

# In Attendance

## To Some of the Particulars Concerning Natural Law, Engineering, Math, Philosophy, Behaviors, Rules, Tools & Folks Thinking about Music as Mystery (not necessarily in that order)

this epistemological study purports to tell No Lies and to provide Tools for those with a desire to play Music for themselves and who are consciously aware of the Idiocy of talking Falsely since the Hour is getting late.

### IDENTIFY THE TASK

Natural Law governs what works. Music follows Natural Law.  
Observing Natural Law reveals rules of behavior.  
Rules of behavior in Music can be observed.

Unknown behaviors are problems. Music has unknown behavior.  
Tools are used to solve problems in unknown behavior.  
Problems with music can be solved using tools.

### LEARN THE JARGON

Every discipline has a specialized set of words, a vocabulary that identifies the phenomenon being observed and discussed. These become your tools. There are surprisingly only a few of them and they do all the work.

### NATURAL LAW IS... NATURAL

If you can hear it, feel it, see it, measure it and repeat it with the same results with different people in different places in different times, then you can THINK it.

### THE PRACTICUM

*Take a piece of graph paper or use the chart provided at the end of this treatise. Make the drawings as you go though the monograph. Chew through it slowly.*

At the top of the paper, draw a line 24 spaces long. Make an oblong waveform (**sine wave**) above and below the line connecting at each end. To the left of the line write, 1:1. This is the mathematical term (expressed in ratio) that says, "It is what it is. It is itself-- whatever it is."

To the right of the line write "root." This is the musical term that says, "given a vibrating string of any length, the tone produced by causing this to vibrate will be the foundation, the **root** of all other tones (and terminology) derived from and associated with it."

Draw another 24 space line beneath the first. Make the lines parallel and leave room to draw in another sine wave.

Count 12 spaces. Mark the line with a dot at that point. Draw a "figure 8" sine wave that begins at one end, crosses at the middle point, continues to the end of the line and mirrors itself on the way back to the point of origin (once again crossing in the middle.)

To the left of the line write, 2:1. This is the mathematical expression that says, "Whatever that other thing was, this is exactly half of that."

Above the dot, the intersection of the sine wave, write "octave." This is the musical term that says, "given a vibrating string of any length, the tone produced by cutting it in half is 8-tones: do-re-mi-fa-sol-la-ti-do (**octave!**) higher in pitch than the **root**."

Draw another 24 space line beneath the first. Again, make the lines parallel and leave room to draw in another sine wave.

Count 8 spaces in from both ends. Mark the line with dots at these points. Draw a sine wave that begins at one end, crosses at the first point, goes to the other side of the line, crosses to the other side at the next point, continues to the end of the line and mirrors itself (duplicates the formation upside down) on the way back to the point of origin.

To the left of the line write, 3:2. This is the mathematical term that says, "Given that 2:1, this value is 1/3rd of that "1".

Above the two points write the musical term, "fifth." It is also called the "dominant". And here is an observable phenomenon of the underlying natural law: When 3:2 (the **dominant/fifth**) is played at the same time as 1:1 (the **root**) the resulting **standing wave** literally **dominates** all other combination of **tones** (vibrational relationships) in measurable, discernible strength and volume. Like wind and wave working together, it builds.

Draw another 24 space line beneath the first. Again, make the lines parallel and leave room to draw in another sine wave.

Count 6 spaces in from both ends. Mark the line with dots at these points. Draw a sine wave that begins at one end, crosses at the first marked point and then next crosses in the middle at the 12th space (the **octave**), goes again to the other side of the line at the next point, continues to the end of the line and mirrors itself on the way back to the point of origin-- a double figure 8.

To the left of the line write, 4:3. This is the mathematical term that says, "Given 3:2 and 2:1, these values are four parts of that original 1."

