Rhythm Bones Player

A Newsletter of the Rhythm Bones Society

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[Note to Reader: This is a draft version of Vol 28, No 4, released to preview at the 2026 Mini-Fest. The final version will have Highlights from the Mini-Fest, and will be posted in mid December.]

(Continued on Page 3)

Acoustics of Rhythm Bones, Part 2

This is Part 2 of a two-part study, and Part 1 is in newsletter, Vol 28, No 2 (https://rhythmbones.org/documents/RBP/V28N2.pdf) which dealt with the more mechanical aspects of rhythm bones acoustics.

This article deals with recording and analyzing rhythm bones tones using spectral analysis which shows the actual frequencies of the sound coming from rhythm bones. It concludes with practical applications of the information from this study to rhythm bone playing.

What we learn from a Marimba Bar (a Google Summary. Also see Part 1 of this study).

To maximize specific vibration modes on a marimba bar, strike at the anti-node (points of maximum displacement) and avoid the nodes (points of zero movement) for each respective mode.

Fundamental Mode (1st long side): Strike at the center (50% or 0.5L) of the bar, where the fundamental anti-node resides. Striking here completely suppresses the 2nd mode because the center is its node. Striking at the end also excites the fundamental.

2nd Mode (1st Overtone): Strike at approximately 22% to 25% (or 75% to 78%) of the bar's length from one end. The center (50%) is a node for this mode, so hitting the middle yields zero 2nd-mode excitation.

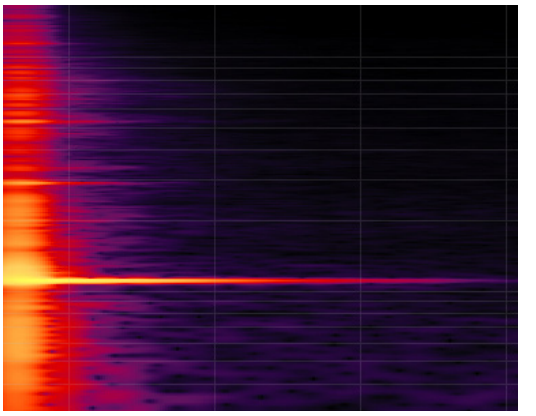
3**rd Mode** (2nd Overtone): Strike at the center (50% or 0.5L) or near the outer anti-nodes at roughly 12% and 88% of the length.

Because the center is an anti-node for both the 1st and 3rd modes, a center strike excites both simultaneously.

Mallet hardness acts as a frequency filter by changing the contact duration (dwell time) between the mallet and the marimba bar.

Hard mallets act as High-Pass Filters: They create a short contact

(Continued on Page 3)



Spectrum of Purpleheart - Center - Temp

Editorial

I think this year's newsletters are all newsworthy starting with No 1, on Technology and Rhythm Bones, Nos 2 and 4 on the Acoustics of Rhythm Bones, and No 3 with Highlights of Bones Fest XXX.

Google says, "Rhythm bones are atonal percussion instruments because they produce unpitched, clicking, or rattling sounds rather than specific, recognizable musical notes with a distinct pitch." Well, "It Ain't Necessarily So" (from the musical Porgy and Bess). This acoustics of rhythm bones study shows that like its cousin, the Marimba bar, it can produce beautiful tone. Part 2 starts on Page 1.

If you tune your bones, let me know if you can here the difference when playing in tune with the song.

What's in a name. Are these 'Marimba Bones? Rhythm Bones With Tones. Rhythm Bones Marimba Style?

Thanks to Gerry Hines for pointing this out.

There may be another Acoustics article after some time has passed with stories from members with more practical applications.

Letters To The Editor

Rhythm Bones Player

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The Rhythm Bones Players welcomes letters to the Editor and article on any aspect of bones playing. All material submitted for consideration is subject to editing and condensation.

Rhythm Bones Central web site: rhythmbones.

(Continued from Page 1)

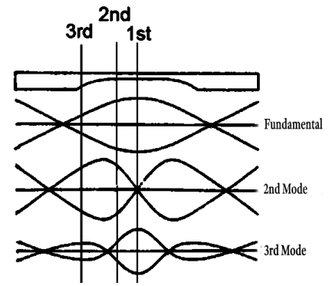
time. This excites higher-frequency modes (2nd and 3rd modes) along with the fundamental.

