Musical Scales from Pythagoras to Dr. H. Spencer Lewis

Robert Waggener, Ph.D., Lawrence Murray, and Doss McDavid, Ph.D.

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Abstract

Pythagoras developed an eight-note musical scale in which ratios of small whole numbers were used to define the length of the strings. While Pythagoras committed nothing to writing, later Pythagoreans wrote a good deal about these matters, and these principles were used to tune musical instruments until fairly modern times. In the seventeenth century, equal-tempered chromatic scales were introduced in which the frequencies of successive notes differ by a common ratio. In the early days of Rosicrucian activity in America, H. Spencer Lewis published a system of "natural harmonics" in which the notes of the chromatic scale were correlated with the colors of visible light and certain vowel sounds. Dr. Lewis used a value of middle C (C4), 273 Hz, that was based on a specific wavelength of green light in the middle of the visible spectrum. Modern scales, on the other hand, use values such as 256 Hz and 262 Hz for middle C. As the physiological and psychic effects attributed to the musical notes may be a function of the scale used, this paper examines and compares different musical scales. Based on this examination, it is believed that no one frequency for middle C is best for all occasions.

Les gammes musicales de Pythagore à Spencer Lewis

Par Robert Waggener, Ph.D., Laurent Murray et Doss McDavid, Ph.D.

Résumé

Pythagore a développé une gamme musicale de huit notes *(accord pythagoricien)* qui utilisait les rapports de petits nombres entiers pour définir l'accord. Tandis que Pythagore ne cocha guère ses théories par écrit, des pythagoriciens ont ultérieurement écrit de nombreux traités sur cet argument et ses principes ont été utilisés pour accorder les instruments de musique jusqu'à la fin du Moyen-Age. Le XVIIe siècle vit l'introduction des gammes tempérées *(tempérament égal),* dans lesquelles les fréquences des notes successives sont reliées par une relation commune *(intervalles égaux).* Dans les premiers temps d'activité de la Rose-Croix en Amérique, le Docteur H. Spencer Lewis publia un système d' « harmoniques naturels », dans lequel les notes de la gamme chromatique sont en corrélation avec les couleurs de la lumière visible et avec certaines voyelles. Le Dr. Lewis utilisa à cet effet une valeur pour le do central de 273 Hz, qui correspond à une longueur d'onde spécifique de la lumière verte du milieu du spectre visible. Les gammes actuelles, en revanche, utilisent des valeurs d'environ 262 Hz. Du moment que les effets physiologiques et psychiques attribués aux notes musicales peuvent différer selon les fréquences utilisées, cet article examine et compare les différentes gammes musicales. On en déduit qu'aucune fréquence unique pour le do central n'est idoine pour toutes les circonstances.

Escalas Musicales de Pitágoras a Dr. H. Spencer Lewis

Robert Waggener, Ph.D., Lawrence Murray, y Doss McDavid, Ph.D.

Resumen

Pitágoras desarrolló una escala musical de 8 notas en la que se usaban relaciones de pequeños números enteros para definir la longitud de las cuerdas. Mientras Pitágoras no se dedicó con algo escrito, más tarde los pitagóricos escribieron mucho sobre estos asuntos y estos principios se usaron para afinar los instrumentos musicales hasta tiempos bastante modernos. En el siglo XVII, se introdujeron escalas cromáticas de temperamento igual en las que las frecuencias de las notas sucesivas difieren en una proporción común. En los primeros días de la actividad Rosacruz en América, H. Spencer Lewis publicó un sistema de "armónicos naturales" en el que las notas de la escala cromática se correlacionaban con los colores de la luz visible y ciertos sonidos vocálicos. El Dr. Lewis usó un valor de C medio (C4), 273 Hz que se basó en una longitud de onda específica de luz verde en el medio del espectro visible. Las escalas modernas, por otro lado, usan valores como 256 Hz y 262 Hz para C. media. Como los efectos fisiológicos y psíquicos atribuidos a las notas musicales pueden ser una función de la escala utilizada, este documento examina y compara diferentes escalas musicales. Según este examen, se cree que ninguna frecuencia para la C media es mejor para todas las ocasiones.