Above the two marked points write the musical term, "fourth" (also called the **sub-dominant**.) In Natural Law when a string oscillates it first creates the pattern in fig. 1, the **root**; next, the **octave** (fig. 2); then the **fifth** (fig. 3); then the **fourth** (fig. 4). These are primal **harmonic** nodes.

As it continues to oscillate (vibrate) it follows the ratios 5:4, 6:5, 7:6, 8:7, 9:8... creating smaller wave patterns. One of the basic **musical progressions** uses the **root** (1:1) and the **fifth** (3:2) and the **fourth** (4:3) elements to define structure. The **4th** and **5th** can appear in any order of sequence but the tune always returns to the **root** or to the halving of the root-- the **octave**.

This natural pattern is "hard-wired" into human perception and is constantly being discovered and "reinvented" by new players. As a friend of mine once pointed out, "The function of genius is to call attention to the obvious." This is also what the British folk historian, Cecil Sharp, meant when he said, "Unless corrupted by an outside influence, the taste of the people is impeccable."

### THE RULES AND TOOLS:

In the rule of Natural Law a vibrating string of ANY length creates a "first-order" **root** tone. That **tone** may be ANY **frequency**. All other relative tones are derived from it. This basic **tone** upon which a musical structure is built is called a **key**. Keys are given letter names: **A - B - C - D - E - F - G**.

To distinguish between different **octaves** (since the **notes** repeat in name) a "baseline" is established called, "**Middle C**". Other **notes** are referred to as being either above or below it. This "**C**" **note** is in the middle of most voice ranges-- a *vox humana* (human voice). Different **octaves** are identified by using capitals, lowercase and hash marks.

Since 1955 it has been *consensually* agreed that music is measured using the rule that the **tone** called, "**A above middle C**" has the vibrating **frequency** of **440 Hertz** (1 Hz = 1 **cycle per second**.) The modern **scale** uses an equal temperament **note** placement with a formula based on deriving the 12th root of 2 over distance. This follows the **natural harmonic series** but not exactly.

In 1720, English pitch pipes had **concert A** at 380 Hz. Across the channel Bach played organs pitched at 480 Hz.-- 2 **whole notes** apart! As for the **pitch** of the other **notes**, many methods to determine them have been tried over the centuries. 6 are still in use: Just, Pythagorean, Mean, Well, Equal, & Syntonic. (But for the most part you don't need to know this!)

In Natural Law when a root **tone/note/sound** is cut exactly in half, it produces a tone vibrating at TWICE the **cps** of the **root**. The length is shorter, thus higher, (if longer, then lower.) Cut in half again (the remaining distance) it doubles again in **frequency** and creates a second **octave**. Half the distance again creates still another **octave**-- ad infinitum-- e.g. (A,,27.5) (A,55) (A 110) (a 220) (a'440) (a''880) ... **5ths, 4ths** and all other ratios apply to all **octaves**.

The nominal human hearing range is 20 Hz to 20,000 Hz. The frequency range most useful in music falls between 20 Hz to 5,000 Hz. Many older folks can no longer hear high notes. (Dogs hear to 45,000, cats to 64,000, mice to 91,000!)

The musical "names" for the 8-tone scale are: **Do-re-mi-fa-sol-la-ti-do**. They are also referred to as: **1-2-3-4-5-6-7-8**. Don't confuse **fret** positions with **notes**. A string played open is a "1" (a "Do") that shifts ALL "place-value" references for **frets** especially when there are "extra" frets or "missing" frets from the **standard 12-per-octave** found on guitars, mandolins, banjos, etc.

In France and other parts of the world it is taught that C is the "do" scale; D the "re" scale; E the "mi" scale, etc. By that musical jargon, for example, what Americans would call a "G" scale they would say: **sol-la-ti-do-re-mi-fa-sol**.

**Harmony** is when **notes** sound good together-- complimentary **sine waves**. An easy rule of thumb is that as long as two successive **notes** (such as do-re, la-ti, etc.) are not played *simultaneously*, overt **discordancy** can be avoided.

