18 feet. The other dimensions of the King's Chamber are 17 by 34 feet, which is a note B. According to some of my theories of the chakras these dimensions are the root chakra C and the crown chakra B which theoretically encompass the entire chakra system. Another of my theories is that the ancients knew a way of assimilating time and space by having the wavelengths and the frequencies as close together as could be.

For instance the length and width of the King's Chamber is a relationship of an octave musically, 17 by 34 feet. 34 feet in wavelength represents 33 cycles per second in frequency. I have had a theory for many years that as space expands time contracts or vice versa. If this is true then a balance of space / time is more nearly formed in a room of 34 feet which resonates to the note C at 33 cycles per second.

WORLD HARMONY BASED ON THE DISTANCES OF CITIES FROM EACH OTHER MUSICALLY

In 1986 I presented a paper to the United States Psychotronics Association on "International Harmony Based upon a Music of Planetary Grid Systems". It was subsequently published by the USPA and then later republished in a book called "Anti-Gravity and the World Grid", edited by David Childress.

Because of this publication Don Conreux of New York City has been working with this system in designing Peace Bell Gardens around the world. The theory is that if each city has a Peace Bell Garden tuned to the frequencies of

other groups of cities in different countries, harmony on subtle levels might be created among the various and diverse cities.

MUSIC OF THE PLANETARY SYSTEM

There have been others who have been working with the music of the planets. Michael Heleus, a group at Yale University and others. A musical piece was written for the Harmonic Conversion of 1987 based on the notes of each planet in our solar system in their yearly orbits around the sun. The periods of the orbits were converted to seconds to form analogies to musical notes in cycles per second. This is explained more fully in my unpublished math paper. (See chapter: "Mathematics of Musical Sound")

THE CONNECTION WITH THE COPTIC FELLOWSHIP

While in Egypt I met John Davis head of the Coptic Fellowship in America. I decided to continue my interest in Egypt by joining that group. For two years I taught the lessons, given by Hamid Bey, the founder of the Coptic Fellowship, at the Theosophical Society in Boston.

Finally I became an ordained minister of The Coptic Fellowship in America, following the Order of Melchizedek. I gave a workshop, at the Coptic's annual conference in 1989, called the "Sounds of the Sphinx" and played the Grand Gallery cassette.

Two native Egyptians in the room asked "How did you get Egyptian Women to sing in the King's Chamber, they were using words in the native language?" I replied we were all from the United States, and were singing the essence of the place".

A WORKSHOP IN IOWA

I was invited to give a workshop in Iowa several years

ago. They were to pay my airfare from the proceeds of the workshop. A few days before I was to leave, they called to say that only a chiropractor and a farmer had registered for the workshop. I meditated on it and said I would go anyway. I arrived and set up the electronic equipment, microphones, laser / scanner, amplifier, sine-wave generators, speakers, cassette deck and slide projector. About fifteen individuals arrived for the evening lecture. When I showed the Lambdoma matrix, one woman recognized it from somewhere deep in her consciousness of the past. That night she had a dream about Pythagoras and temples and lessons of music and mathematics. The next day was an intensive workshop. During the final question period, at each question, a chiropractor, who was sitting in the first row, would turn around and answer each question with "What she meant was . . ." He was a musician as well as a chiropractor, and several months later he gave a lecture reviewing my presentation.

CONSULTING SERVICES

Over the years I have had many requests for lectures, workshops and concerts of Lambdoma music. Presentations of Lambdoma wisdom have been given at The Maine Composer's Festivals, Real Art Ways in Connecticut, the Maine Healing Arts Festival, the Boston Artist's Guild, Boston Film Video, The Theosophical Society in Boston, as visiting artist at the University of Massachusetts in Amherst, the Swedenborg Society in Boston, the PSI Society in Lexington, the Association for Research and Enlightenment in Virginia Beach, the Institute of Technology at Rochester, Franklin Furnace in New York City, The Coptic Fellowship in America in Michigan and Timeless Architecture in Boston.

