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The Violin Makers Association of Arizona International is an educational organization founded in 1958 to encourage and develop the art of violin making. The association is the oldest violin makers association in the United States. The organization features an annual convention and violin making competition and this publication, the Journal. Member articles, correspondence, and questions are the backbone of the Journal and the association. Novice and beginning makers are encouraged and given special attention. Contact any officer; in fact, try several for different views

Table of Contents

Messages From

The Editor

Each issue that I prepare, I try to look for a common theme as a starting point for this editorial. Each and every month, I realize that the journal actually is eclectic. At first I worried about this lack of a common theme, as a thematic approach to a publication is often espoused. After thinking about this lack of a common thread, I realized that the publication actually reflects the organization. Each of the people who is a member is unique and that is what makes the organization great.

This month, with heartfelt thanks to all the contributors, we have a variety of topics. Nelson Thibodeaux has created quite the gadget that should help many of you with aligning the neck and fingerboard. Two of the articles are from presentations given at the last convention. Elon Howe's deals with f-holes and Pablo Alfaro's deals with raising neck projection. The tone article by Ray Leicht attempts to look at the attributes that contribute to the subjective quality known as tone. There are also a few "newsy" items for you to peruse.

Hopefully, the issue has something for everyone. ....and, as a not so gentle reminder, I am always looking for articles. If you have an idea or article, please share it with us.

The Membership Chairman

We welcome George Bean from Knoxville, Tennessee, as a new member of VMAAI.

I have heard from Nelson Steffy that Ed Campbell has recently suffered two mild heart attacks, and after each attack has had a stint put in.

Jim Trudeau tells me that June is now cancer free. Speedy recovery, June. I hope you can make it to Tucson next October.

For prospective members--
Dues are $25 per year for U.S. and Canada, and all other members are $35.
Dues should be sent to
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That Elusive Quality Known as Tone

by Ray Leicht

What is a “good sounding” violin? Are there specific criteria for assessing a violin’s tone? As with many variables that invoke human perceptions, preferences, and emotions, evaluating the sound of a violin is hardly standardized, objective, or consistent. Because we’re often bound by qualitative judgments, and because so many factors that influence a violin’s sound are subtle and complex, makers often struggle with the definition of sound quality and of obtaining that quality in their output. Players have similar problems in trying to determine what sound qualities they should look for when seeking a new violin [1].

While anyone can easily offer an opinion about the sound of a particular violin, putting the emotional experience of listening to a violin into words which convey the same meaning to any listener is problematic at best. What one perceives when hearing an instrument is not necessarily what another person is hearing or feeling. This is influenced by our culture and environment (attachment to our own instruments, musical experience, type of music being played, etc) and partly by our own biology. We could be using the same words to describe a violin’s sound, but still be registering and perceiving different tonal characteristics in our brain. “Like fingerprints, no two hearings are exactly alike” [2]. Our biology also complicates our ability to objectify an emotional experience and put it into words. The human ear cannot easily distinguish separate harmonics and our brain simplifies things so that we have little idea of the components of any sound; our brains don’t let us hear overtones except in an integrated way [1] [3].

Electronics has been able to explore particular aspects of violin sounds by analyzing and comparing sound spectra of old Cremonese as well as modern violins . For example, it is possible to portray, graphically, the harmonic frequency of sound produced on each string of a violin, or the spread of very high frequency notes which would provide “brilliance,” among other observations [3] [4] [5]. Spectral analysis allows us to observe the timbre of a note and to quantitatively compare what we think is a desirable timbre to an undesirable one. Thus, to some extent, perceptual qualitative differences can be measured and discussed in a quantitative way [6]. But, as Buen [4] notes, “Numbers can’t carry the total subtle information connected to music and musical instruments.” Perception of tone is incredibly more complex than just analyzing sound spectra - -bringing into play personal, emotional, intuitive feelings which do not lend themselves to being measured or quantified. What through spectral analysis should be a great sounding instrument, doesn’t necessarily translate to a great sounding instrument in the ears of the actual player or maker. It is more than just numbers.

We're often resigned to relying on age-old descriptive, if not hackneyed, subjective terminology to describe and evaluate a violin's sound. Perceptions of "sweet," "powerful," "bright," for example, are in the ear of the individual beholder. A pleasant sound to one person, under a given set of conditions, might be perceived as too muffled by another person under the same conditions. Complicating factors which make consistency and accuracy in dealing with violin sound difficult, include musical and tonal preferences, who is playing the instrument, who is listening to the instrument, type of bow, playing and bowing style, room acoustics, physical limitations of player, gender (e.g., with aging, women hear higher pitches than men of the same age do), and other variables.

With these limitations in mind, I thought it might nevertheless be instructive to examine some of the more common subjective terms that are used to evaluate violin sound. These would be descriptive qualities of apparent importance to the majority of players, makers, and listeners (based on my subjective impressions from being around these folks over the years). Realize that, depending on who is listening, there may be huge differences in how these qualities are ranked or even if they should be included in sound analysis at all. These qualities are discussed below.

Projection - For many, "projection" equates with "carrying power," a quality which rates highly among soloists or concerto players. A basic requirement of a string instrument is that it be heard; thus, as with singing, you would not expect a great soprano to have a weak or feeble voice [7]. There is a limit to the sound you can get out of an instrument. This doesn't mean the extreme limit of the instrument's volume must be reached each time it is played. Thus, if you are playing in a quartet or ensemble, the second violin should match the sound of the first violin. However, if you are playing in an orchestra and the conductor calls for more tone, then your instrument should have that reserve [8]. Great violins have a wide array of volume available to the player, ranging from a barely-audible tone caused by light bowing at the tip of the bow to loudness, without distortion at either end [9].

Projection is a much-used term, but not well-defined in words or acoustical measurements. Two violins can have the same sound in a small room, but in a larger room one may sound louder, more distinct, or have more carrying power than the other violin - - i.e., it projects better [5]. "This is not an ear-painful volume, which may or may not carry; it's genuine carrying power: the ability to stand out against a number of other instruments [10]. "Volume" is not the same as "projection" [11]. "Projection" is associated with "penetration," the ability to be heard among accompanying instruments which are louder [12]. Some violins are loud under the ear but don't project well, and vice versa. That "projection" is not simply volume or

loudness, is demonstrated by individuals who don't have an overly loud voice, but who can be heard above all other voices in a noisy or loud room. A muted instrument, in which the sound stays inside the box and does not project, is not a desirable feature for most classical violinists.

The judgment of the player is normally different from that of the listener [13]. What is heard under the ear is not always a true test of a violin's projection, thus, the instrument should be listened to in a large hall [14]. "Carrying power" is often discussed in reference to the violin soloist; however, being heard above other instruments might not be that desirable to a violinist in a Baroque quartet, trying to blend in with other instruments playing in a smaller hall or room. As Darnton [15] notes, "Carrying Power" is only important if you're really going to tap that (i.e., are you a soloist?) . . ." "For most players, what's happening under the ear is really more important though."

The use of vibrato is an important factor in influencing carrying power. The violin soloist playing in a symphony orchestra can be heard above the violins and other instruments in the orchestra by liberal use of vibrato. The vibrato changes the mix of harmonics and directions just enough to redirect some of the sound rays coming from the solo instrument . A player, however won't be able to determine this quality of a violin just by playing it, as his or her ear is too close to the vibrating surface to reliably assess what the power and sound quality of the violin is at a distance [1].

Response – A quick response, especially in fast passages, may be an important consideration when evaluating an instrument's sound (14]. A responsive violin speaks immediately; each note starts quickly and cleanly with a good clean sound, without any initial noise (not even an icy harshness). In a fast passage (or even slurred passages), all notes separate from each other with a distinct pop . Good response also equates with getting a good, clean sound with minimum bow pressure at speed near the bow tip. What you hear in the audience is an unusual cleanliness at the beginning of each note and a separation from the previous note (which stops sounding instantly without lingering into the next note). Good response is a major contributor to higher playing quality, since the player doesn't have to spend energy ensuring that his or her attacks are just right to compensate for the violin's own lack of good temper [10] [15].

A quick response or articulation depends partly on the damping of wood from which the violin is made [1]. Damping is a property which permits a brief space of silence between notes in spiccato playing, preventing overlap for greater clarity and brilliance [2]. It is noteworthy that some players choose to purchase their violins primarily based on which starts to vibrate most quickly on each note as a very fast passage is played. The feel in the left hand may also be important, in that an instrument

responding so the player can feel vibrations in the violin's neck is seen as a plus [1].