**"Scale"** describes a fixed order of **notes** by which a melody is built. They are referred to as being either **major** or **minor** for having a "lighter" or "darker" feel (e.g. C-major, A-minor.) This *subjective* perception is largely

defined by one's culture, not necessarily the by the **note** sequence. Not all of the notes in any particular **scale** have to be used to create a melody.

The do-re-mi... do (**major**) **scale** sounds like it is perfect with evenly-spaced harmonic intervals. IT IS NOT. There are 2 "**half-steps**" in the sequence. Get used to it. Learn the rule: **There are no half steps between B-C and E-F.**

**Diatonic Scales** are the 7 white **notes** (referring to a piano) and its closing final. These start at each "lettered" **key**. There are 7 of them. *Only* the one that starts in "C" and ends in "C" sounds like the standard: Do-re-me-fa-sol-la-ti-do. The others have **half-step notes** that appear **flat** or **sharp** to the ear.

Traditionally, each **diatonic scale** is referred to as a **mode**. Historically, each **mode** was associated with a unique starting **keytone** and a fixed series of **whole steps** and **half steps** in the **scale**. The piano demonstrates this best.

Using only the white keys, starting and stopping on each "lettered" **note**, the names and ranges of the **modes** are: **Mixolydian** (G-g); **Aeolian** (A-a); **Locrian** (B-b); **Ionian** (C-c); **Dorian** (D-d); **Phrygian** (E-e); **Lydian** (F-f).

Players of the mountain dulcimer, historically a *pre-chromatic* instrument, often refer both to a **modal** name as well as a modern **keytone** when describing the **key** and type of **scale** a tune will use. For example saying "*the tune is in D-Mixolydian*" means they are using the **scale** associated with **note intervals** "native" to the half steps and whole steps of the **mode** G to g (just the white keys!) but are substituting the **keytone** of "D" to start and end.

Draw a two-inch circle. Preceding clockwise around the outside edge of the circle starting with "F" at the top, write: **F - C - G - D - A - E - B**. This is the **Circle of Fifths**. Clockwise it reveals when a note is FIVE **whole steps** away from the preceding one. That establishes the **root (1:1)** and the **dominant (3:2)**. Counter-clockwise, it reveals notes a **fourth (4:3)** of a step away.

Memorize: **Fried Chicken Good Dinner Ate Every Bit**. (F-C-G-D-A-E-B). This reveals the primary musical pattern for each **root key** by identifying its **dominant** and **sub-dominant**. Remember: By far, most folk and pop music starts with a **root** and uses it's **fifth** and **fourth** and **root** in varying sequences.

**DIABOLUS IN MUSICA:** Between the "B" and the "F" there are only 4 1/2 steps (**intervals**). The *no-notes-between* B-C and E-F has caught up in the cycle. In the Middle Ages the "extra" notes of F-**sharp** (going clockwise) and

B-flat (counter-clockwise) were "snuck in" to make the B-F **interval** work. A hard thing to remember is that although **scales** sound regular, they are not!

The Greek word for color is *chromos*. During the Renaissance the 5 "missing" **notes** were *colored in* to make the scale **chromatic**. The piano's black **notes** form a **pentatonic scale** positioned to fill in these notes-between-the-notes. Some dulcimers now have a "6 1/2 fret", the **half-step** before the (2:1) **octave**.

The 5 black **notes** along with the 7 white **notes** form our 12-tone **chromatic scale**. **Sharps** use a "tic-tac-toe" symbol (e.g. F#.) **Flats** are written with a small b (e.g. Eb.) To **flat** or **sharp** means to raise or lower a tone a **half-note**.

## DEBUNKING MATH AND MUSIC AS MYSTERY

There is an art to good anything-- music or engineering or painting or weaving or bicycle riding. Some approaches and designs excel, others only just perform. Still others collapse and fail. That said, yes folks, there is also a "feely" side to this music stuff – artistic nuances defying analysis– BUT these still must follow the same rules. These nuances appear as touch, tone, timing, loudness, softness, strong, gentle-- hundreds of expressions. That's art.

