Integrative Music of the Lambdoma

Presented at The Pavlovian Society's Plenary Session, October 1, 1999

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Introduction

MUSICAL NOTES ARE SOUNDS at specific frequencies. At the present time in the Western world, scales are usually based upon a fixed man-made formula, called a tempered scale. The original harmonic scale, based upon Pythagoras' insights, was made up of a matrix of *whole-numbered ratios. These ratios determine the harmonic progression* and sub-harmonic progression of a cluster of scales. When a specific frequency is multiplied by a specific ratio a second frequency is defined. The relationship between any two frequencies in music is called an interval. When two tones, whose frequencies are in a whole-number relationship to each other, are played simultaneously, the interval is harmonic. Harmonic intervals are "consonant" or "pleasing" or "smooth" and provide aesthetic satisfaction. All the intervals in a Lambdoma matrix of ratios are consonant with each other. The word "octave" describes the doubling or the halving of a frequency, such as the note "C" and the similar note "C" above or below the original "C" (a ratio 2:1 or 1:2). A musical "fifth" (a ratio of 3:2) and a musical "fourth" (a ratio of 4:3) are of universal preference. Pythagoras attempted to find a mathematical relationship between intervals and aesthetics, suggesting that the simpler the ratio of the two parts, into which an instrument's string is divided, the more perfect is the consonant of the two sounds produced. Finally, the Lambdoma matrix is based upon harmonic ratios, all defining consonant relationships to any fundamental frequency of sound that is given as the 1:1 entry for the 16 by 16 matrix. This means that *multiple scales of different frequencies, all in a harmonic relationship to each other, may* be found for an infinite variety of fundamental frequencies in an infinite variety of matrices. It is this factor that leads to an interdisciplinary decoding of harmonic relationships between objects in many fields, including the arts, sciences, and human behavior.

The Lambdoma matrix includes special harmonic scales of music that enhance our sensation of physical, emotional, mental and spiritual stimuli levels. With the advent of the computer, these scales can be reproduced in any audible frequency based upon any keynote. The full Lambdoma matrix can encompass 256 separate intervals that are completely harmonic in their 16 ascending harmonic rows of scales and 16 descending columns of

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Integrative Physiological and Behavioral Science, July-September 2000, Vol. 35, No. 3, 224–232.

sub-harmonic scales. Due to the whole number ratios that generate the music of the Lambdoma matrix, analogies may be drawn to frequency, wavelength, color and geometry. This music is interdisciplinary and applies to the physiological and behavioral sciences.

Musical intervals based upon The Lambdoma Matrix's (attributed to Pythagoras) appear to have remarkable psychophysical properties inherent within them. The psycho-physiological effects on human adaptation are evident when the Lambdoma Matrixís whole-number ratios are translated into harmonic musical intervals, by the hardware and software of the Lambdoma Harmonic Keyboard. See Figure 1. The use of the Lambdoma keyboard, to aid in stress reduction and to enhance a feeling of well being, offers many possibilities.

History of the Early Research of the Lambdoma

The research of the Lambdoma was created to discover additional alternative methods for applying music to benefit individuals psychologically and physically. Current methods include those of Pythagorean origin (Pythagoras was assumed to have healed with music). Pythagoras used whole-number ratios to create what is known as the diatonic scale. This paper attempts to illustrate the powerful healing effects of harmonic interval music. The Lambdoma method enables one to choose an audible fundamental frequency that governs an entire matrix of ratios encompassing a mathematical harmonic structure. The client's choice of frequency appears to yield psycho-physiological effects. This study suggests that listening or playing harmonic interval music based upon the Lambdoma method influences a change of consciousness, a recognition of one's life's missions, relief from pain and heightened awareness.