If response is an important consideration, the player should focus on vibrato when assessing response. How fast does it let you go and how wide does it let you go. The player should be able to start the vibrato right away, not after first making the note stable. In other words, the faster the vibrato starts, the better. A good testing method is to try to do vibrato on short notes like eighth notes [16]. Another test is to see how little movement it takes to make a vivid vibrato, with less movement of the finger being better [15].

Evenness - A high value is often accorded an even volume of tone and an even gradation of quality from one string to the next over the playing range; all should be equal [8] [14]. There should be balance across all the strings [17]. The player does not want the added variable during a performance of having to deal with unevenness between strings and the need to compensate for these differences in volume during playing. Classical players often appreciate the deep, mellow character of the two lower strings and the brilliance of the high E string. However, it is middle register that may be weak and cause problems for them, especially when playing with a piano. Raymond Page [8] notes that "On a fine violin, the soft grazioso character of the violin part will be heard without forcing. If the instrument doesn't respond, it is hard to resist the temptation to force in an effort to be heard, although this will destroy the balance with the piano as well as the character of the music" [8].

Tonal unevenness on a given string may be a considerably more complex structural issue. It can be observed on individual strings, where the quality of sound in a violin is not the same for each note [1]. On a particular string, there might be weak notes, less responsive notes, or wolf notes, and players may sense uneven tonal qualities with small changes in pitch. Players can often hear changes in the quality of overtones as different notes are played, due to different vibration patterns as the frequency is changed. According to E. Leipp [13], a homogeneous response curve, determined by the fundamental frequencies peculiar to each constituent part of the instrument, is desirable in instrument making; otherwise, some notes are shrill and others are weak. While noticeable tone changes on different notes can often be observed on student-quality instruments, even top-of-the-line instruments have a few uneven tone quality notes (Witness silver medal winning violins from the 2004 VSA competition in which uneven or weak notes on particular strings were observed for several of those instruments) [3].

Tone Quality – Tonal quality is a product of the bowed string. It is a characteristic of sound and relates to what makes the violin pleasing to listen to, or not pleasing to listen to. A mix of high overtones factors strongly in the tone of a string instrument [1]. As with many aspects of tone, it can often hinge on individual

preference, as exemplified in the use of adjectives such as: sweet, mellow, brilliant, round, full, dark, bright, rich, and many other subjective impressions used to describe the tone of a violin. As Carolyn Plummer, Associate Professor of violin at Notre Dame University notes, "… sound is very personal and you need to love the sound!" [14].

To many players, a *focused* tone contributes to a good sounding instrument. Players often seek a *focused* sound, trying to avoid a muddiness, where notes don't speak out the way you want them to and there are weak harmonics, especially on the low register. Focus might also relate to clarity and lack of dissonance, in which every note is clear and clean, internally (the harmonics) in tune and smooth, without anything extraneous [10].

"*Flexibility*" is an important criterion, in which you can work from a core sound and, for example, make that sound brighter or darker easily. If the instrument is only "dark" or only "bright," its potential will be limited and it will not be as effective [17]. A professional quartet performer has said that what he likes most about his instrument is to be able to "… adjust the sound so that it becomes brighter when I want it to sound more like a violin; thicker and darker when I want it to blend better with the cello" [8]. "Brightness" (high frequency emphasis) is caused by strong harmonics relative to the fundamentals; "darkness"is related to weak high frequencies [10]. "Flexibility" relates to *complexity* in tone quality, a characteristic valued by many violinists. A great violin has tonal *complexity*, a rich tonal palette available to the player, ranging from dusty and foggy when bowing over the fingerboard to harsh and aggressive near the bridge [10].

Other tonal qualities may or may not be held in high regard by musicians or players. One such quality is *Mellowness - - a* sweet, rich warm tone. If it favors the lower register, it is more alto sounding; if it favors the upper register, it has a soprano quality [18]. While many new fiddles are mellow in the slower passages, that mellowness seems to evolve to muddiness with increased tempos.

Although a *hollow* sound doesn't seem to be valued by most players, according to Peter Prior certain western music players seem to favor a more hollow sound, almost wolfiness [18]. Many players (and judges) prefer a *hard* sound, a sound that has an edge to it [18]. At a recent VSA convention, several tone judges (unofficially) indicated a preference for instruments that had a "bite" when playing loud passages, where the bow seems to want to grab the string (personal communication). *N*asalness , a pinched or pointed sound, can be viewed as a positive or negative quality. The timbre of some fine old Cremonese instruments has a nasal sound which is often pleasing [13] [18]. Finally, although many fine old Italian instruments have a *sandy* quality to the sound, players should be concerned about excessive sa*ndiness.* It probably should be

available, but not all the time, and some instruments have too much of it [17].

Techniques for Evaluating a Violin's Tone – Violinists employ various playing and listening techniques to evaluate an instrument's tone. Darnton [15] bases complexity in tonal quality on two things: 1) the greatest change in tonal character when bowing at the end of the fingerboard versus near the bridge, and 2) how little movement it takes to make a vivid vibrato, with less movement of the finger being better. Often the evaluation of an instrument's tone has someone listening in a large hall for projection, as what is heard under the ear is not always a true test. Listen to the instrument played well by someone you trust. Play in an acoustically dead room and see if it sounds good there - - if it does, it will sound great with better acoustics. Play both full and very soft passages to test for clarity [14]. One player suggests playing with a slow bow near the bridge, particularly up on the E string. A clean, hiss free sound, would be a sure sign of a good violin [16]. Many players, when trying out a new violin, will play in the upper register of the G string, as few violins sound good in that area. It is said that this is the area that separates good from great violins [2].

When trying out new violins, take your own violin along, so you can assess whether the new violins really do sound better . "The tradeoff between easy or hard to play is that more challenging instruments should reward the player with a richer palette of tone qualities, whereas the easy instrument is often one dimensional " [19].

A violin may also be tested by playing artificial harmonics. On the E string, first position, gently touch the note A with the third finger; the sound should be E two octaves above. Then play F natural, first finger, and gently touch the B flat note with the fourth finger; the note would be f natural two octaves above. Then move to F sharp, first finger, and gently touch the b natural with the fourth finger, and so on up on a chromatic scale. See how far it lets you go - - the higher the better. Listen for a good, loud sound. According to one source, that range is the quality of the best violins [16].

The Bottom Line – The issue of violin sound is complex and subjective. There are few absolutes, which is what makes the violin so fascinating and unique. Because of the wide variability in tonal tastes, there is no "one size fits all." Although the tonal criteria discussed above are important to many players, especially classically trained musicians, these criteria are not necessarily valued by all players or listeners. "Tone" often revolves around what you want the instrument to do. A bluegrass or country music fiddle can benefit by being brash to be heard over the banjo and other instruments. Many players of bluegrass or country music favor a darker, less brilliant treble than classical musicians do. A chamber music instrument for quartets needs to be responsive and intimate, or it can be overpowering. I personally have encountered violinists

whose instrument displayed abysmal qualities of projection, response, and evenness, but was very soft, sweet, and mellow under the ear, and they would not have traded their instrument for anything!

Regardless of how a particular violin stacks up against the tonal criteria discussed above or other formal criteria, there is likely to be someone who will be attracted to and appreciate that violin for its tone. I've long thought that for every violin, regardless of tone, there is a corresponding "soulmate" violinist out there who will fall in love with that instrument. The trick is to find that soulmate! In evaluating tone, the very diverse range of expectations and objectives of players and listeners must be considered. At a fundamental level, at least for the player, election of the "right" violin might largely boil down to whether the instrument sounds and feels good and is fun to play!

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FOR SALE

Some of you might remember Ignazio Nat Argento, who used to regularly attend the VMAAI conventions until about 20 years ago. "Nat" is still cranking out two violins a year and is not letting his age (93) deter him in the least. Nat has decided to sell fifteen of his library of violin making and related books including--

Encyclopedia of VIolin Makers by Jalovec
The Secrets of Stradavari by Sacconi
The Guarneri Family of Makers by Hill
etc.

Contact Nat at either natarg@att.net
or 2133 Pine Knoll Dr. Unit 3
Walnut Creek, CA 94595
925-932-2056

The New Mexico Musical Heritage Project--an update

by Peter White

The New Mexico Musical Heritage project has expanded this semester with an addition of a room for students who are working on their second and third violins and intend to go on to study at a violin making school or with a master violin maker. These three students we call apprentice students, and they help the beginners who started in the fall. We now have about 12 students, each taking three credits of American Studies and working in their class from 8 to 11 AM on Tuesday and Thursday. Several students come into the shop every afternoon to work on their instruments as after class studio work. Most of the time I am able to help them, unless I have other class matters to attend to or fund raising or accounting.