Escalas Musicais de Pitágoras ao Dr. H. Spencer Lewis

Robert Waggener, Ph.D., Lawrence Murray e Doss McDavid, Ph.D.

Sumário

Pitágoras desenvolveu uma escala musical de 8 notas, na qual as proporções de pequenos números inteiros eram usadas para definir o comprimento das cordas. Enquanto Pitágoras deixou nada por escrito, os pitagóricos escreveram muito sobre esses assuntos, e esses princípios foram usados para sintonizar instrumentos musicais até tempos relativamente modernos. No século XVII, foram introduzidas escalas cromáticas de temperamento igual, nas quais as freqüências de notas sucessivas diferem por uma relação comum. Nos primeiros dias da atividade rosacruz na América, H. Spencer Lewis publicou um sistema de "harmônicos naturais", no qual as notas da escala cromática eram correlacionadas com as cores da luz visível e certos sons de vogais. O Dr. Lewis usou um valor de C médio (C4), 273 Hz, que foi baseado em um comprimento de onda específico de luz verde no meio do espectro visível. Escalas modernas, por outro lado, usam valores como 256 Hz e 262 Hz para o médio C. Como os efeitos fisiológicos e psíquicos atribuídos às notas musicais podem ser uma função da escala usada, este artigo examina e compara escalas musicais diferentes. Com base neste estudo, acredita-se que nenhuma frequência para o meio C é a melhor para todas as ocasiões.

Die Musikskala von Pythagoras bis Dr. H. Spencer Lewis

Dr. Robert Waggener, Lawrence Murray, und Dr. Doss McDavid

Zusammenfassung

Pythagoras entwickelte eine musikalische Skala bzw. Tonleiter aus 8 Noten, wobei das Verhältnis natürlicher Zahlen genutzt wurde, um die Länge der Saiten zu bestimmen. Da keine Schriften des Pythagoras überliefert wurden, haben die Pythagoreer im Nachhinein viel hierüber niedergeschrieben. Diese Prinzipien wurden zum Stimmen von Musikinstrumenten noch bis vor Kurzen in unserer heutigen Zeit angewandt. Gleichzeitig temperierte und alterierte Skalen wurden im 17Jh. eingeführt. In diesem Modell waren die Frequenzen der aufeinanderfolgenden Noten durch ein einheitliches Zahlenverhältnis differenziert. H. Spencer Lewis bracht zur Anfangszeiten des Rosenkreuzertums in Amerika ein System „natürlicher Harmonien" heraus, wobei die Noten der alterierten Tonleiter verbunden wurden mit den Farben des sichtbaren Lichtes und mit bestimmten Vokalklängen. Hierzu nutzte Dr. Lewis den Wert des mittleren C (C4), nl. 273 Hz beruhend auf einer bestimmten Wellenlänge des grünen Lichtes, das sich in der Mitte des sichtbaren Spektrums befindet. Jedoch nutzen moderne Skalen für den mittleren C differenzierte Werte wie 256 Hz und 262 Hz. Insofern sie eine bestimmte Skala folgen, sollten bestimmte Musiknoten physiologische und psychische Auswirkungen hervorbringen. In diesem Sinne untersucht und vergleicht diese Abhandlung verschiedene Musikskalen. Beruhend auf die Ergebnisse kann man annehmen, dass es keine bestimmte Frequenz des mittleren C gibt, die generell am besten geeignet sei.

Development of the First Music Scale in the Western World

Pythagoras is commonly recognized as being the first in the Western world to provide a mathematical description of the octave and the seven notes of the diatonic scale. As Pythagoras never wrote anything, all of the available information about him was written by Pythagoreans after his time. Beginning with the ancient lyre, a seven-stringed instrument, Pythagoras added an extra string that gave him the ability to form what is known today as an *octave* (Levin 1994, 76-79). We believe the scale that Pythagoras originally used ran from a note that today we would identify as E3 (E below middle C). Pythagoras added the eighth string to the lyre as E', one octave above E and today known as E4. For the sake of simplicity, this discussion uses the eight notes of the modern scale running from C to C' as opposed to the original Pythagorean scale. The eight notes are as follows:

C, D, E, F, G, A, B, C' (C' has twice the frequency of C)

Using a monochord, a single string mounted in a keyboard with the fret being movable up and down the string to give different tones (Levin 1994, 24-28), Pythagoras quickly discovered that by using strings of the same size and type of material under the same tension, their relative length was related to their frequency (Levin 1994, 83-86). The shorter the length, the higher the frequency. He found that C', or twice the frequency of C, required a string length of ½ the length of the string length for C. So, doubling any frequency requires a string length of ½ the original string length. He also found that using 1 for the first-string length, or C in our notation, a string of ¾ length gave a harmonious tone with C, or what we now call note F above note C. In addition, he found that using a string of 2/3 length gave a harmonious tone above note C, or what we now call note G. (This interval is said to be the most harmonious in the octave.) These two notes, F and G, were also harmonious with C', or the frequency twice that of C, but with their relative string length reversed with the string length of C'.

Pythagoras had spent several years in Babylon (Boyer 1985, 41, 61) and apparently brought back the following mathematical concepts: (1) Arithmetic Mean, (2) Geometric Mean, and (3) Harmonic Mean (Guthrie 1987, 81). When these means are calculated between the note C and C' (twice the frequency of C), one obtains the following:

(1) Arithmetic Mean = (C + C') / 2 = (1 +2) / 2 = 3/2 or note G. The ratio of G frequency to C frequency (a musical fifth) is 3/2. The corresponding ratio of string length is 2/3.

(2) Geometric Mean = (C x C')^(0.5) = (1x2)^0.5 = 1.414… or note F#.

The Geometric Mean resulted in a note that was not used in the 8-note scale of Pythagoras, as it vibrated between the note we call G and the lower note we call F. This note (F sharp or G flat) is critical to our scale today and one can derive from it the square root of 2, which was not understood well at that time in Greek mathematics. This number is vital to current mathematics and musical scales.

(3) Harmonic Mean = 2x(C x C') / (C+C') = 2x(1x2) / (1+2) = 4/3 or note F. The ratio of F frequency to C frequency (a musical fourth) is 4/3. The corresponding ratio of string length is 3/4.

The only frequencies readily associated with Pythagoras are the base frequency, the fourth (defined by the harmonic mean), the fifth (defined by the arithmetic mean), and the octave or double frequency. At the same time, it is known that he used an eight-stringed lyre with eight distinct frequencies. Pythagoras wrote nothing concerning his scales, and other authors writing later used suppositions and conjecture concerning the actual values of some of the notes. The frequencies mentioned by various writers and by ourselves are conjectures, but they are for the most part realistic conjectures.

Our research has led us to conclude that Pythagoras had two separate diatonic scales. The scale most commonly identified with Pythagoras is a scale based on the so-called circle of fifths (Sethares 2004). The latter is derived by progressing to higher and higher frequencies using nothing but fifths (i.e., successive multiplication by 3/2 – F followed by C, G, D, A, E, B) and then bringing the frequencies into a single octave by multiplication or division by two. The relative frequencies for C, D, E, F, G, A, B, and C' using this scale are respectively 1, 9/8, 81/64, 4/3, 3/2, 27/16, 243/128, and 2. A second scale, today called the "just" intonation, uses the ratios 1, 9/8, 5/4, 4/3, 3/2, 5/3, 15/8. This system (Sethares 2004; Partch 1979; Campbell and Greated 1994; Wright 2009; Johnson and Gilmore 2006) has been attributed to Ptolemy (second century C.E.) but may actually go back to Pythagoras himself who used it as an esoteric system while popularizing the chain of perfect fifths as an exoteric system. Pythagoras may have realized that if G/C = 3/2 or musical fifth and F/C = 4/3 or musical fourth, then the ratio 5/4 can also be used to give the frequency of E or musical third so that the series (5/4), (4/3), and (3/2) represents the relative frequencies of E, F, and G with their relative string lengths being 4/5, 3/4, and 2/3. The note we call A was determined by raising E by a fourth. Thus (5/4) x (4/3) = 20/12 = 5/3. The note we call B was determined by raising E by a fifth. Thus (5/4) x (3/2) = 15/8. The note we call D was obtained by lowering G by a fourth. Thus (3/2) x (3/4) = 9/8. The note C' = 2xC. This gives all seven (or eight) notes of the diatonic scale used by Pythagoras, which we regard as the correct scale for mystical and occult purposes. In modern times, this scale was the one used by H.P. Blavatsky in her Esoteric Instructions (Blavatsky and Caldwell 2004).