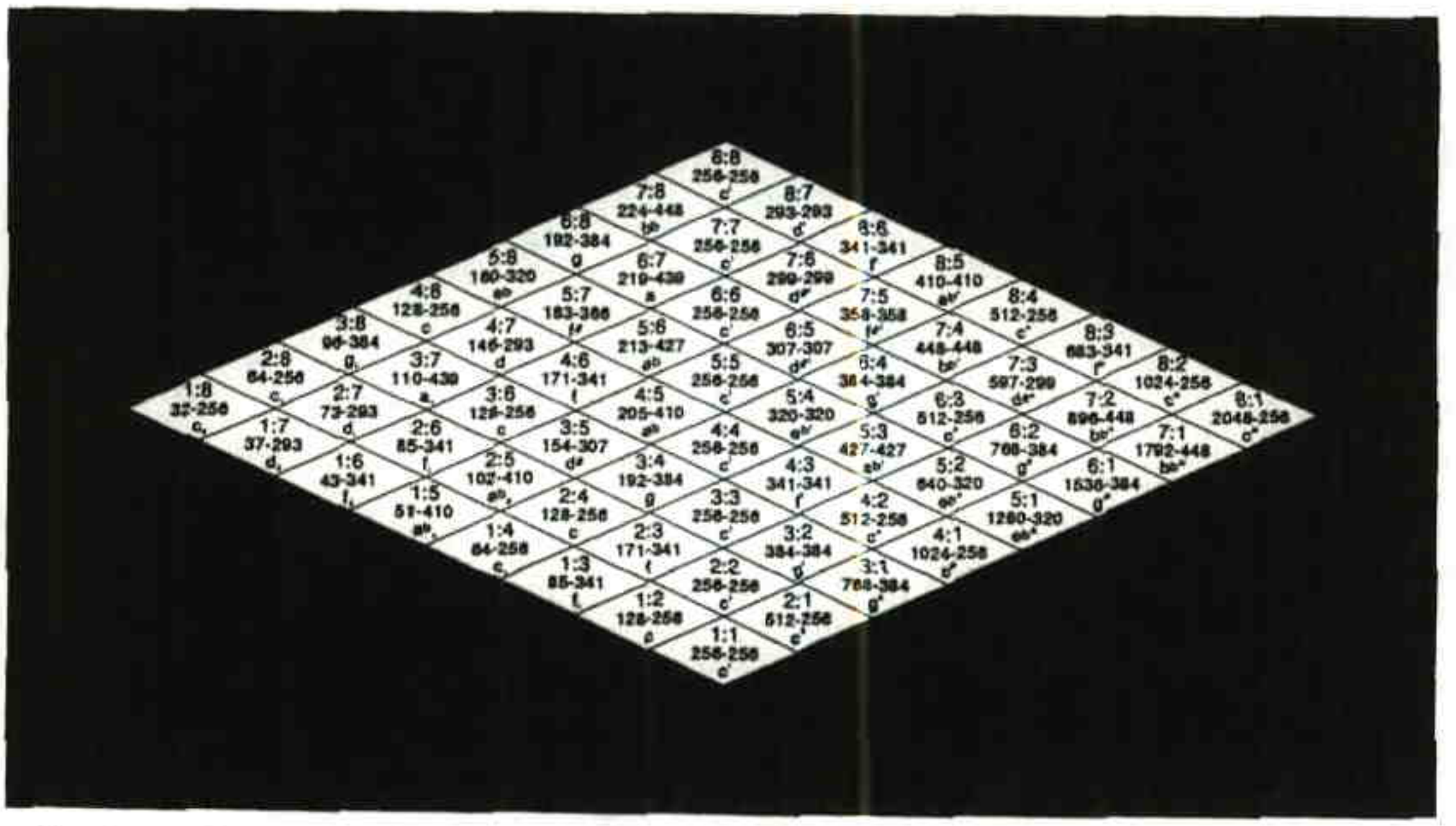

FIG. 1. The One-Quadrant Lambdoma Harmonic Keyboard

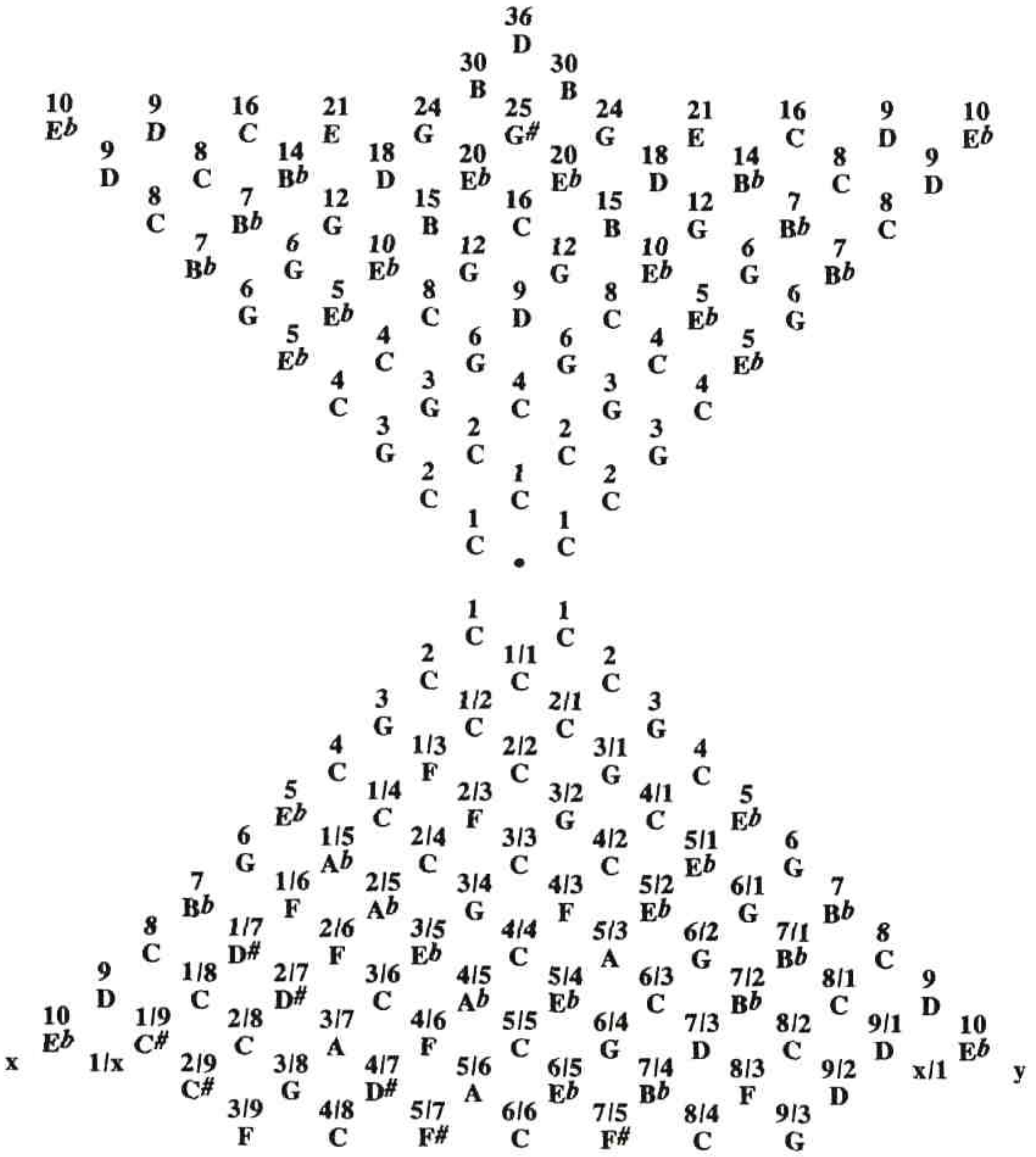

FIG. 2. The Pythagorean Tetractys "Chi X" with Notes Added

Background

One of the origins of the Lambdoma appears to be the Pythagorean Tetractys or Chi X shown in Figure 2. One can only surmise how Pythagoras developed the Tetractys, but according to Alexander Roob "The Tetractys forms the basis of the image of the cosmic soul, to whose structure in the form of a Chi (X) Plato refers in the 'Timaeus'. In line with the law of the proportional division of the (musical) chord, the matrix of all earthly phenomena unfolds here as a network of coordinates of fractions and multiples." The main similarity of the Lambdoma matrix and the Tetractys is found in the lower section (of the hourglass-like figure) that includes whole-number ratios except for the borders of whole numbers on either side. Figure 3 shows this similarity in a partial version of the Lambdoma matrix.

Music is created from the Pythagorean Tetractys figure or the Lambdoma matrix by selecting any frequency in the audible range and specifying it as the fundamental frequency. The audible range extends from about 20 to 20,000 cycles per second (Hertz) (Hz), for most people. No matter which frequency is chosen there will always be a harmonic relationship between all the frequencies in the lower part of the Tetractys. The highest frequency will be the chosen fundamental frequency multiplied by 10. The lowest frequency will be 1/10 of the chosen fundamental frequency. The Lambdoma harmonic series may be thought of as composed of the whole numbers 2, 3, 5, 7, 9, 11, 13, and 15. Since frequencies of these low numbers are inaudible, they may be raised to an audible octave range by doubling. A simple way to calculate musical notes from the following numbers is to remember that 2 is <C, 3 is <G, 5 is Eb, 7 is <Bb, 9 is <D, 11 is <F#, 13 is <Ab, and 15 is <B in the harmonic series. By doubling these odd numbers a sufficient number of times we generate our reference octave scale, of 256 <C, 288 <D, 320 Eb, 352 <F#, 384 <G, 416 <Ab, 448 <Bb, 480 <B and 512 <C. Figure 4 illustrates a full 16 by 16 Lambdoma matrix with the closest tempered scale note correspondences. Once we have