**Music is not just a good idea, it's the law!** Draw a line of 24 spaces. Mark points: 6, 8, 12, 16, 18. Look at your preceding drawings: 6 and 18 are **fourths**, 8 and 16 are **fifths**, 12 is the **octave**. On a stringed instrument above each **node** is a **harmonic**-- a pure, bell-like chime. These are your audio verifications of the underlying Natural Law. Mark the harmonics with a circle.

There is only one at the mid-point, the others come mirrored in pairs. Like timing an engine with a strobe light to find top dead center, with the right equipment you can see harmony-- regular, complimentary vibrational cycles blending together. With touch, you can feel harmony-- pulses of long waves rather than ones that shudder like a bad bearing or wobbly wheel. With attentive ears, you can hear harmony. Just listen.

**Music itself teaches music.** Listen, analyze, compare. Verify its truisms. With three independent sources of verification you move from conjecture and hypothesis to observation and fact-- from theory to definable, applicable law.

Draw another 24 space line. Mark a point 6 from the left side. Compare to the ones above. There's your **sub-dominant fourth (4:3)** again. Mark a point 8 from the right-side. Compare to above. There's your **dominant fifth (3:2)**.

Egyptian pyramid-building architects wore a status symbol that proclaimed they possessed a secret knowledge. It was a simple cord with knots at 1/3rd (3:2 dominant) it's length from one end and 1/4th (4:3 sub-dominant) it's length from the other. With the ends placed together, drawing the knots tight and away from each other made a right triangle in the proportions of **3 - 4 - 5**, a tool for *square and plumb*, literally the cornerstone of civilization.

We doubled the 3-4-5 ratio numbers to make it easier for us to see these relationships: "**a**" **squared** (6 x 6) + "**b**" **squared** (8 x 8) = "**c**" **squared** (10 x 10). Pythagoras found that this conceptual tool is not just for making buildings and pyramids. It is itself a building block with an observable, quantifiable principle that can be used to examine phenomena in the physical universe.

Observe. Analyze. Experiment. Listen! Evaluate success through trial and error. Stay at it. Understand the jargon. Trust your senses. Musical truths can be measured-- seen, felt and heard. It's not easy but it sure is fun. My Dad said a little hard work never hurt anyone; I can appreciate that now.

Still, these notes are just what some old geezer wrote about music after a lifetime of tinkering around with it. In the end, **only music teaches music**. If it sounds good. It is good. We are all of us biologic harmony detectors.

So, bring on the mystery! Since the Egyptian architects had their knotted rope belts in the 3-4-5 ratio, let's have our *own cord* with an added knot in the exact middle for the **octave**. We'll be *Architects of Music*. It'd be even better if we could think up a secret handshake and a special ear-waggle, too.

Whether you build woodsheds or musical mansions, you'll know you're building squarely, plumb and with honest tools. Oh, and get that covered front porch done. 'Cause now, I do attest, jes' sitting back and bumping along on 1 - 4 - 5 chord progressions with my friends, I believe there ain't much more pleasurable than jes' sittin' and pickin'-- less'n it be the grinnin'.

Robert L. Force, Jr.  
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I leave beside this highway of thought special thanks and acknowledgement to John (Ian) Griffin and Don Berry. Both of these intellectual giants have left this earth. Before they did, each in his own way planted the seeds of musical mathematics and musical philosophy in my brain. It was nearly 40 years before the part of my brain that was intermittently gnawing at this "universal field theory" of music finally got me to spit out this paper with an, "Oh, that's so easy! Duh." Of course mastering the jargon and that weird b-c, e-f thing, along with the tens of thousands of hours awash in the harmony of playing, certainly gave me a big leg up.