Traces of these two systems can be found in ancient writings in which different writers following Pythagoras use two ratios to describe the same notes. The following table shows the ratios for the two scales along with their notes and string lengths. C is given a relative frequency of 1, and the other frequencies are a fraction higher than C up to C', which has a relative value of 2. Where one sees a difference in the frequency or string length for a particular note from those on the left side below, this indicates it was used for ordinary music. In those cases where they do not coincide, the exoteric scale differs from the esoteric scale by 81/80. For example, (5/4) x (81/80) = 81/64, (5/3) x (81/80) = 27/16 and (15/8) x (81/80) = 243/128. This difference is just at the limit of the ordinary ear for hearing the difference between two note frequencies. It would appear that Pythagoras was secretive about his occult and mystical scale and didn't tell everyone about it.

For both diatonic scales, it is possible to derive the relative frequencies of the chromatic scale, including the five black notes on the keyboard of a piano, or C#, D#, F#, G# and A#. Table 1 indicates these relative frequencies. If one takes the frequency number for note 1 and multiplies it by the frequency number for note 13, one obtains 1x2 = 2; similarly, for note 2 and note 12 (using the just intonation) one obtains (16/15) x (15/8) =2; note 3 and note 11 yields (9/8 x (16/9) = 2; note 4 and note 10 yields (6/5) x (5/3) = 2; note 5 and note 9 yields (5/4) x (8/5) = 2; and note 6 and note 8 results in (4/3) x (3/2) = 2. This leaves note 7 as square root (2) x square root (2) = 2.

Pythagorean Esoteric Scale			Pythagorean Exoteric Scale		
Note	**String Length**	**Frequency**	**Note**	**String Length**	**Frequency**
C	1	1	C	1	1
C#/Db	15/16	16/15	C#/Db	243/256	256/243
D	8/9	9/8	D	8/9	9/8
D#/Eb	5/6	6/5	D#/Eb	27/32	32/27
E	4/5	5/4	E	64/81	81/64
F	3/4	4/3	F	3/4	4/3
F#/Gb	(1/2)^(.5)	2^(.5)	F#/Gb	(1/2)^(.5)	2^(.5)
G	2/3	3/2	G	2/3	3/2
G#/Ab	5/8	8/5	G#/Ab	81/128	128/81
A	3/5	5/3	A	16/27	27/16
A#/Bb	9/16	16/9	A#/Bb	9/16	16/9
B	8/15	15/8	B	128/243	243/128
C	1/2	2	C	1/2	2

Table 1. Esoteric and exoteric scales of Pythagoras.

Besides the effect of string length, Pythagoras was also aware of the effect of string tension on frequency. The mathematical relationship that has been attributed to Pythagoras was wrong, but his original teaching seems to have been misunderstood and subsequently distorted by the passage of time (Levin 1994, 93-94). Today we know that as well as being inversely proportional to its length L, the frequency of a vibrating string is directly proportional to the square root of its tension T. Mathematically, the fundamental frequency of a vibrating string can be expressed as $f1 = (1/2L)\,(T/u)^{0.5}$, where u is the linear mass density. If one takes the same length of string for the following notes, C, F, G and C', and places a weight of 36 units on C, a weight of 64 units on F, a weight of 81 units on G and a weight of 144 units on C', the respective strings when struck will give the correct values for the ratio of their frequencies. The person writing about this used 6, 8, 9 and 12 for the weights (Levin 1994, 93-94). This was wrong and interestingly enough, Isaac Newton picked this up (McGuire and Rattamsi 1966, 108-143). Newton was very kind to Pythagoras and mentioned the ravages of time destroying the truth. Newton was also quite adamant in stating that the equations describing the gravitational attraction between two objects had been known in ancient times (Godwin 1993, 303-306).