Soft Mallets act as Low-Pass Filters. They create a longer contact time where sound energy is absorbed by the mallet instead of being released in the air. The mallet stays on the bar long enough to dampen high-frequency vibrations, leaving mostly the fundamental mode.

Interaction Between Strike Location and Mallet Type

Striking the Center (50%):With a Soft Mallet: Yields a pure, warm fundamental tone. The soft mallet dampens the 3rd mode, and the location naturally suppresses the 2nd mode. With a Hard Mallet: Yields a bright tone with strong ring/ping. The hard core actively excites the 3rd mode, which shares the center anti-node.

Striking the Off-Center (22%–25%):With a Soft Mallet: Yields a hollow, weak tone. The location suppresses the fundamental, and the soft mallet dampens the 2nd mode overtone. With a Hard Mallet: Yields a sharp, piercing



overtone chime. This fully isolates and excites the 2nd mode frequency.

https://www.lafavre.us/FFT-mallet-position.htm

Striking Location "Because the characteristic attack for most percussion instruments is sharp and clear, followed by a quick decay, the common misconception is that percussionists have little or no control over articulation. While the ability of percussionists to affect the sustain and decay of a sound is by all accounts limited, the ability of percussionists to change the attack of a sound with different implements is virtually limitless. In addition, where percussion articulation is limited, there are many techniques that allow performers to match articulation with other instruments." [The Art Of Marimba Articulation, Adam B. Davis, 2018]

Application to Rhythm Bones.

Rhythm bones be they straight or curved have similar characteristics to Marimba bars. Most are closer to the ideal bar in that they have the same shape along their long length. Bones have a hard exterior and are like the hard marimba mallet exciting lots of frequencies.

Rhythm bones are not ideal since the grain of the wood is not straight, there are imperfections in the woods, and most rhythm bones are curved.

Straight bones come close but makers round the ends while the ideal bar has straight ends. Most curved bones have an oval not rectangular shape meaning the salt test to find its fundamental node does not work on them.

Since they are held in the hand, some tones are dampened by the palm and fingers. There is no resonator (but see Mardeen Gordon's article in Vol 28, No 2). The articulation is limited since both bones are held in the same hand (flip like Tim, or remove fingers).

The Studies. Recordings were made of a variety of wood and animal bones. Bones were supported on a cushion of air, free-free support, using a large plastic bubble wrap (a jiplock sandwich bag also works), recorded using a microphone on a tripod, and weighed on a Taylor scale as shown in the photograph. A Hardell, Digital, 12 Inch, Micrometer Caliper was used to make precise measurements on bones. An online pitch detector (onlinemictest.com/tuners/pitch-detector) measured their pitch.

Recording and analysis was made using Adobe Audition, and the tools used were Amplification, Spectral Display, and Frequency Display. Recording sample rate was 96,000 samples per second and saved as floating point numbers. The Fast Fourier Transform was used to make the displays using the Blackman-Harris window, and the window size was 8128 that gives accurate measurements.

Bones were marked for identification with blue painter's tape. Recordings were saved to storage identified by identifier, type of bone, where struck, and which striker.

There were three Marimba mallet strikers, a soft fine thread covered ball, a



rubber ball, and a hard plastic ball.

Amplification. I was unable to build a device that delivered a consistent strike so recordings could be objectively compared. Strikes were made by hand held strikers and recordings were amplified to a common amplitude.

Spectral Analysis

The Waveform Display, top left image on Page 8, shows the recorded sound wave. The X-axis is time (zero to 0.25 seconds). and the Y-axis is amplitude in decibels.

The Spectral Display, bottom left image on Page 8, presents a spectrogram that adds the dimension of time, plotting frequency on the Y-axis (from 300 Hz to 10,000 hz), time on the X-axis (zero to 0.25 seconds), and intensity via color/brightness. This is the best tool for explaining how the sound evolves.