INFINITY / INFINITY

					1/1							
				1/2	**2/2**	**2/1**						
			1/3	**2/3**	**3/3**	**3/2**	**3/1**					
				1/4	**2/4**	**3/4**	**4/4**	**4/3**	**4/2**	**4/1**		
			1/5	**2/5**	**3/5**	**4/5**	**5/5**	**5/4**	**5/3**	**5/2**	**5/1**	
		1/6	**2/6**	**3/6**	**4/6**	**5/6**	**6/6**	**6/5**	**6/4**	**6/3**	**6/2**	**6/1**
	1/7	**2/7**	**3/7**	**4/7**	**5/7**	**6/7**	**7/7**	**7/6**	**7/5**	**7/4**	**7/3**	**7/2**	**7/1**

ONE / INFINITY **INFINITY / ONE**

FIG. 3. A partial Lambdoma Matrix of Ratios

x → / y ↓	Funda- mental	Octave 128	4 th	Octave 64	6 th minor	4 th	2 nd	Octave 32	7 th minor	6 th minor	5 th diminished	4 th	3 rd minor	2 nd	2 nd minor	Octave 16
Funda-	C=256 Hertz															
mental	1:1 C	2:1 C	3:1 G	4:1 C	5:1 E♭	6:1 G	7:1 B♭	8:1 C	9:1 D	10:1 E♭	11:1 G♭	12:1 G	13:1 A♭	14:1 B♭	15:1 B	16:1 C
Octave 128	1:2 C	2:2 C	3:2 G	4:2 C	5:2 E♭	6:2 G	7:2 B♭	8:2 C	9:2 D	10:2 E♭	11:2 G♭	12:2 G	13:2 A♭	14:2 B♭	15:2 B	16:2 C
4 th	1:3 F	2:3 F	3:3 C	4:3 F	5:3 A♭	6:3 C	7:3 D♯	8:3 F	9:3 G	10:3 A♭	11:3 B♭	12:3 C	13:3 D♭	14:3 D♯	15:3 E♭	16:3 F
Octave 64	1:4 C	2:4 C	3:4 G	4:4 C	5:4 E♭	6:4 G	7:4 B♭	8:4 C	9:4 D	10:4 E♭	11:4 G♭	12:4 G	13:4 A♭	14:4 B♭	15:4 B	16:4 C
6 th minor	1:5 A♭	2:5 A♭	3:5 D♯	4:5 A♭	5:5 C	6:5 D♯	7:5 F♯	8:5 A♭	9:5 B♭	10:5 C	11:5 D	12:5 D♯	13:5 F	14:5 F♯	15:5 G	16:5 A♭
4 th	*1:6* F	*2:6* F	*3:6* C	*4:6* F	*5:6* A♭	*6:6* C	*7:6* D♯	*8:6* F	*9:6* G	*10:6* A♭	*11:6* B♭	*12:6* C	*13:6* D♭	*14:6* D♯	*15:6* E♭	*16:6* F
2 nd	1:7 D	2:7 D	3:7 A	4:7 D	5:7 F♯	6:7 A	7:7 C	8:7 D	9:7 E	10:7 F♯	11:7 G♯	12:7 A	13:7 B	14:7 C	15:7 C♯	16:7 D
Octave 32	1:8 C	2:8 C	3:8 G	4:8 C	5:8 E♭	6:8 G	7:8 B♭	8:8 C	9:8 D	10:8 E♭	11:8 G♭	12:8 G	13:8 A♭	14:8 B♭	15:8 B	16:8 C
7 th minor	1:9 B♭	2:9 B♭	3:9 F	4:9 B♭	5:9 D	6:9 F	7:9 G♯	8:9 B♭	9:9 C	10:9 D	11:9 E♭	12:9 F	13:9 G♭	14:9 G♯	15:9 A	16:9 B♭
6 th minor	1:10 A♭	2:10 A♭	3:10 D♯	4:10 A♭	5:10 C	6:10 D♯	7:10 F♯	8:10 A♭	9:10 B♭	10:10 C	11:10 D	12:10 D♯	13:10 F	14:10 F♯	15:10 G	16:10 A♭
5 th diminished	1:11 G♭	2:11 G♭	3:11 D♭	4:11 G♭	5:11 B♭	6:11 D♭	7:11 E	8:11 G♭	9:11 A♭	10:11 B♭	11:11 C	12:11 D♭	13:11 E♭	14:11 E	15:11 F	16:11 G♭
4 th	1:12 F	2:12 F	3:12 C	4:12 F	5:12 A♭	6:12 C	7:12 D♯	8:12 F	9:12 G	10:12 A♭	11:12 B♭	12:12 C	13:12 D♭	14:12 D♯	15:12 E♭	16:12 F
3 rd minor	1:13 E♭	2:13 E♭	3:13 B	4:13 E♭	5:13 G	6:13 B	7:13 C♯	8:13 E♭	9:13 F♯	10:13 G	11:13 A	12:13 B	13:13 C	14:13 C♯	15:13 D	16:13 E♭
2 nd	*1:14* D	*2:14* D	*3:14* A	*4:14* D	*5:14* F♯	*6:14* A	*7:14* C	*8:14* D	*9:14* E	*10:14* F♯	*11:14* G♯	*12:14* A	*13:14* B	*14:14* C	*15:14* C♯	*16:14* D
2 nd minor	1:15 C♯	2:15 C♯	3:15 G♯	4:15 C♯	5:15 F	6:15 G♯	7:15 B	8:15 C♯	9:15 D♯	10:15 F	11:15 G	12:15 G♯	13:15 A	14:15 B	15:15 C	16:15 C♯
Octave 16	1:16 C	2:16 C	3:16 G	4:16 C	5:16 E♭	6:16 G	7:16 B♭	8:16 C	9:16 D	10:16 E♭	11:16 G♭	12:16 G	13:16 A♭	14:16 B♭	15:16 B	16:16 C
		OCTAVE	5 th	OCTAVE	3 rd	5 th	7 th minor	OCTAVE	2 nd	3 rd	4 th aug- men- ted	5 th	6 th minor	7 th minor	7 th	OCTAVE