The new class started in the fall and is composed of students of various ethnic backgrounds, including Hispanic, Native American, and other nationalities. One of the students in the program just got accepted to dental school for next year, and Ryan Fini is applying to the North Bennet Street School in Boston to work with Roman Barnas.

An additional educational benefit is that Wladyslaw Stopka, from Poland, came to teach scroll carving .

In February, **ABQ, the Magazine**, did an article on Cedra Wood and our New Mexico program. We are in the process of fundraising now with the help of the Development Office at the University of New Mexico.

In terms of research, we have made some preliminary, very exciting sort of local discoveries about the Native American music and dance (as well as Hispanic) called matachines. It seems that the horse headed violin from Mongolia is called in Chinese Ma tou qin (pronounced matachine). It is called in Mongolian Erhu. Perhaps traders like Marco Polo brought this violin from Mongolia to Italy and/or Spain and it traveled to Mexico and New Mexico where it produces the music for the matachines dances done in the Pueblos of New Mexico as well as in Hispanic church and community festivals. Many scholars have worked on this problem of the origin of the matchines dance and music. Perhaps we have discovered a missing link.

Finally, we hope to have some instruments to enter in the contest in Tucson in October, and we look forward to seeing everyone and having a good time.

Peter White and his student Cedra Wood made a copy of an Andrea Amati viola. They entered the viola in a contest in Pisogne, Italy, and won a medal for antiquing. An article on the contest was featured in the November **Albuquerque Journal**.

Raising Neck Projection

as presented at the VMAAI Convention by Pablo Alfaro

At the 2010 VMAAI Convention, Pablo Alfaro's workshop presentation covered several interesting and practical techniques for improving or repairing stringed instruments. One of the topics focused on "raising neck projection," for which Pablo provided a novel and useful solution for a neck projection that is too low.

For some newly constructed or for older instruments, it might be observed that the neck projection as measured at the bridge line is too low. The normal neck projection is in the 26mm - 27.5mm range depending upon the arching. Once the violin is strung up, the neck projection will lower, more in some instruments than others, depending on construction, wood, adjustment, and other factors.

Steps for Raising Neck Projection

•Open the upper bout with a spatula and separate the top plate from the ribs and upper block (from approximately the center of the upper bout to the neck block).

Opening upper bout

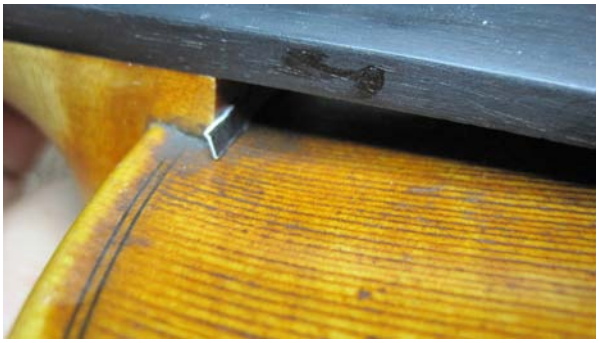
•Prepare a piece of cardboard the thickness of a business card.

•Adjust the size of the cardboard to fit between the top plate and the neck hill (tenon). The size of the cardboard is approximately 3.5mm (the thickness of the top plate) X 31mm (the width of the neck where it goes into the top mortise).

•Color the cardboard black with a Magic Marker or similar marker.

Example of cardboard insert

•Adjust the size of the cardboard to fit between the top plate and the neck hill (tenon). The size of the cardboard is approximately 3.5mm (the thickness of the top plate) X 31mm (the width of the neck where it goes into the top mortise).



Adjusted and colored cardboard ready to insert

•Put the cardboard between the neck and the top plate. {When the top plate is separated from the ribs and the upper block, there will be a small space between the top plate and the hill of the neck. You can pull down the neck a little bit, like trying to raise the projection, and put the cardboard in that space}.

•After the cardboard is in place, glue the top back to the ribs and upper block using a spatula. It is not really necessary to add glue to the cardboard, as it is going to get some glue from the block anyway.

Glueing top plate

(*The finished project. The cardboard insert is now between the neck block and the top plate. The repair is almost invisible.--ed)*

NECK/FINGERBOARD ALIGNMENT JIG

BY NELSON THIBODEAUX

One of my toughest problems in instrument making has been proper alignment of necks with fingerboard attached. Over the course of making 100 plus violins and violas, I have constructed several jigs, in an attempt to solve this problem. I always cut the mortise for the neck, with the fingerboard temporarily glued on. But, many times, after gluing in, and clamps removed, I found that it was not set in accurately, being a little off center of the instrument. My previous jigs were complicated, and not so accurate.

My most recent jig to accomplish the task, is the best I have ever conceived. I will now give you benefit of my new neck/ fingerboard alignment jig. I constructed it about three years ago. I have never seen anything like it. As far as I know, it is an original idea. It is the ultimate in simplicity, and works perfectly. You will be amazed at how simple it is to make, and to use. I kind of like the KISS method. This one is for violin, but this concept can be used for any instrument.

You will need a piece of wood, the length of your top plate, 1 ½ in. thick and approximately 3 ½ in. wide. With your bandsaw, on the bottom of the board, cut an arch approximately 17 mm (if using it for violin) high, sufficient to lay lengthwise over your instrument top plate, with a little clearance It must clear the top, when you lay it lengthwise on the top plate. On the top side of the board, cut a similar arch, making the ends of the board

approximately ¼ in. thick. The thickness at the ends of the jig are not critical. The picture should be explanatory. Those of you who choose to receive your Journal electronically will have benefit of a larger, and clearer picture, in color.

The cutout portion of the board is the only critical measurement. This must be very accurate. This cutout is the exact dimensions of your fingerboard. Some of us make the fingerboard slightly wider, and others slightly narrower. So, it is important to use your exact measurements to make this cutout. Measure carefully, and it is critical that this cutout is exactly centered on the board. Make a BOLD, very visible center line on the board before cutting it out. The centerline must extend all the way down to the end pin. At the lower end of the board, you can make a saw cut on the center line, as I have done. This aids in aligning the jig over the end pin.

Underneath the board, under the four corners, glue small pieces of cork. This prevents scratching of the instrument.

In use, the board will lay down over the top plate of the instrument, with the fingerboard laying in the cutout portion. You merely have to sight down the centerline at the bottom of the instrument, and see if the centerline lies directly over the end pin hole. Make adjustments to the mortise, until it does. Of course, as you are doing this, use your normal jig (whatever you use) to check for the projected height of the fingerboard.

Illustration 1--the jig

Illustration 2--application

The other Side of the bench--

My youngest grandson, Vincent, and his sister were playing together. As is normal for older sisters, she was bossing him around. (I do know from experience that the older sister always assumes she is the boss simply because I was the older sister and I was **always** the boss.) He listened to her and then promptly announced “OK Samara, you can be the boss, but we are going to do it my way.” After we laughed about his comment and about how he sounded much like his mother, we kind of let it slip out of our minds. As I was considering the topic for the piece this issue, his little comment kept creeping back into my mind.

We live in a world of “one size fits all.” The regional dialects are disappearing probably due to mass media and travel. Cars all pretty much look alike and unless one is a real car enthusiast no one really knows what manufacturer made what. We all have box stores that are exactly the same in every city. You see one Home Depot, Gap, Walmart, etc., you’ve seen them all. All the malls seem to have the same stores in every city. The diversity we are so proud of as Americans seems to be fading into oblivion, which to me is too bad. Vince’s comment to his sister shows that unique style that is so us. If you can’t move the obstacle in your path (in this case his bossy sister) you find a way to go around it.

So what does this have to do with luthiers? As makers of fine instruments, many of you get to be in that unique position of being the boss i.e. setting the time you work, what you do each day, and how much you accomplish. Also many of you are either self-employed or hobbyists, which allows you to do it your way. To me the doing it your way is the key phrase. How many of you have taken classes, learned from others, or read about techniques and then tried them, only to find that you could do something another way that was faster or better or more to your liking? How many of you have developed some gadget that helps you do it your way? These sparks of independence are the primary motivation for new methods, studies, and ideas that build the knowledge base of lutherie. That spark of independence keeps all of you striving for that new, better, and “perfect violin.” As for me, I hope all of you keep being the boss and doing it your way.--*Karen*

(Elon's article is presented in a different format. In order for the reader to see the digital pictures and read the information on them, I decided to present them in a full page, rather than columnated version.--ed)

MY PERSPECTIVE ON F-HOLES

By Elon S. Howe

At the last VMAAI Convention in October, 2010, I gave a talk about placing the f-holes geometrically. I have been doing a lot of research over the years on this subject and have written many papers, many notes, drawn diagrams, taken hundreds of photos, etc., etc., all heading toward the solution of how best to place the f-holes. I will attempt to condense all this work into a few pages, drawings and pictures to give the reader an opportunity to understand what I have been working on these past years.