The Frequency Display, right image on Page 8, shows detail at the location of the cursor in the Waveform Display. There is not enough information for the FFT to work at the point of the cursor so a window is used that has samples both before and after the location of the cursor. I used that to measure the frequency of the tones present.

At the exact millisecond of impact, the spectrogram shows a massive spike across all frequencies. This represents the sharp, unpitched "clack" of the two objects colliding followed by a quick decay leaving only certain frequencies depending on where it was struck.

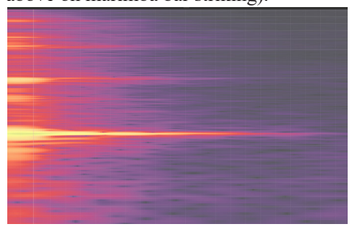
The horizontal lines in the spectrogram and the peaks in the Frequency display show the dominant frequencies present which for this study are the fundamental and modes 2, and 3. Unlike a guitar

string which produces neat harmonic overtones (integer multiples like 1f, 2f, 3f), a concussion idiophone produces unaligned, geometric resonant overtones (1f, 2.76f, 5.4f).

The tallest peak usually represents he fundamental resonance of the physical material. For example, if you are looking at a hardwood or bone instrument, you will likely see a highly concentrated, prominent peak somewhere between 800 Hz and 1200 Hz.

Single Bone Studies

The initial studies above were done with a single bone supported on an air cushion and hit with a striker. What would be a good striker? I purchased several marimba mallets made of different materials, cut them to 8" in length, and tried them selecting three to test with, soft thread wrapped ball, rubber ball, and hard crystalline ball (see the discussion above on marimba bar striking).



Spectrogram of a bone held by the middle and fourth fingers at its node

Type of Wood	Mode 1	Weight
Pine	885	14
Oak	938	19
Cherry	908	20
Rosewood	896	22
Maple	940	23
Oak	967	23
Rosewood	990	26
Maple	1031	26
Maple	984	27
Maple	996	27
Rosewood	961	29
Hickory	1096	29
Rosewood	973	30
Rosewood	990	30
Ebony	791	42
Ebony?	797	42
Ebony	756	45
Ebony	785	45
Ebony	721	46
Ebony?	826	49
Ebony?	896	51

The Danforth Study

Percy Danforth designed wood bones were made by Ray Schairer and now by Sandor Slomovits. The design is the same for all of the different woods they are made from, size, 1" x 0.25" x 7.2," shape oval with maximum thickness 0.25," curvature measure on a flat surface to maximum height in center, 0.5."

I hypothesized we could compare the fundamental frequency to figure out what type of wood it is made of. Studies using the rubber ball striker and striking in the center were done using Cherry, Ebony, Maple, Oak, Pine, and Rosewood measuring the fundamental frequency as well as their weight in grams as shown in two tables sorted by weight and frequency. This study was repeated with wood bones from many makers.

Type of Wood	Mode 1	Weight
Ebony	721	46
Ebony	756	45
Ebony	785	45
Ebony	791	42
Ebony?	797	42
Ebony?	826	49
Pine	885	14
Rosewood	896	22
Ebony?	896	51
Cherry	908	20
Oak	938	19
Maple	940	23
Rosewood	961	29
Oak	967	23
Rosewood	973	30
Maple	984	27
Rosewood	990	26
Rosewood	990	30
Maple	996	27
Maple	1031	26
Hickory	1096	29

Quality Control

After studying dozens of rhythm bones I was amazed at the lack of uniformity in commercially made rhythm bones (not surprising since they are handmade). If there were a prize for best it would go to the late Jerry Mescher who was a perfectionist and Barry Patton. If you are only interested in the percussive sound, the clack, this is likely not an issue, but if you are interested in tone it does matter. So what can you do?

Tuning a rhythm bone

From Marimba knowledge, we know that the fundamental, 2nd and 3rd modes are tunned by removing wood from various places on the underside of the bar. Applying this to rhythm bones you can lower or raise the pitch.

To lower the pitch sand the middle of the inside curved area to give it less stiffness which lowers the pitch. Be careful to not weaken it by removing too much wood

To raise the pitch you can shorten the length by sanding or cutting off wood from the end of the bone. This takes some precision so you might want to practice before trying it on your best Ebony bone.

