A BRIEF DESCRIPTION OF THREE TUNING SYSTEMS

EQUAL TEMPERAMENT

With equal temperament, all intervals are equally out of tune. It is often argued that equal temperament can be offensive to musicians with keen ears. The space of an octave is divided into twelve equal parts called semitones or half steps, with each tone equal distance from the next (octave equivalence). These tones do not exactly agree with the frequencies of pitch found in the overtone series. The tones are tempered or adjusted; the tuning system is called equal temperament, since the twelve half steps are equal in size. The intervals in equal temperament are fixed as a piano keyboard.

PYTHAGOREAN SCALE

Pythagoras, a Greek mathematician and philosopher (582-500 B.C.), is thought to have made certain acoustic experiments with a vibrating string called the monochord. By using two monochords, he performed an experiment in which the string of one monochord was successively shortened by one-half (raising the pitch an octave), and the string of the other was shortened each time by two-thirds (raising the pitch a fifth). After seven octaves and twelve fifths, Pythagoras discovered that the B# from the second monochord was not exactly the same as the C produced by the first monochord, but slightly higher. This small discrepancy is called the Pythagorean comma. The tuning systems differ in the manner in which this comma is handled.

The Pythagorean scale derives all tones from the interval of the pure fifth (3/2) as it occurs in the overtone series. This tuning system produces a sharper, brighter sound and is particularly good for barbershop harmony.

JUST INTONATION

This system attempts to improve upon the deficiencies of the Pythagorean scale by basing the calculations on both pure fifths (3/2) and pure thirds (5/4). The just intonation scale multiplies its difficulties as soon as chromatic tones are introduced. Sharps are actually lower in pitch than the flats. Some musicians love just temperament dearly. One musician had a harmonium just tuned in the key of C. It sounded excellent in C, but dreadful when played in any other key.

COMPARISON OF SELECTED FREQUENCIES USING THREE TUNING SYSTEMS

Scale Tone	Interval From Root	Equal-Temperament Scale Log Cents	Equal-Temperament Scale Freq. Hz	Pythagorean Scale Log Cents	Pythagorean Scale Ratio	Pythagorean Scale Freq. Hz	Just Intonation (Overtone Series) Zarbino Scale Log Cents	Just Intonation (Overtone Series) Zarbino Scale Ratio	Just Intonation (Overtone Series) Zarbino Scale Freq. Hz
A	Unison	0	220.000	0	1:1	220.000	0	1:1	220.000
A# / Bb	Min. 2	100	233.082	90	256:243	231.7695	112	16:15	234.667
B	Maj. 2	200	246.942	204	9:8	247.500	204	9:8	247.500
C'	Min. 3	300	261.626	294	32:27	260.7407	315	6:5	264.000
C# / Db	Maj. 3	400	277.183	408	81:64	278.4375	385	5:4	275.000
D	Perf. 4	500	293.665	498	4:3	293.333	498	4:3	293.333
D# / Eb	Aug. 4 / Dim. 5	600 600	311.127 311.127	612 588	729:512 1024:729	313.242 309.026	590 610	45:32 64:45	309.375 312.889
E	Perf. 5	700	329.628	702	3:2	330.000	702	3:2	330.000
F	Min. 6	800	349.228	792	128:81	347.6543	814	8:5	352.000
F# / Gb	Maj. 6	900	369.994	906	27:16	371.250	884	5:3	366.667
G	Min. 7	1000	391.995	996	16:9	391.111	996	16:9	391.111
G# / Ab	Maj. 7	1100	415.305	1110	243:128	417.6562	1088	15:8	412.500
A	Octave	1200	440.000	1200	2:1	440.000	1200	2:1	440.000