Much of my research has been about how to use Phi (Φ), the Golden Ratio (1.61803), the Fibonacci Sequence and descriptive geometry, and how Stradivari may have used some of this information to set his f-holes into place.

I have used many tools to aid my research. Some of the tools I have used have been the straight-edge (ruler), a compass, and a divider, all of which have been used throughout the centuries by architects, builders and mathematicians. Mathematics has also been a big part of my research for without mathematics, there would be no way to locate the position of the f-holes proportionately on the instrument. So here goes my attempt to explain my perspective on the f-holes.

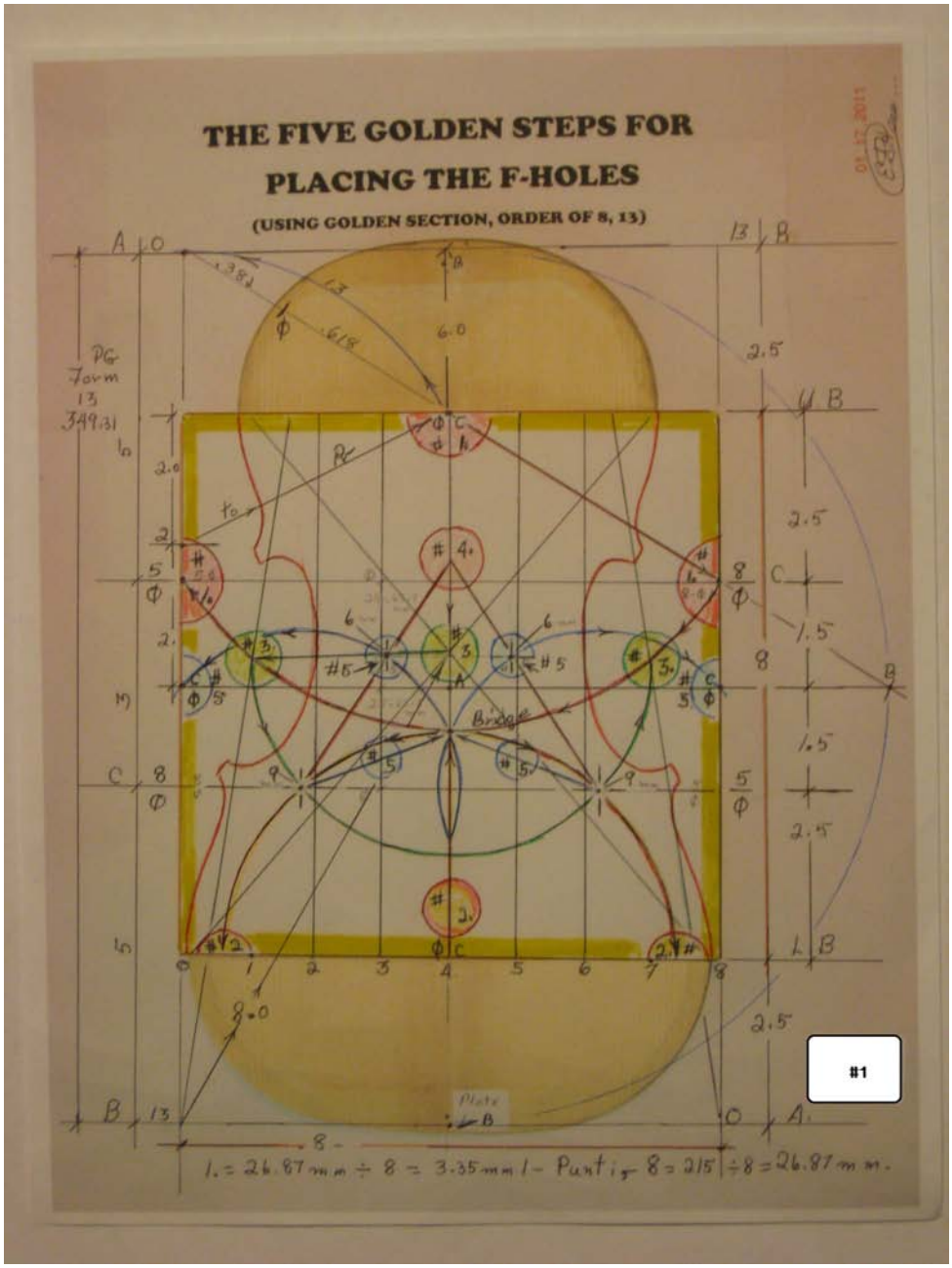


Illustration 1 shows all five steps, in 360° detail, and arrow points using the proportioned square of the Order of 8 (8 x 8 or 215mm sq.). The f-hole position is set using the compass and metric ruler. All of the numbers (0- 13) are shown on the "Fibonacci Stick". The proportions follow the order of 8 rather than 13. The Golden Section of an 8 x 8 square (or 215 mm square) is a square that sets the 8 x 13 rectangle, positioned at the center "A". The square is set in a grid of 64 parts. On the left #2 and #4 is set by the compass on the rectangle length of 13. The six parts of the square sets the upper bouts of Strad's 1689 PG form to the 6 parts or 161.2 mm width. The C-bout is set from 6 Φ; the lower bout is set at 7.5 parts, 201 mm, by the center bout x 2. The geometry of the steps are accomplished using a compass in the 1-2-3 (4); by the metric straightedge – all by the steps 1 to 5, 360° circle.