Both Newton and Pythagoras shared a common bond in the sense that their major interest was not the research that made them both famous. Pythagoras' main obsession was the "music of the spheres," and the musical scale was simply discovered or invented to serve this obsession. For his part, Newton's main interest was a search for "A Hidden Code in The Original Old Testament." This required Newton to learn the ancient Hebrew language. He never found the hidden code; however, the code was actually found in modern times by the Israeli Secret Service and others after it was said to reveal the assassination of an Israeli president (Witztum, Rips, and Rosenbert 1994, 429-438; Drosnin 1998).

Musical Scales in Modern Times

In addition to the two systems of Pythagorean ratios that may be used for generating the notes of the chromatic scale, there is equal temperament. In this method, a constant multiplier is used between successive notes of the scale. To accomplish this, a factor of 2^(1/12) = 1.059463094… is used as the ratio between each successive note. This mathematical innovation was introduced by Simon Stevin at the beginning of the seventeenth century (Christensen 2002, 205). Using equal temperament, each note in our current scale is either lower or higher than the next note by a factor of 1.05946…. This automatically yields 2 as the difference for each octave. This multiplier is what is called an irrational number, meaning that the remainder goes on forever without repeating itself. Pythagoras is believed to have had no concept of an irrational number, and in fact when it appeared it was a great shock to the Pythagoreans in the time of Plato and almost destroyed their group. (Levin 1994, 120)

In 1938 and 1939, just before the outbreak of World War II, Adolph Hitler, using his propaganda minister, Joseph Goebbels (Tyrell 2015, 105), pressured the European countries to adopt 440 cycles/second (Hz) for A as the fundamental frequency for their music. It is known that an A4 = 435 Hz was common in France at that time and that 23,000 French musicians voted to keep A4 = 435 Hz. There were no changes at that time, but after World War II, A4 = 440 Hz was adopted as the frequency from which to tune. It is possible that the jazz musical industry in the U.S. lobbied for this tone. At the current time, many piano tuners in the U.S. are unable to readily tune from any note other than 440 Hz. Breaking from this custom, it has become popular in some circles to use 256 Hz for the frequency of middle C. With equal temperament, this results of a value of 430 Hz for A4.

Equal-tempered musical scales are a Pythagorean nightmare because 11 of 12 notes are necessarily irrational numbers. Even the chromatic scale based on the scale of Pythagoras has to have one irrational number in order to be accurate. This note is F#, the frequency of which is the square root of two times the frequency for C, or F = C x (2)^(1/2), which denotes the 7^{th} note in a 12-note octave.

A Rosicrucian "System of Natural Harmonics"

The Rosicrucian teachings include a great deal of information about the use of vowel sounds for mystical and occult purposes such as spiritual attunement and healing. Each vowel sound is associated with a particular musical note on which it is intoned. The assignment of these musical notes has an interesting history. One hundred years ago, in the early days of the present cycle of Rosicrucian activity, Dr. H. Spencer Lewis released a series of publications for members called "CROMAAT" (Lewis 1918). In one of these publications (CROMAAT C), a "system of natural harmonics" was presented in which various sounds were associated with specific notes of the chromatic scale and their corresponding vibratory rates in cycles per second (Hz). Table 2 indicates this association.

Sound	Musical Note	Frequency (Hz)
O as in "oh"	C	273
O as in "off"	C#	290
U as in "ruby"	D	306
I as in "in"	D#	323
E as in "red"	E	341
A as in "may"	F	361
A as in "hat"	F#	382
I as in "rice"	G	403
U as in "us"	G#	426
A as in "ah"	A	452
AU as in "Paul"	A#	476
E as in "bee"	B	505

Table 2. Correspondence among voice sounds, musical notes, and frequencies.

This system seems to have been used, at least in the beginning, to determine the notes on which the various vowel sounds are to be intoned. Thus, for example, OOM and AUM are intoned on D above middle C, while RA and MA are intoned on A (Waggener and McDavid 1983; Waggener and McDavid circa 1983).