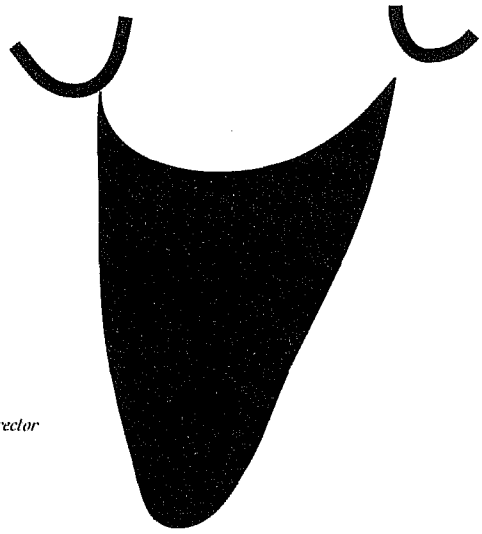
Pythagorean Tuning

Scale Position		DO	SOL	RE'	LA	MI	TI	FI	DI	SI	RI	LI		SE'	RA	LE'	ME'	TE'	FA
	KEY	**0**	**+2**	**+4**	**+6**	**+8**	**+10**	**+12**	**+14**	**+16**	**+18**	**+20**	**-14**	**-12**	**-10**	**-8**	**-6**	**-4**	**-2**
	C	C	G	D	A	E	B	F#	C#	G#	D#	A#	Cb	Gb	Db	Ab	Eb	Bb	F
	G	G	D	A	E	B	F#	C#	G#	D#	A#	E#	Gb	Db	Ab	Eb	Bb	F	C
	D	D	A	E	B	F#	C#	G#	D#	A#	E#	B#	Db	Ab	Eb	Bb	F	C	G
	A	A	E	B	F#	C#	G#	D#	A#	E#	B#	F##	Ab	Eb	Bb	F	C	G	D
	E	E	B	F#	C#	G#	D#	A#	E#	B#	F##	C##	Eb	Bb	F	C	G	D	A
ENHARMONIC KEYS	**B** **Cb**	B Cb	F# Gb	C# Db	G# Ab	D# Eb	A# Bb	E# F	B# C	F## G	C## D	G## A	Bb Cbb	F Gbb	C Dbb	G Abb	D Ebb	A Bbb	E Fb
		0	+2	+4	+6	+8	+10	+12	+14	+16	+18	+20	-14	-12	-10	-8	-6	-4	-2
	F# **Gb**	F# Gb	C# Db	G# Ab	D# Eb	A# Bb	E# F	B# C	F## G	C## D	G## A	D## E	F Gbb	C Dbb	G Abb	D Ebb	A Bbb	E Fb	B Cb
	C# **Db**	C# Db	G# Ab	D# Eb	A# Bb	E# F	B# C	F## G	C## D	G## A	D## E	A## B	C Dbb	G Abb	D Ebb	A Bbb	E Fb	B Cb	F# Gb
	Ab	Ab	Eb	Bb	F	C	G	D	A	E	B	F#	Abb	Ebb	Bbb	Fb	Cb	Gb	Db
	Eb	Eb	Bb	F	C	G	D	A	E	B	F#	C#	Ebb	Bbb	Fb	Cb	Gb	Db	Ab
	Bb	Bb	F	C	G	D	A	E	B	F#	C#	G#	Bbb	Fb	Cb	Gb	Db	Ab	Eb
	F	F	C	G	D	A	E	B	F#	C#	G#	D#	Fb	Cb	Gb	Db	Ab	Eb	Bb
	KEY	**0**	**+2**	**+4**	**+6**	**+8**	**+10**	**+12**	**+14**	**+16**	**+18**	**+20**	**-14**	**-12**	**-10**	**-8**	**-6**	**-4**	**-2**
Scale Position		**DO**	**SOL**	**RE'**	**LA**	**MI**	**TI**	**FI**	**DI**	**SI**	**RI**	**LI**		**SE'**	**RA**	**LE'**	**ME'**	**TE'**	**FA**

Tuning Chart

Key Signature	Key	+8 mi	+6 la	+10 ti
—	C	E	A	B
1♭	F	A	D	E
2♭	B♭	D	G	A
3♭	E♭	G	C	D
4♭	A♭	C	F	G
5♭	D♭	F	B♭	C
6♭	G♭	B♭	E♭	F
7♭	C♭	E♭	A♭	B♭
1♯	G	B	E	F♯
2♯	D	F♯	B	C♯
3♯	A	C♯	F♯	G♯
4♯	E	G♯	C♯	D♯
5♯	B	D♯	G♯	A♯
6♯	F♯	A♯	D♯	E♯
7♯	C♯	E♯	A♯	B♯

My Director's Always Saying...



by Lorraine Barrows (#25, Chapter-at-Large), headquarters' Director of Education, IES Planning Committee, Certified Director

"Pythagorean Tuning"

One Education Direction Committee member was heard to say, "How will Pythagoras change my life? And is he busy Saturday night?"

Simply put, Pythagoras could make your highs higher, your lows lower, and you'd be satisfied! Though many different scales exist, all with different advantages, Pythagorean tuning alters certain scale steps ever so slightly to accommodate the "lock and ring" of common barbershop chords. In its simplest form, the 3rd, 6th, 7th, and # 4th steps of the scale are the notes most noticeably raised (or sung a little bit sharp). In the key of C, we would raise the E, A, B, and F# when it is written in as an accidental. (Although some scale steps can be used to slightly flatten, most directors don't say anything about them to keep chorus members from flatting any more than they do on their own!)

Women of Note/Directors of Note

Sweet Adelines International recognizes the following international program participants on their recent advancements.

Director Certification Program

Advanced to Master Director:

Christine Ferguson, #1, Royal River Chorus
LeAnn Hazlett, #2, Spirit of Detroit Chorus
Becki Hine, #23, Song of Atlanta Chorus
Molly Huffman, #4, Capital City Chorus
Ann Jarchow, #3, Grand Rapids Chorus
Bev Miller, #4, Capital City Chorus
Anna Nyberg, #32, Stockholm City Chorus
Sandy Robinson, #26, Lions Gate Chorus

Advanced to Certified Director:

Fay Baker, #34, Chapter-at-Large
Heather Bartlett, #31, City of Roses Chorus
Sally Beck, #25, Sooner Sensations Chorus
Jerri Beyrodt, #24, Mountain River Harmony Chorus
Margaret Butt, #1, North Shore Chorus
Judith Hunt, #31, Surrey Harmony Chorus
Jeanette Hupe, #7, Wamego Dutch Mill Chorus
Jenny Lawson, #31, Surrey Harmony Chorus
Wendy Lenihan, #15, Eastern Suffolk Chorus
Barbara Letcher, #35, Greater Auckland Chorus
Mike McGee, #11, Agoura Hills Harmony Chorus
Christien Oberholster, #35, Whangarei Harmony Chorus
Carol Reed, #16, St. Lawrence Chorus
Peggy Staats, #11, Channelaire Chorus
Carol Stenstrom, #14, Southern Harmony Chorus
Gwen Topp, #31, Aberdeen Chorus
Nancy Watson, #16, Greater Kingston Chorus

"Lies My Music Teacher Told Me"--Gerald Eskelin

(Music Theory for Grown ups)

Very entertaining, written for the musician, great insights on relative pitch, tuning, lock and ring, methods of teaching pitch and intervals, use of Pythagorean Tuning and rhythm teaching that illustrate ideals of a cappella singing. A book I wish I'd read years ago! Great discussion of the overtone series in a fun, entertaining presentation. Great applications to chorus and quartet singing. Full of memorable quotes.