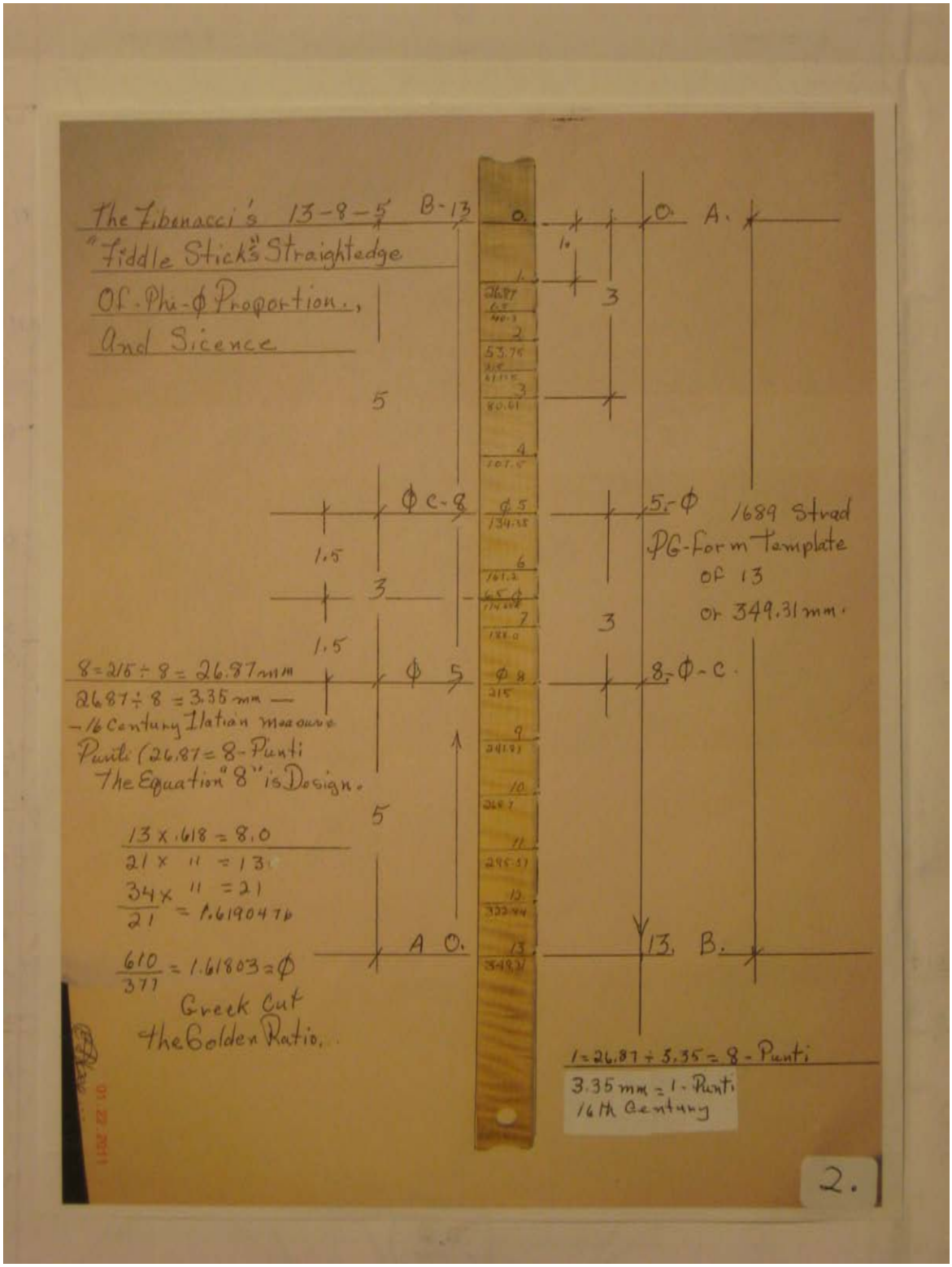
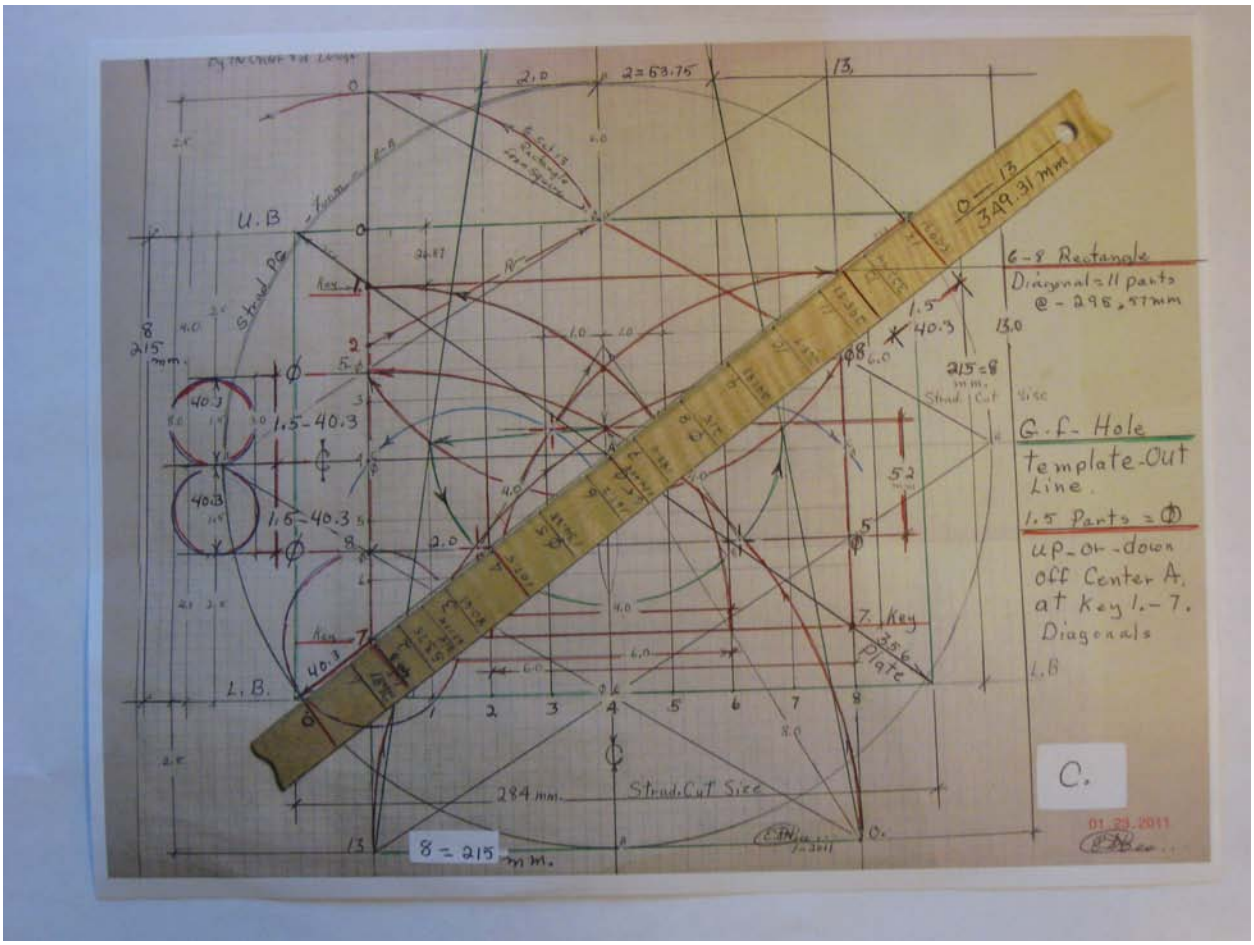
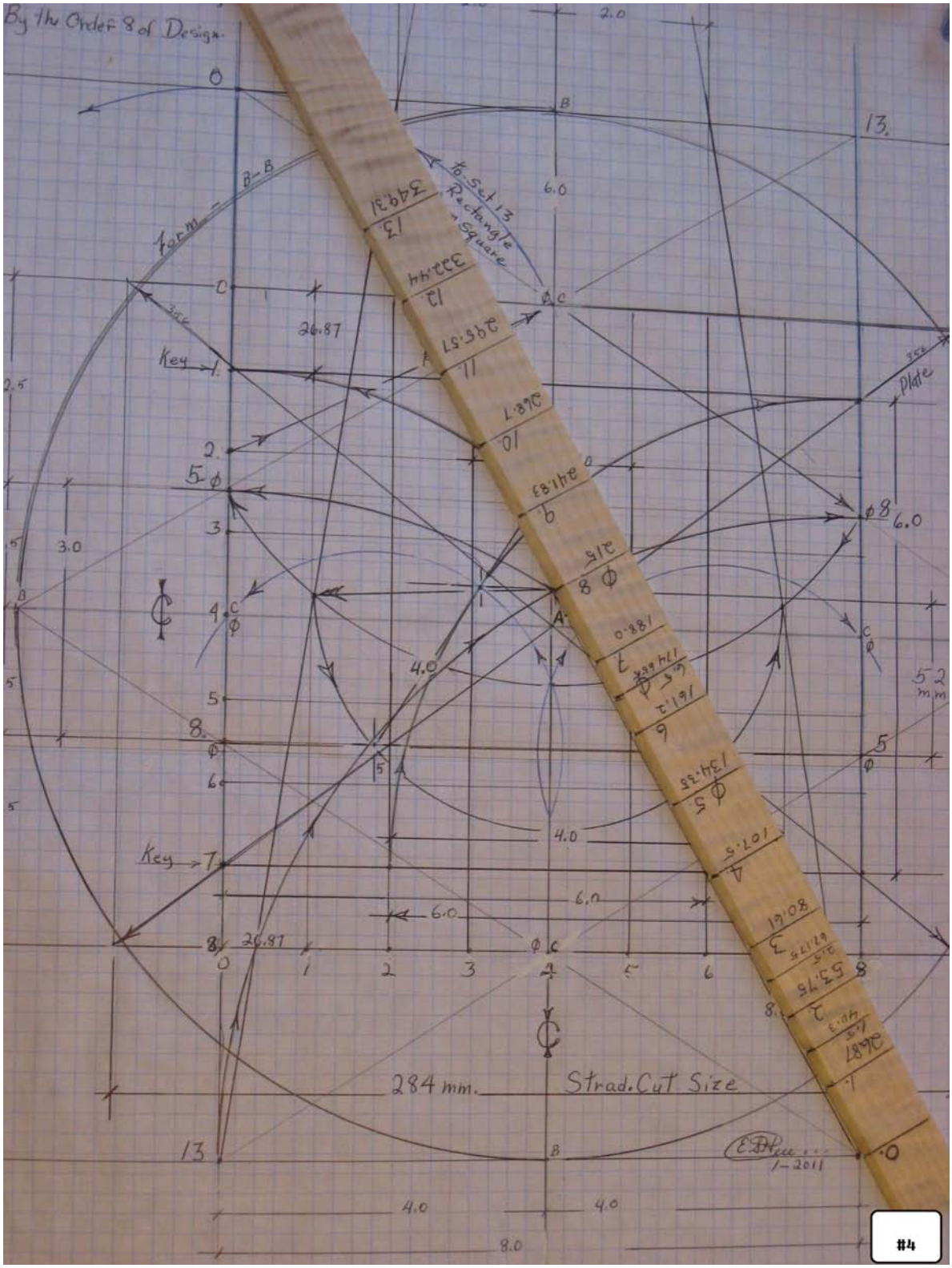