In the "cosmic keyboard" chart at the beginning of CROMAAT C, the chromatic scale was aligned with various colors of the visible portion of the electromagnetic spectrum. The tabulated values begin with F# above middle C (thermal red), followed by G (dark red) and G# (black red). The usual prismatic colors then follow, the note A being assigned to the color red and followed by A# (orange), B (yellow), C (green), C# (blue), D (indigo), and D# (violet). The rest of the series was composed of two shades of extreme violet. Thus, after violet came E, assigned to "ultraviolet" (this refers to a visible color, not actual ultraviolet beyond the visible spectrum), followed by F (dark violet).

This color scheme can be extended to musical notes above and below those assigned to the various colors. Thus, middle C, which begins Dr. Lewis' table of vowel sounds, would correspond to the color green, followed by C# (blue) and the rest accordingly. The frequency assigned to C appears to have been derived from the color of green light. A representative value for the wavelength of green light is 5×10^{-7} meters. This corresponds to 500 nanometers (500×10^{-9} meters) or 5000 Angstrom units (5000×10^{-10} meters). One can convert this wavelength to frequency by dividing it into the speed of light. Thus 3×10^{8} meters/sec divided by 5×10^{-7} sec^{-1} $= 6 \times 10^{14}$ = 600 trillion cycles/sec. If one begins with this frequency and divides by 2, one obtains a frequency that is one octave lower than the original frequency. If one continues to divide again and again by 2, one goes down octave by octave until the range of frequencies associated with audible sound is reached. One thus arrives at a sound that is harmonically equivalent to a color. For green light with a wavelength of 5000 Angstroms, the corresponding audible "harmonic" is 272.848 cycles/sec (Hz), which rounds off to 273 (Hz). This is the number that appears for middle C in Table 3. The expanded table, including the colors assigned to each note, would be:

Sound	Musical Note	Frequency (Hz)	Color
O as in "oh"	C	273	Green
O as in "off"	C#	290	Blue
U as in "ruby"	D	306	Indigo
I as in "in"	D#	323	Violet
E as in "red"	E	341	Ultraviolet
A as in "may"	F	361	Dark Violet
A as in "hat"	F#	382	Thermal Red
I as in "rice"	G	403	Dark Red
U as in "us"	G#	426	Black Red
A as in "ah"	A	452	Red
AU as in "Paul"	A#	476	Orange
E as in "bee"	B	505	Yellow

Table 3. Correspondence among voice sounds, musical notes, frequencies, and colors.

There are several ways to generate the other frequencies in the table; however, it is difficult to know for sure what method Dr. Lewis used. One way is to use an equal-tempered scale as used in modern music. Another possibility is to use the esoteric and exoteric Pythagorean scales described above. Table 4 indicates the frequencies calculated using each of these three methods and compares them with the frequencies put forth by Dr. H. Spencer Lewis.

	Musical Note	Esoteric Pythagorean Scale (C4 = 273 Hz)	Exoteric Pythagorean Scale (C4 = 273 Hz)	Equal-Tempered Scale (C4 = 273 Hz)	Lewis frequencies
1	C	273	273	273	273
2	C#/Db	291.2	287.6049	289.2334	290
3	D	307.125	307.125	306.4321	306
4	D#/Eb	327.6	323.5556	324.6535	323
5	E	341.25	345.5156	343.9584	341
6	F	364	364	364.4113	361
7	F#/Gb	386.0803	386.0803	386.0803	382
8	G	409.5	409.5	409.0378	403
9	G#/Ab	436.8	431.4074	433.3605	426
10	A	455	460.6875	459.1294	452
11	A#/Bb	485.3333	485.3333	486.4307	476
12	B	511.875	518.2734	515.3554	505
13	C	546	546	546	546

Table 4. Comparison of Esoteric, Exoteric, and Equal-Tempered Scales (C4 = 273 Hz) with Lewis Frequencies.