FIG. 4. A Full Lambdoma Matrix of Ratios and Notes

chosen a fundamental frequency, in the middle C octave, the ratios of the matrix automatically define all of the other harmonic frequencies. Note the ratios in the enclosed rectangle of the 8th sub-harmonic row in figure 4. These ratios are 8:8, 9:8, 10:8, 11:8, 12:8, 13:8, 14:8, 15:8 and 16:8.

Techniques of Composing Lambdoma Music

In the early 1970s, Barbara Hero first created Lambdoma intervals and music by using two sine wave generators and dialing the frequencies based upon a harmonic series. Indi-

vidual sounds were recorded and then combined using "sound with sound" to create overlays of individual pairs of frequencies. Later, an oscilloscope and laser device were used to project the shapes of the individual pairs of frequencies, both visually and audibly, which allowed for fine-tuning of the recorded intervals into the most correct ratios. The rhythms were created solely by the natural sound relationships between two or more sine waves being heard simultaneously.

The Lambdoma Harmonic Keyboard relies upon a musical structure of an entire 256-entry, whole-number-ratio matrix. A matrix of harmonic and sub-harmonic scales, all related to a selected fundamental keynote, is heard as opposed to hearing a linear melody line of only one scale. The Lambdoma harmonic scale consists of eight interval notes based entirely upon the ratios from the eighth harmonic through the sixteenth harmonic: 8:8, 9:8, 10:8, ... and16:8. Much like the traditional tempered scale, (C, D, E, F, G, A, and B), the Lambdoma scale has notes assigned the letters P, Q, R, S, T, U, V and W. Different letters are used in order to differentiate the Lambdoma scale from the tempered scale in terms of number of interval notes and ratios. Table 1, below, describes the Lambdoma scale with the corresponding sound frequencies, tempered scale notes and ratios.