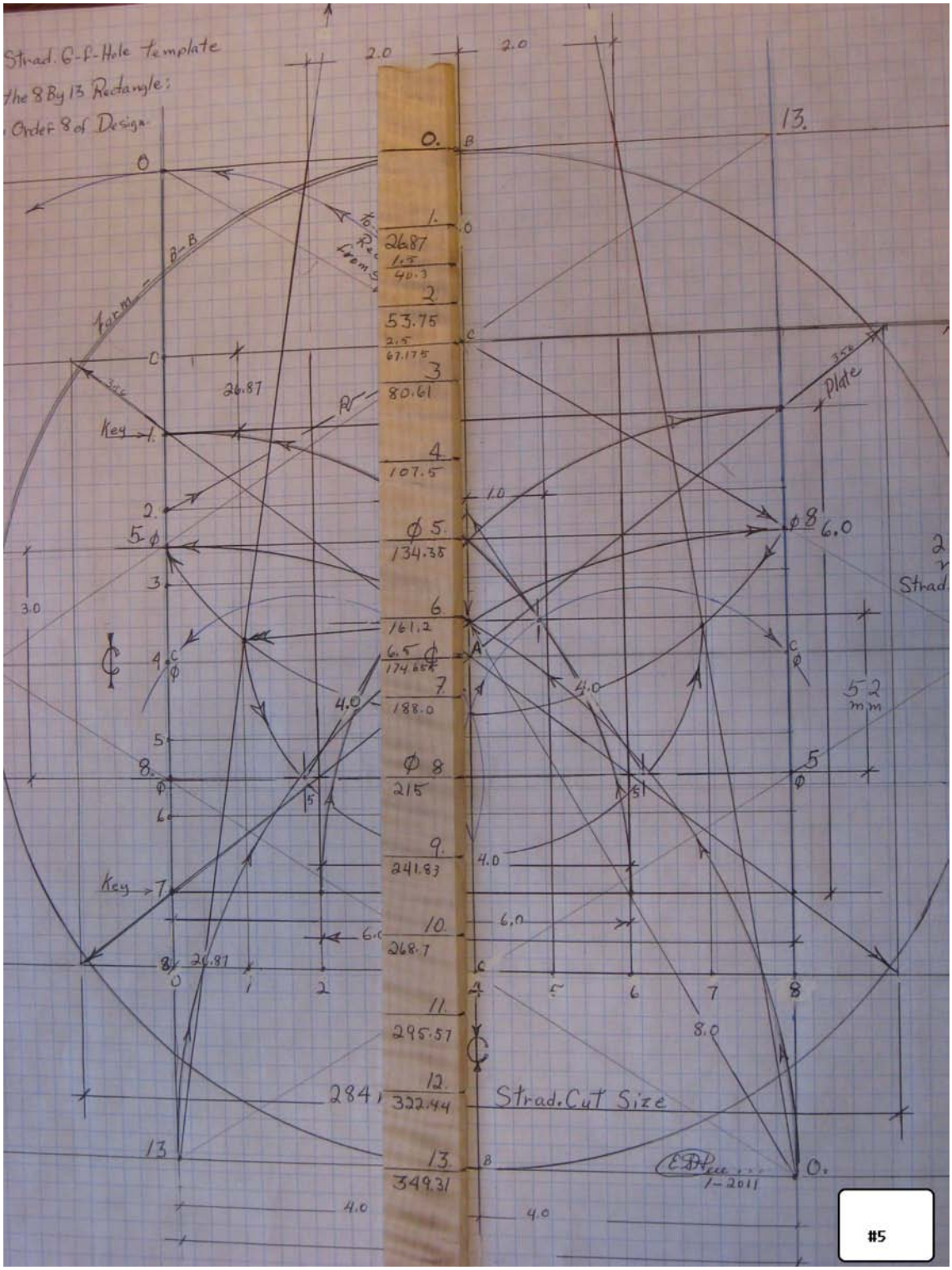
Illustration #2 shows the proportion of 0 – 13, or 349.31 mm, the length of the 1689 PG form with the end block in this form.



The G-mold f-hole template outlined in green in Illustration #3 measures 284 mm x 215 mm with a 90° arc of the order of 8 and the order of 6 squares. The straightedge overlaying the proportions of 0 -13 showing the relationship of 1.5 and 3 of the 360° sphere (outlined in red), follow the Phi Φ equation.

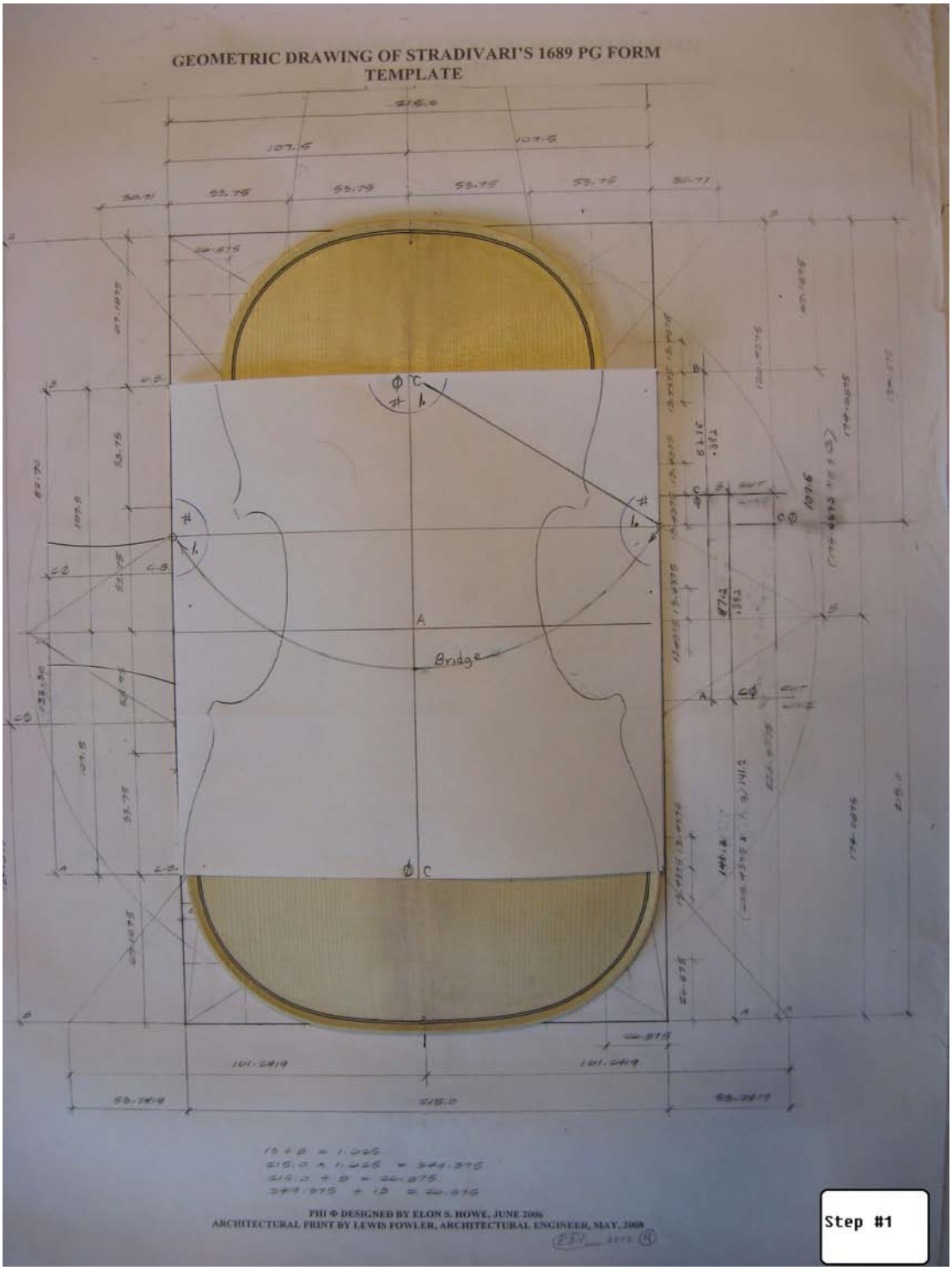


In Illustration #4 the straightedge set at a diagonal shows the intersecting lines to the 90° arc that centers the 6 mm hole positioning.