I tried it with a rectangular bar of Purpleheart I cut to the size of a Danforth bone. Using a pitch detector, it measured pitch as 996 hertz or B5+35 cents. [Between each half-step of pitch, like from C to C#, there are 100 units of measure called 'cents.' Graphic Pitch Detectors typically have 10 unit marks between half-steps each representing '10 cents'] In this experiment the pitch of the bones was about a third of the way between B5 and C6. [The numbers 5 and 6 mean it is in the 5th or 6th octave of an 88 key piano].

I was going for a pure C pitch since there are a lot of songs in the key of C. I went to the saw and cut off 1/8" which measured 1008 hertz or C6-14 cents. Progress. The next cut was very small or so I thought, it measured C6+16. I should have used sandpaper on the end.

Now let's see if sanding wood from the center of the bar really works. Using a belt sander on the center plus/minus about one inch, I overshot to C6-28. Back to sanding the end measuring -11, -8, -2, and finally +1, and I quit as this is likely closer to C6 than many instruments are tuned.

Find the Fundamental Node

How can you find the node of a bone without setting up a test jig. You can measure (22.4% times length) or as shown in the photograph, spread your fingers wide and place a bone where you



guess the nodes are at. Starting in the center strike the bone as you move towards its end until you find a dull sound. That is a node and repeat to find the node at the other end. Adjust your fingers so they are under those two spots and strike the center for a rich, clear sound.

After you have done this a few times, you wont actually need to find the node separately as you can find it by ear by adjusting the movable bone up and down in your hand. I use the other bone as the striker before placing it in my hand.

Another issue with nodes is our fingers are thicker than the supports in a test jig causing some damping of the sound. In practice, the finger bones touching the movable bone are narrow and hard and the surrounding flesh soft enough for minimal dampening.

How Bones are held Traditionally.

Typically two bones are held in the hand with a stationary bone between the first and second fingers or between the thumb and first finger and pressed against the palm of the hand by the middle finger. A second bone is placed between middle and ring finger with their curved sides hitting each other such that it is able to move back and forth striking the stationary bone producing a clack or the percussive sound.

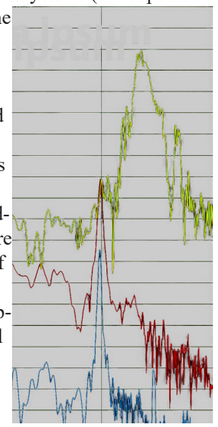
Two Bones in the Hand Studies

Since each bone has its own independent properties as described above it is difficult to study as a pair trying to identify what sounds come from each bone.

It is fortunate for rhythm bones players that you can strike bones at the center or the ends to excite its fundamental pitch because striking them at the end is easier to do and produces a louder sound.

To begin to understand the sound from two bones hitting each other, think of it like mixing blue and yellow paint. The stationary bone is a bright yellow and the movable bone is deep blue. The eye never sees the individual colors; it just perceives a vibrant shade of green. Since vibrating bones produce many frequencies, the combination of two bones will generate new frequencies, and these will change depending on how they are held and where the bones are struck. Since a bone has a hard surface, it excites more and stronger overtones than a softer striker .

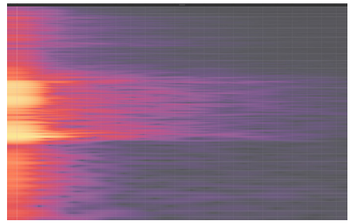
This was tested as shown in the Frequency Display using two rosewood bones with the fundamental frequencies of 961 Hz, and overtone2 of 2640, shown in red, and 985 Hz, shown in blue, and the sound from hitting them together of 1673 Hz, shown in yellow (the expected result is overtone blue - fundamental red = 1655 Hz). The perceived sound has a different frequency and is wider than that from the individual bones (ignore the amplitude of the waveforms as they were separated for visual clarity).



Below is a discussion on why the traditional playing does not produce tones. It is followed by three scenarios that do produce tones.