TABLE 1
Lamboma Scale, Frequencies and Ratios

Scale Note	*P*	*Q*	*R*	*S*	*T*	*U*	*V*	*W*	*P*
PFrequency (Hz)	256	288	320	352	384	416	448	480	512
Tempered Note	C	D	Eb	F#	G	Ab	Bb	B	C
Ratio	8:8	9:8	10:8	11:8	12:8	13:8	14:8	15:8	16:8

When P (256 Hz) is chosen as the fundamental frequency, the difference between each interval on the keyboard is 32 Hz, as 256 Hz can be divided into 8 portions containing 32 cycles per second. When Q (288 Hz) is chosen as the fundamental frequency, the difference between each interval increases to 36 Hz. As one continues the progression, 4 Hz are added each time between each of the keynote intervals of P, Q, R, S, T, U, V and W. To obtain a harmonic scale pattern, the fundamental frequency is multiplied by each of the ratios, beginning with the eighth harmonic. For example, the harmonic scale pattern for the note Q is represented by Table 2, below.

Methodology of using the Lambdoma Keyboard to access profound States of Consciousness

Preliminary studies suggest that some individuals. while playing the Lambdoma harmonic keyboard, have accessed enhanced states of consciousness. In these studies, the subjects were asked to select a fundamental frequency that was appealing to them, a duration for each interval, and a favorite quadrant (from which the most appealing frequen-

TABLE 2
Lambdoma Scale Transposed to the Original Q's Frequency of 288 Hz

Interval Frequency by Ratio	*36x8*	*36x9*	*36x10*	*36x11*	*36x12*	*36x13*	*36x14*	*36x15*	*36x16*
Frequency (Hz)	288	324	360	396	432	468	504	540	576
Ratio	8:8	9:8	10:8	11:8	12:8	13:8	14:8	15:8	16:8

cies derived) was noted (Figure 5). As each subject played the Lambdoma keyboard, their chosen fundamental frequency was programmed into the keyboard and sounded simultaneously with the harmonically similar interval frequency created by the key pressed. The duration, that each interval would be sounded, was chosen by the subject to be either 1/8, 1/4, 1/2, 1, 2 or 4 seconds.

In developing the harmonic matrix, definitive properties for each quadrant came to light. The first quadrant contains the greatest range of octaves, from three octaves below the fundamental frequency to three octaves above the fundamental frequency. The second quadrant contains the highest frequencies, whereas the third quadrant contains the lowest frequencies. The fourth quadrant contains the micro-tonal frequencies and is more like a typical scale. Each quadrant represents some form of psychological or physiological quality. The first quadrant is said to be the emotional quadrant, whereas the second quadrant represents spirituality. The third quadrant is said to be the physical quadrant and the fourth quadrant is the mental quadrant. The subjects were encouraged to explore psychological or physiological questions pertaining to the quadrant they were playing, such as focusing on physical problems while playing the third quadrant or asking themselves higher-self questions while playing the fourth quadrant.

Results

Though the results of the preliminary studies are not quantitative, they suggest that Lambdoma keyboard music played using a chosen frequency changes both the psychological and physical states. The subjects reported that psychologically, they felt relaxed and sleepy, with "good" energy. For some subjects, the music unlocked memories, or brought about mental images of a kaleidoscope of colors, whereas for others the music provided a sense of their missions or goals in life. When the subjects focused on their physical pain