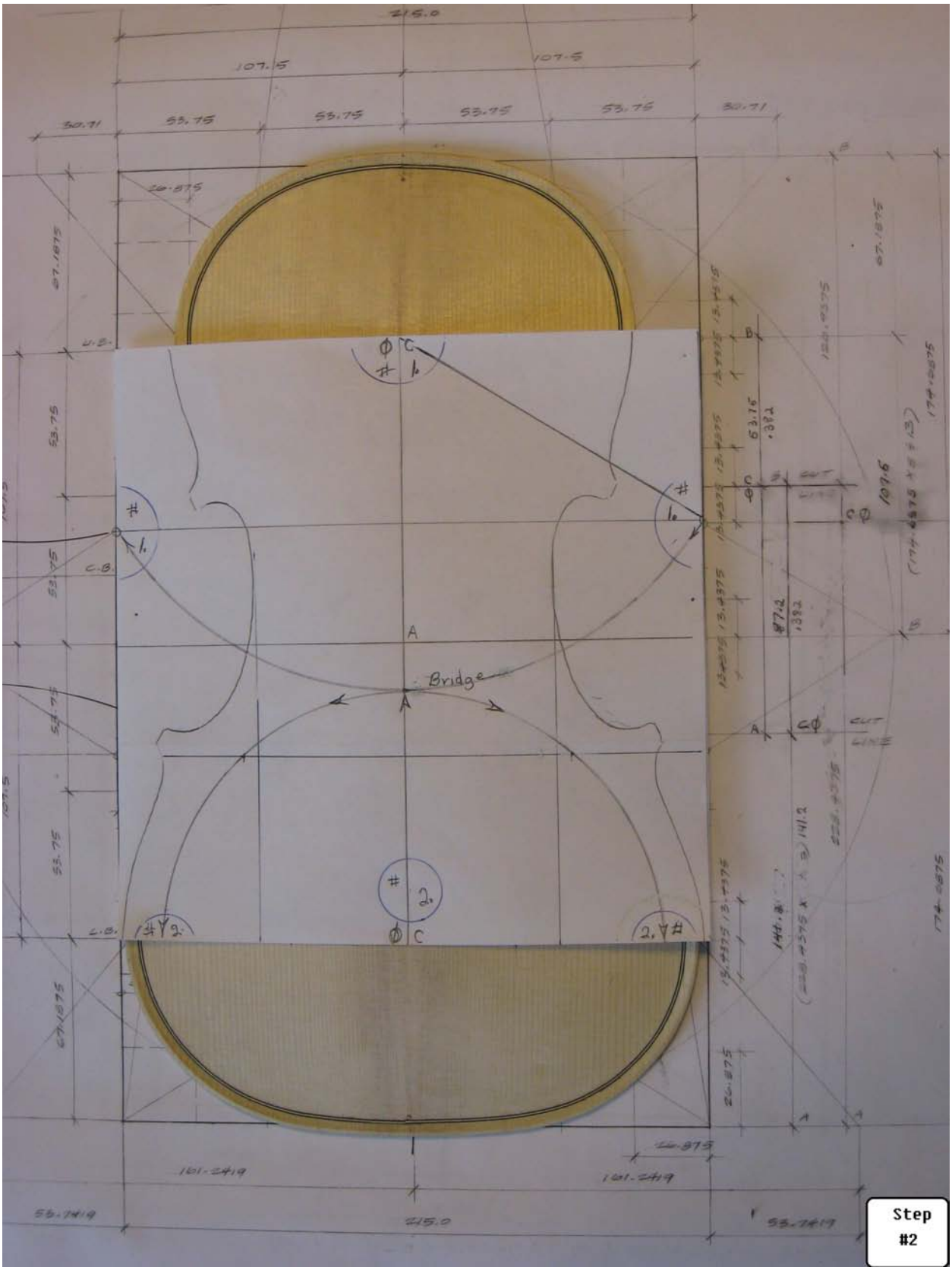
The vertical proportions of the G-mold f-holes in relation to the square and the rectangle are defined in Illustration #5.

The top plate laid over the reconstructed drawing of Stradivari's template for the 1689 form in a one-to-one placement.

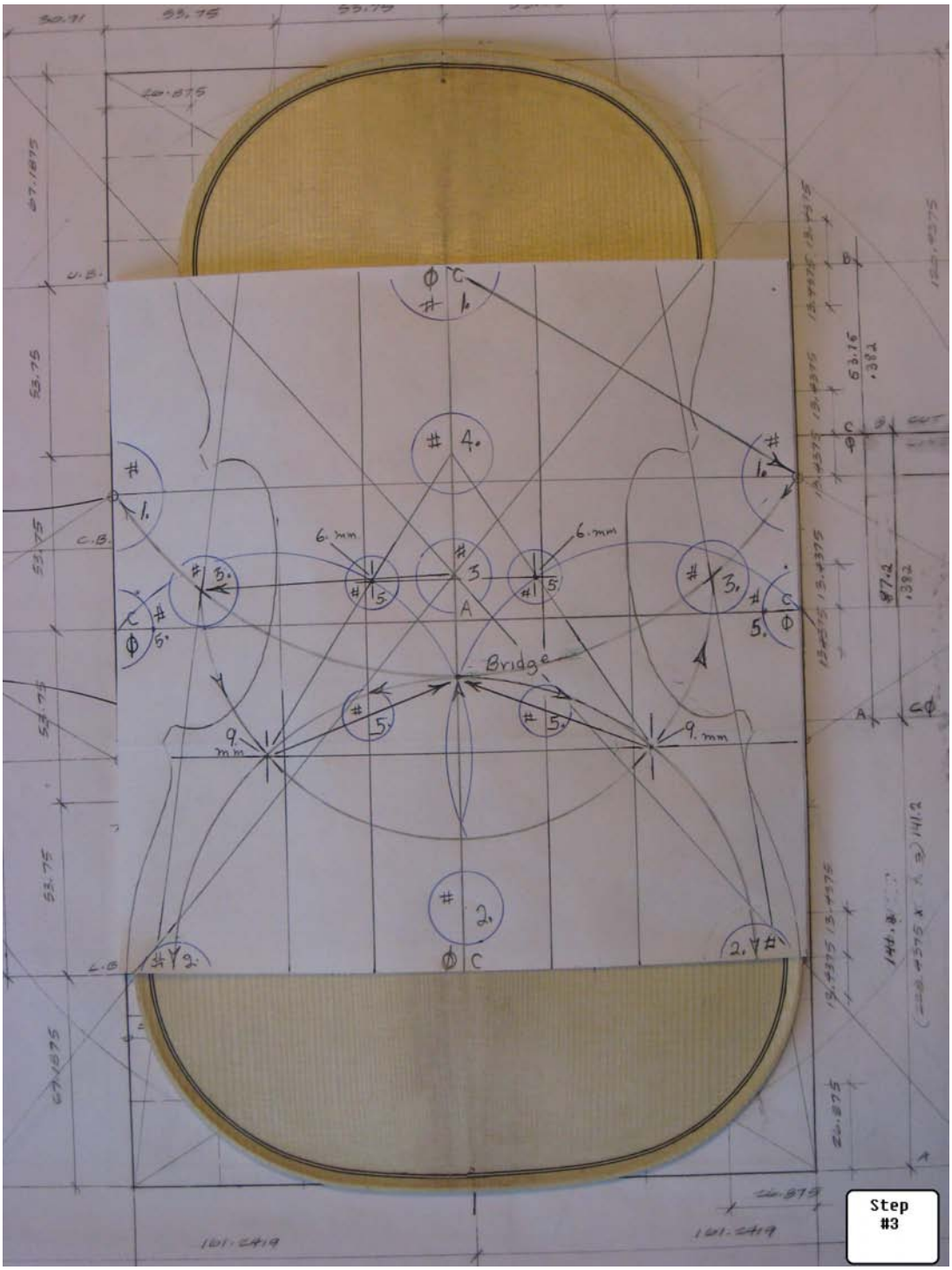


The following illustrations show the detailed steps for placing the f-holes.