Traditional Hold is Atonal

When the firmly held stationary bone is struck by the movable bone its sound after the initial clack quickly dampens as shown in the spectrogram. Most of the sound after the initial clack is from the movable bone, and it is not tonal since the location of the strike is not at the fundamental anti-node or the end of the bone. The stationary striker bone has a hard surface that excites higher, rapidly decaying clack frequencies. The air at the point of contact is forced sideways



Spectrogram of a bone pressed firmly into the palm of the hand by the middle finger. The sound is just the percussive clack.

at great velocity creating a mini-pop that becomes part of the atonal clack.

If a bone is held at its end the acoustics change. The fundamental is damped out, and the overtone frequencies are much higher (1f, 4f, 9f). The decay of sounds is shorter as the sound that should be released into the air is absorbed by the soft tissues of the fingers.

Holding the stationary bone between the thumb and first finger holds the stationary bone such that the middle finger can be lifted off which changes the damping. It also makes it easier to change the location of the strike.

Parallel Bones

Stop reading and read the articles on Page 7 on the parallel hold technique used by 'Grampa Lavernne' and 'Brother Bones' (Freeman Davis). I have no idea how they discovered this holding technique with the bones parallel with each other, but it might be as simple as they heard something unique.

Try holding the two bones parallel with each other with the movable bone at its node and the stationary bone is at or below the end of the movable bone. Since the stationary bone has a hard surface, its strike will excite the fundamental and overtones creating a strong percussive sound. Use a gentle strike or a softer striker to make a clearer fundamental sound.

If you raise the stationary bone in small steps you can hear individual overtones.

Flynn-Gordon Hold

Both Skeffington Flynn and Mardeen Gorden found a way to strike the moving bone at its center as shown in the photographs below. The movable bone is held at its or near its node and the stationary bone is raised such that it strikes the center, the anti-node, of the movable bone.

To test this combination, I held two rosewood bones as shown below that had nearly identical fundamental frequencies, and struck them together to make a Tap.

The recording showed a quite different Frequency Display with the peak frequency higher than each bone struck alone. Since two sound waves create new frequencies when they combine, calculations between the fundamental and the overtones showed a peak at the frequency displayed. The explanation is



the stationary bone when held as shown is not acoustically dead but contributes to the overall sound.

Non-Bone Striker

If the tightly held stationary bone does not contribute much but excite the atonal percussive clack, it is time to try something else and one such striker is a marimba mallet.

The photographs below show holding the movable bone at its node and a mallet as the stationary bone that strikes the movable bone at its end. The left image is a medium soft marimba mallet and the right image is a possible bone replacement version using a Bakolite ball. Holding a Marimba mallet for a while causes some between the finger pain.

From the marimba mallet discussion at beginning of this article as applied to bones, the soft thread mallet produces the purest sound, but it is quiet and would need amplification. The hard mallet excites many frequencies and makes an atonal sound, and the soft rubber mallet works well and was used for all the spectrographs in this article.

The striker location discussion at the beginning of this article shows where to strike to excite the overtones.

Two Hand Playing.

Now the fun begins. Play rhythm bones using parallel bones or a non-bones striker. Try different bones and hear different tones to see if any play better to music.

Use a pitch detector to find the pitch of each of your bones, and they will not likely match to a standard note, like C. Find two bones whose pitch harmonize together (say a third or a fifth apart), and make up a solo piece. Get with another rhythm bones player and find four bones that harmonize and play a tune together, like a bell choir.

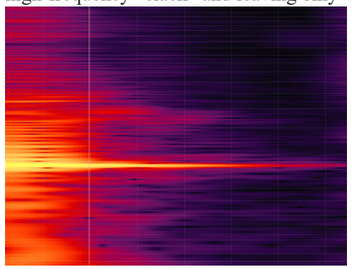
Studies on Animal Bones.

Animal bones share acoustical properties with wood bones. The stationary bone is a striker, and is like the hard crystal ball striker exciting more frequencies.

Animal Rib. On the Frequency Display: Instead of narrow needles, the peaks are "fatter" or broader at the base. The porous internal structure of ribs acts as a natural acoustic absorber, diffusing the frequency energy. The fundamental peak often centers as a warm, round hump around 940 Hz.