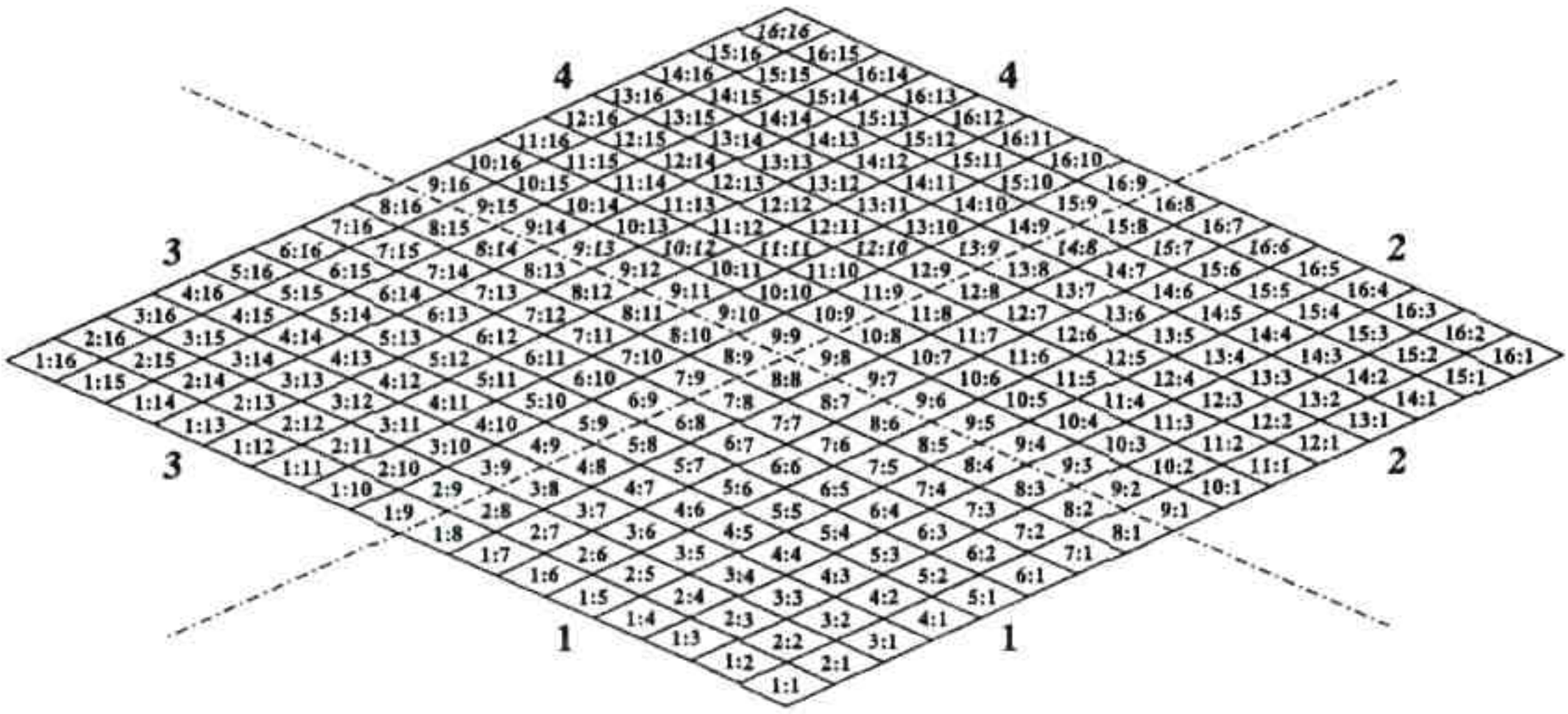

FIG. 5. The Four Quadrants of the Full Lambdoma Harmonic Keyboard with Ratios

while playing the Lambdoma music, many reported relief from pain, a sense of warmth and relief from headaches. Others "felt" the music in their bodies.

Conclusion

In the studies presented in this paper, subjects were able to listen to harmonic intervals of their own choosing that appeal to them and subsequently reported psychological and physical relief upon conclusion of these studies. As more and more composers and musicians become interested in utilizing music as effective therapy, examination into these alternative methods is essential to unlocking the "powerful effect of music." With the advent of computer technology, audio and graphic software programs are increasing the ability to develop more harmonic musical sequences. Other areas of study may include examining why subjects choose particular quadrants, discovering the neurological pathways activated while listening to harmonic music, and comparing the keynotes most frequently chosen (and why). Controlled studies would be more likely to find more answers to these and other questions.

Acknowledgments

My appreciation to Robert Miller Foulkrod without whose expertise in computer programming, understanding of hardware, electronics and editing, this material might have lain hidden. Our thanks go to Richard M. Norley who helped wire the first prototype Lambdoma Keyboard as well as being the web master for the Lambdoma web-site and domain. Richard Lord programmed the Lambdoma Keyboard's internal chip to shake hands with the Amiga computer. David Bellantone designed the housing for the Lambdoma Keyboard. A conversation with the just intonation composer Erv Wilson, an Editor of Xenharmonikon is responsible for the suggestion of the diamond shaped keyboard. My thanks to Dr Frances Ehrlich, M.D. for helping assist in several workshops. My thanks to Dr. Daniel Schneck, of Virginia Tech for recognizing the value of the harmonics of the Lambdoma Matrix, and for enabling this wisdom to spread to wider and more diverse audiences such as the IEEE Engineering in Medicine and Biology Society and the Pavlovian Society.

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