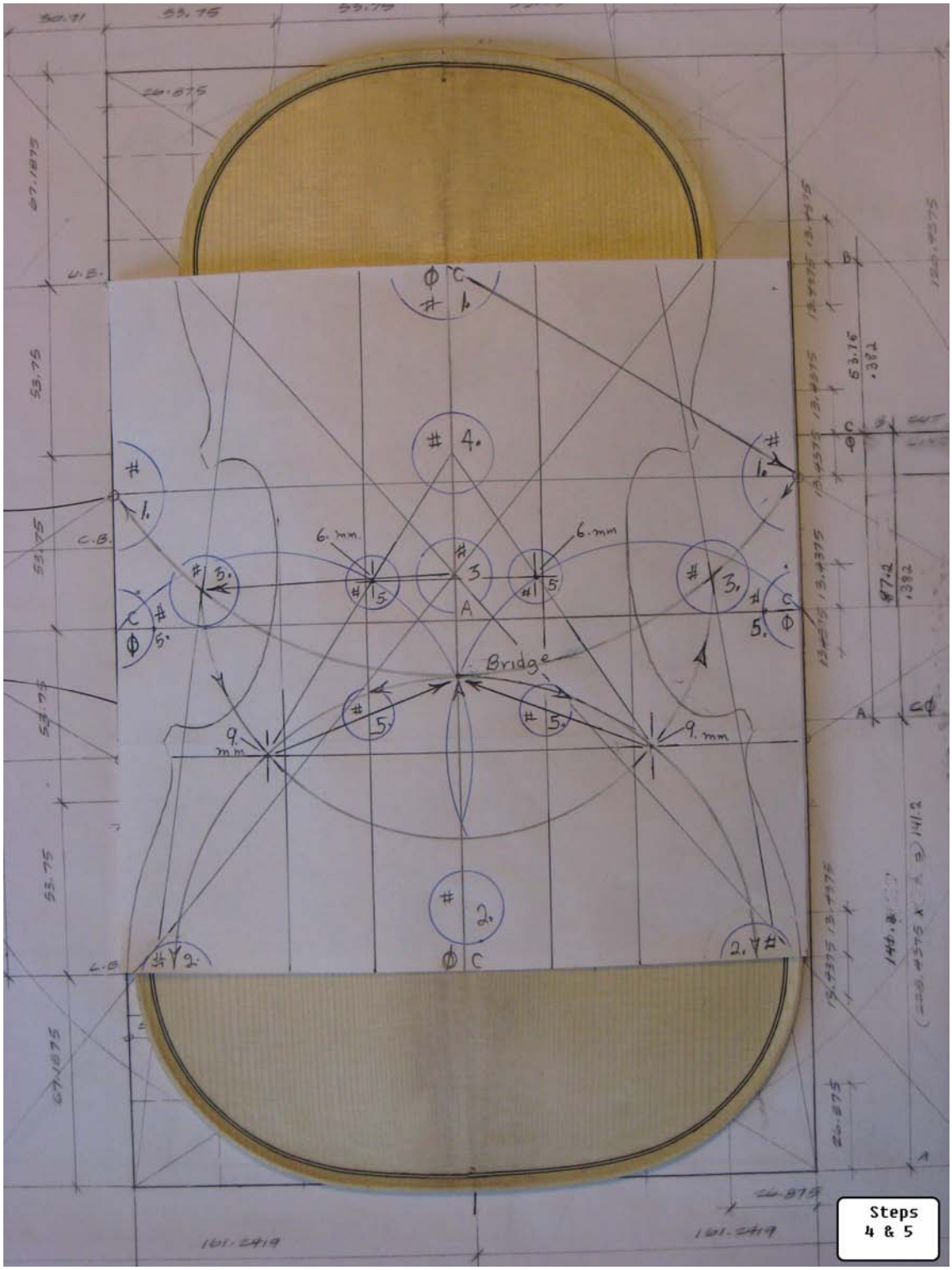
•Step 1: Follow the arrows by using a divider or compass.



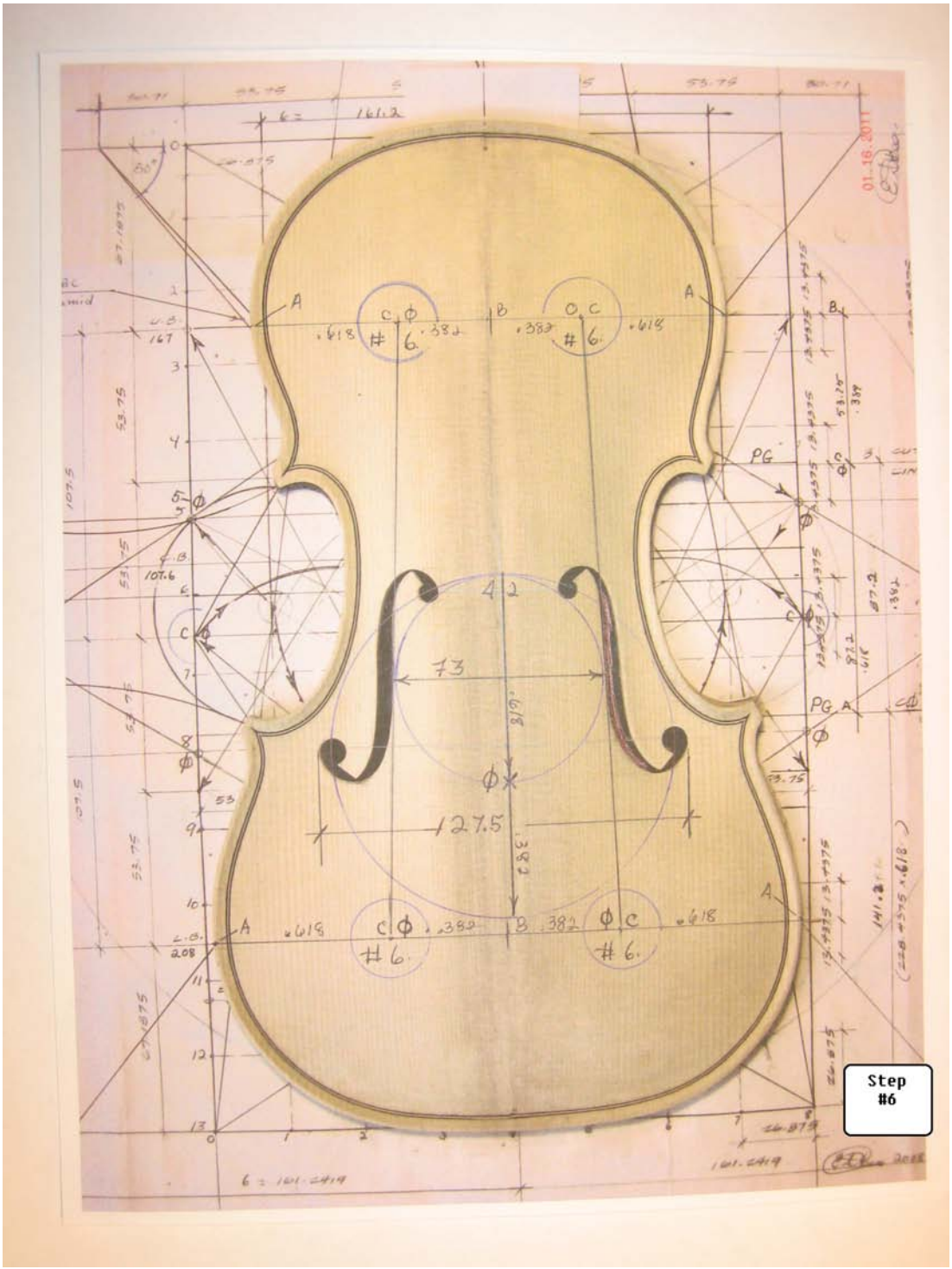
Step 2: Add the lower f-hole geometry



Step 3: Add Step 3 of the Bridge Arc to the trapezoidal perspective line using the radius from #6 to #7 part intersection confirming the position of the lower 9 mm hole as shown. Note the 5 mm outside the vertical line, #2 and # 6. (*See Illustration #1)*



Step 4: This step places the two 107.5 mm diagonal lines (in 4 parts) as shown.
Step 5: The radius from the 9 mm hole to the bridge is set by the compass from C Φ on center horizontal outwards 107.5 mm from the geometric center “A”. The intersection at 107.5 diagonal is the 6 mm f-hole at 3 mm inside the vertical lines of #3 and #5. (*See Illustration #1*).



Step 6: This step positions the f-holes geometrically by use of the plate. It places the inner f-hole vertical line and the 73 mm bridge table much like the 1721 Kruse Violin by Stradivari (*see the Strad Poster of the Kruse Violin.*)

In conclusion, there are so many things that are not in this particular article because it really can't be a book. I have left most of the interpretation to the mind and imagination of the reader, if the reader wants to know.