Test this! You will also notice fewer distinct high-frequency overtone peaks; they get swallowed up by the bone matrix.

On the Spectrogram: The visual tells a clear story of attenuation. The vertical impact wall is still intense, but the upper frequencies slope downward almost instantly at a steep angle. The inner marrow behaves like a tiny acoustic baffle, quickly scrubbing away the high-frequency "clack" and leaving only



a brief, hollow horizontal tail of the core fundamental pitch.

3D Printed. See Vol 28, No 1, Pages 3 and 4 for photograph and details. Fundamental is 633 Hz, D2 -2 cents. it is hollow and has a hollow sound.

Calculating Young's Modulus

Because wood is an anisotropic, natural material, the true frequencies will shift depending on the specific moisture content, the orientation of the grain, and how tightly the bone is mounted or supported.

When I compared the frequency of my Danforth maple bones to other Danforth maple bones they did not match. There is a formula to calculate Young's Modulus that uses length, thickness, width, weight, and frequency, with correction factors for the oval shape and cut curve shape (which for Danforth bones is 0.5 inches at the center). Use an online detector to find the frequency of vibration. A scale is needed to measure the weight. Input this data to Google, and it will do the calculation.

When I compared the results for my maple bones to the Young's Modulus Table in the Vol 28, No 2 newsletter, they did not match other maple values. Then I remembered this maple was recovered from the bottom of Lake Michigan, and a Google query described how it adsorbed minerals and became stiffer over time. Turns out the higher calculated value is reasonable. I lost one of my set of four and now know which one is the replacement which I use as a stationary bone.

Straight and Curved Bones

Straight rhythm bones are closer to the ideal bar and can make clear tones. Makers of straight bones, however, round the ends and make other changes to the geometry of the bones that make it less ideal. Since wood is anisotropic, no bone is ideal.

Curved rhythm bones come in two varieties, sawed and steam-bent. Almost all wood rhythm bones are sawed curved patterned after the curved animal rib which makes them not ideal for producing tones. The wood grain is severed which increases internal damping, slows down sound waves, and yields faster acoustical decay.

Steam bent bones can have straight grain when made carefully, and are closer to the ideal than saw cut bones. There are only three people known to make steam bent wood bones, and only one with dimensions similar to sawed wood bones so they can be compared.

For studies I am using a pair of rosewood steam bent Ezikiel Bones and rosewood cut curved Danforth bones. Very preliminary results show that the duration of the sound with the steam bent bones is almost 20% longer than the cut curve bone suggesting less internal sound resistance. Quantitative studies are beginning

How to Make a Striker

A striker should be acoustically dead.



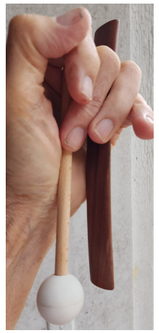
We've seen that the palm and finger dampen the frequencies, but dead is better if it produces no sound.

A stationary curved bone does not make a tonal striker as the strike location is some distance from the end depending on how it is held. If the location is close to the fundamental node, there is only the rapidly decaying higher nodes that make the percussive sound.

As shown on Page 7, a rhythm bone can be used as a tonal striker by holding it in parallel with the movable bone so that they hit each other on their ends.

A marimba mallet cut to an appropriate length makes a good striker and you can buy mallets with soft, medium, and hard surfaces to excite different modes. Its problem is holding the shaft can hurt your fingers.

Buy a 5 gallon paint stirrer, or try some other wood, and put a hard adhesive piece on end like the ACE hardware small adhesive slider as shown in the

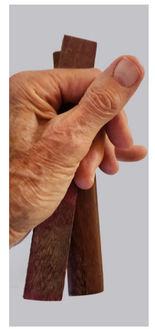




photograph to the left. (how about soft, medium, and hard ends?)

Other Articulations

There are other ways to strike a bone that excite different sounds. A bone with a striker bone can be played as is normally played then scissored such that the sides strike the location of other modes.



Striking on the side of the end excites the torsional (twisting) vibrations which occurs with a partial scissor hold. With practice I think side striking for different sounds is possible by controlling the scissoring.