Columns 1 and 2 show the "esoteric" and "exoteric" Pythagorean scales respectively. Column 3 is an equal tempered scale in which each frequency is greater than the previous frequency by a constant factor. While none of these scales is an exact match, all three scales have an excellent correlation with the frequencies given by Dr. Lewis. The equal tempered scale actually has the highest correlation coefficient (0.9994) followed by the esoteric (0.9993) and the exoteric (0.9992) Pythagorean scales.

In any event, it is obvious that Dr. Lewis knew the correct frequencies for the chromatic scale and that he related these to the colors of the visible spectrum and to various vowel sounds. We believe that Dr. Lewis was given the system by the French Rosicrucians and he brought them to the United States. During the seventeenth and eighteenth centuries, the French had a significant number of musicians writing music who were interested in the original Pythagorean Music Scale numbers. They were also outstanding musicians. So, in some fashion, the correct Pythagorean Scale for a 12-note scale was known in France at the end of the nineteenth and beginning of the twentieth century. We have tentatively identified three French musicians who could have, whether in person or through an intermediary, given the musical scale to Dr. Lewis. These are Albert Freiher von Thimus (1806-1878) (Godwin 1993, 303-306), Saint-Yves d'Alveydre (1843-1909) (Godwin 1993, 303-306), and Emile Abel Chiza, (1855-1917) also called Azbel (Godwin 1993, 303-306). A possible intermediary may have been Isaac L. Rice (1850-1915) (Godwin 1993, 303-306), who came to Philadelphia from Bavaria when he was six years old but had a musical education in Paris (1866-1869). He returned to the U.S. and amassed a great fortune in New York as a lawyer and inventor. He may have built the first American submarine. In addition, he was an exceptionally noted chess player. His book *What is Music* (Rice 1875) was very erudite and shows unmistakable knowledge of esoteric science. We suggest, since he was present in the right times and places, that he was a Rosicrucian, that he knew Dr. Lewis, and that he may have even helped in the establishment of the AMORC in America.

It seems reasonably certain that Dr. Lewis chose the value of 273 Hz for middle C based on a particular wavelength of green light. This choice was not an arbitrary one, as it was an integral part of the system of esoteric numerology described in CROMAAT C. While a value of 256 Hz has been adopted by AMORC and appears in the chart of the "cosmic keyboard" dated 1958 as well as in the current AMORC teachings, one might ask whether this change was fully justified. Table 5 compares the current musical scale with A = 440 Hz with the scale and middle C specified by Dr. Lewis. For comparison, the frequencies for an equal tempered scale with 256 Hz as middle C (C4) are also given in Table 5.

	Musical Note	Equal-Tempered Scale (C4 = 256 Hz)	A4 = 440 Hz Scale	Lewis frequencies
1	C	256.0	261.6255653…	273
2	C#/Db	271.2225521…	277.1826310…	290
3	D	287.3502842…	293.6647679…	306
4	D#/Eb	304.4370212…	311.1269837…	323
5	E	322.5397885…	329.275569…	341
6	F	341.7190023…	349.2282314…	361
7	F#/Gb	362.0386669…	359.9944227…	382
8	G	383.566611…	391.9954360…	403
9	G#/Ab	406.3746685…	415.3046976…	426
10	A	430.5389637…	440.0	452
11	A#/Bb	456.1401426…	466.1637615…	476
12	B	483.2636468…	493.8833913…	505
13	C	512.0	523.2511306…	546

Table 5. Comparison of Equal-Tempered Scale (C4 = 256 Hz) and A4=440 Scale with the H. Spencer Lewis Scale.

Concluding Remarks

After considerable thought, we believe there is no one frequency for middle C that is best for all occasions. It is also known that many symphony orchestras will drop the frequency of A4 down to 420 Hz and lower. The longer wavelengths resulting from dropping the frequency make the music sound much better in large auditoriums, perhaps because their resonances are amplified. The equal tempered scale will sound better in normal music, particularly music that is transposed into a key other than its original; however, for vowel intonations and meditation music, the scale of Dr. Lewis may be preferable. One of the Grand Temples of the Rosicrucian Order, AMORC, for example, the Grand Temple in San Jose, California, would be an ideal location for research in this area, as the Temple was originally designed to produce excellent musical harmonics. The topics that we have addressed should be the scope of further research.

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