Selecting a Pitch

It will take some time to figure out if and when tuned bones are useful. Many songs use the standard three chord progression, i.e., Tonic, Subdominant and Dominant, for example in the Key of C, they are C, F, and G (or G7). The Tonic and Dominant both share the C note while the Subdominant is based on the F note, so one possibility is one bone tuned to C and the other to F.

Another possibility is tuned to a third or fifth so they play in harmony.

Practical Applications

The good news is that there are practical applications of the study:

Node Finding. You can easily find the fundamental nodes by spreading your fingers and resting the bone on the outside fingers while searching with a striker for the two dull spots.

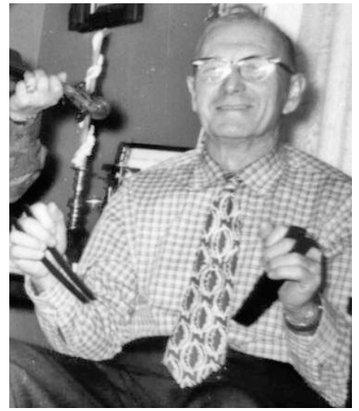
Listen to the Fundamental frequency. While supporting the bone at its nodes with fingers or something else, strike the bones at its center.

Find the bone's pitch. Use an online Pitch Detector while striking the center of the bone. When someone jokingly asks "what key are your bones," you can tell them.

Match your rhythm bones. See how well matched are your rhythm bones.

Buying rhythm bones. If you are at a store or at the Bones Marketplace at a Bones Fest, you can test rhythm bones before you buy them. When buying on the internet and depending on return policies, you might use this test to ask for a replacement.

Grampa Laverne



Gerry Hines sent me the photograph below showing the way his grandfather, Laverne Lumbard, held his rhythm bones. In his right hand, on your left, he holds the bones in parallel so the end of the stationary bone strikes the movable bone at its end. In his left hand the movable bone is raised close to the fundamental node. When he plays the raised movable bones is free to make a clear sound and by striking that bone at its end, it excites the fundamental tone. If we had a recording we could verify that hypothesis. I have more success if I separate the bones by two fingers. *Steve Wixson*

Brother Bones Revisited

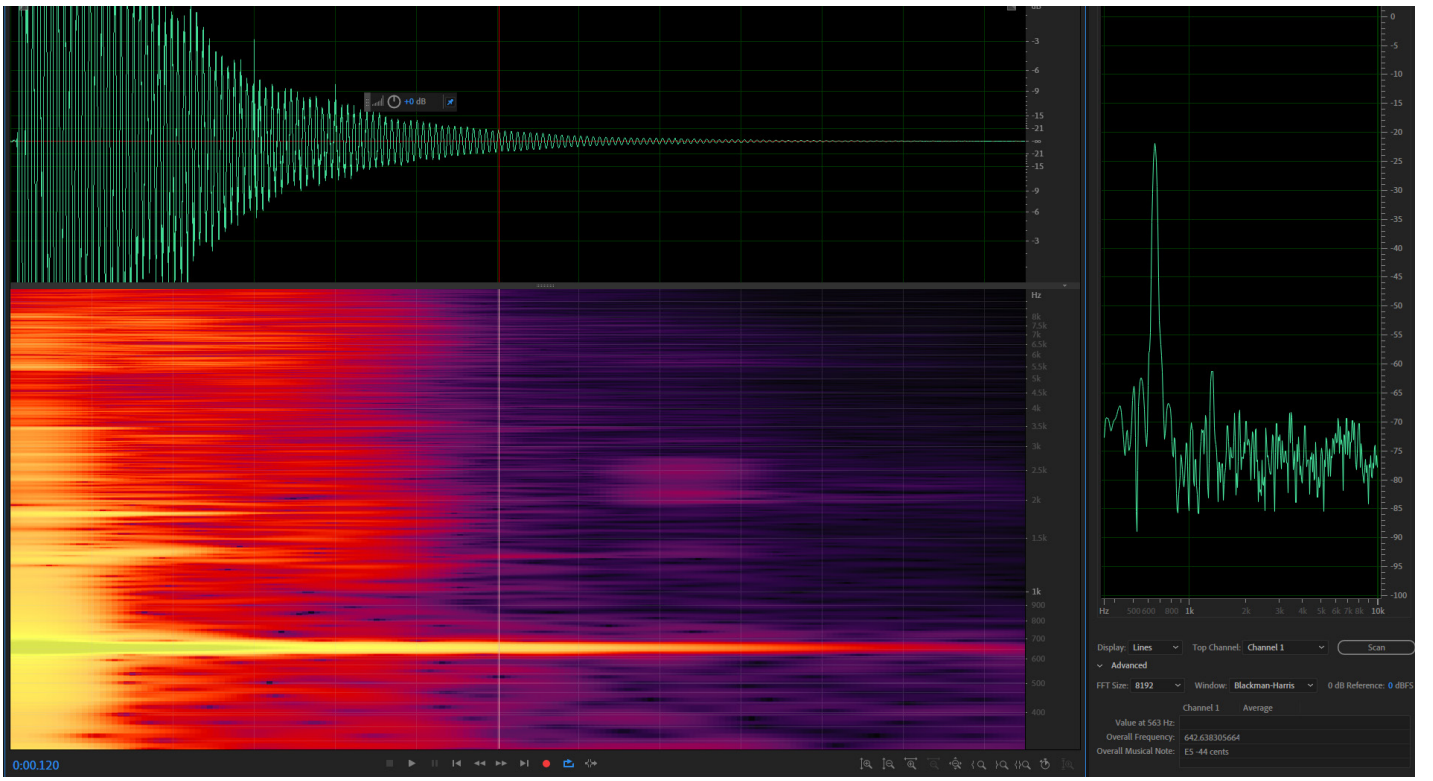
Gerry Hines also sent me a Brother Bones record cover showing a similar holding method augmented by a shorter bone between the 3rd and 4th fingers. The stationary bone is longer than its parallel bone. It also looks like the first and second bones are below the node point.



Since this photograph was on a record cover, I assume this is how he held rhythm bones for some or all of the album recordings. I listened to the *Sweet Georgia Brown* song again, and there are more than two bones in each hand. Listen to it at [add its URL]

Joe Birl in his black plastic rhythm bones patent application talk at Bones Fest III, showed a photograph taken during a chance meeting with Brother in a record shop in Philadelphia. With the new information, I looked at the photograph with new eyes, and below is an enlargement showing four bones in each hand held in an unusual way, two parallel and two parallel reversed such that bones 1 and 2 touch bones 3 and 4 at the center, and all bones appear to be held at or near their nodes. The parallel bones are stuck at the end exciting the fundamental and the bones 2 and 3 are struck at their center also exciting the fundamental. [Got to record this and see what's happening.]





Typical Display from Adobe Audition. Upper image is the recorded waveform, lower image is its Spectrogram, and right image is its Frequency Display.

Estimate the type of wood. The pitch of a bone is directly related to its stiffness (as is shape and ???). [add expanded table for Percy bones.] Moisture changes it. More thought.

Change the Pitch. There are ways to change the pitch. Strike it at its center or end to get the fundamental, strike it at its node to get the 2nd Mode.

Change the Pitch while playing. Lifting a finger changes damping effects. Study this.

Change the pitch mechanically.

If your bones almost match

You could change the pitch to match the closest standard pitch, say middle C on the piano. The process is described above.

Summary

This study shows that rhythm bones have the acoustical properties of a Marimba bar, and when properly supported and accurately struck can produce clear tones. They can be tuned to make so those tones match notes on a piano. The striker can be a parallel bone or a non bone striker. Volume is an issue and amplification might be needed for good sound. There are practical applications of this study.

Conclusions

I am not sure what this study contributes to rhythm bones playing. Rhythm bones as an atonal percussion instrument will continue though some might use the information here to make adjustments to their holding method. As a tonal instrument, playing one tone per hand limits its usefulness, but I have no doubt that understanding the 'acoustics of rhythm bones' is a step forward. *Steve Wixson*

P.S., I have a technical background, but acoustics is not my field of work so please challenge this study as needed.

[Note: Finish the analysis of Russ Myers pitch changing.]