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A Journey Within the Making Mind

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CONTENTS

ABSTRACT (English/Français)

The personality of an instrument is an integral part of life for any musician involved with historically inspired performance practice. Because there is no single "correct" way, or any clear-cut answers about how to play the music of the past, musicians often spend quite some time finding a companion in an instrument that perfectly matches their personal sensibilities. Likewise, instrument makers sometimes struggle to create musical tools that perfectly suit the diverse needs of these musicians. This challenge is especially relevant in the field of bowed string instruments, as the craft of violin making is often thought of, depicted, and even marketed as being completely shrouded in mystery. The bass members of the violin family, in particular, have been the subject of drastic alteration over the centuries, leaving the world of modern standardization relatively ill-prepared to understand their musical qualities and obscure history. Hoping to provide a sense of direction and long-lasting value to this fascinating craft, this project documents my journey as a musician and violin maker in training, emphasizing the importance of unearthing the mindset, or "making mind," that created these instruments long ago. My experience with one of these so-called "lost" instruments, the bass violin, serves as an important backdrop to this research, which reflects my quest to enrich the fabrication of new instruments for historical performance.

La personnalité d'un instrument de musique fait partie intégrante de la vie de tout musicien spécialiste de la pratique historique. Comme il n'existe pas d'approche unique à l'égard de l'interprétation de la musique ancienne, pas plus que d'indications claires sur la façon de jouer cette musique du passé, les musiciens investissent souvent beaucoup de temps dans la recherche d'un instrument adapté à leur sensibilité personnelle. De façon similaire, les facteurs d'instruments peinent parfois à créer des instruments qui correspondent parfaitement aux besoins particuliers des musiciens. Ce défi s'applique tout particulièrement à la classe des instruments à cordes de la famille du violon, puisque l'art de fabriquer un violon est souvent considéré, décrit et même « publicisé » comme une entreprise empreinte de mystère. Les instruments de basse de cette famille ont fait l'objet de modifications particulièrement importantes au cours des siècles, ce qui en fait maintenant, en notre ère de standardisation, des instruments dont nous saisissons mal les qualités musicales et l'évolution nébuleuse. Ce projet, qui a pour objet de tracer l'orientation et la valeur pérenne du métier d'art fascinant qu'est la lutherie, met en lumière mon cheminement en tant que musicien et apprenti luthier, dans une optique de revalorisation de l'esprit « artisanal » qui a présidé à la création de ces instruments il y a longtemps.

FOREWORD

In the beginning of my formal studies as a baroque cellist, I was extremely fortunate to have benefited from the services of violin dealer/restorer William Monical. In addition to being a world renowned authority on the historical evolution and conservation of original instruments, Monical is also a veritable expert in the realm of sound adjustment. During this time, I became fascinated, even flabbergasted over Monical's uncanny ability to listen to an instrument and maximize its acoustic potential according to that instrument's inherent strengths and weaknesses. He could often accurately diagnose the problematic aspects of an instrument's musical response through listening alone, without even having to touch it, as well as match an individual musician to an instrument perfectly suited to his/her needs depending on the musical situation. I took the time to travel to Monical's workshop on Staten Island with other musicians on several occasions, just so I could observe his listening process more objectively, and gain insights as to how one could diagnose as readily, and approach solutions as logically and consistently as he could. I often wonder if he ever thought, "It's that pesky kid again!" in response to my constant questioning. It was through these interactions that I saw how a skilled luthier with a mature, developed ear could be the difference between an instrument that is utterly frustrating, and an instrument that feels wonderful to play, exhibiting a few baseline indicators of musical quality, including: a complex tonal palette, a balanced sensation of resistance to the sound production, enhanced resonance and powerful projection of overtones, and a sense of immediacy and control over articulation.

With Monical's unexpected retirement in 2013, I realized the importance of preserving this crucial, yet not so easily taught facet of the violin maker's craft. Learning acoustic enhancement, I thought, carried a special gravitas within the world of period instruments and historically informed performance, because the lack of

standardization and modern aesthetics in this field means that instruments are as unique as individual musicians who each have their own interpretation of the immensely varied music of the 17th and 18th centuries. In my search to get to the root of the subtle art of acoustic enhancement, I began to see that much much of the violin maker's craft was essentially a marriage between intimate musical acquaintance, the ability to listen critically, and a deep acquaintance with guiding acoustic and geometric principals. What I initially saw as talent in a great luthier, was actually the knowledge of how to balance these areas effectively, while recognizing that slight changes to one minute variable in the instrument always has significant ramifications elsewhere. Seeking to also apply these principles to the construction of new instruments designed for historically informed performance, my attention turned to various sources relating instrument design to the historical development of gut string technology, among them Monical's *Shapes of the Baroque: The Historical Evolution of Bowed String Instruments*.

When Prof. Hank Knox approached me in 2016 regarding the acquisition of a bass violin for McGill's baroque instrument collection, I thought, what better way to apply my research than to commission a violin maker who would be willing to combine his skills with my guidance, while accepting me as a trainee in the craft? And what better instrument than the bass violin to test our ability to create a musically convincing reconstruction of a historical instrument, as the majority of these were cut down in size, converted into modern cellos, or otherwise lost to the ravages of time? For this project, I enlisted the service of violin maker Nate Tabor, whom I had already regarded as a friend and mentor for some time. Tabor is a prolific craftsman who possesses a particular gift for selecting and evaluating the acoustic properties of wood materials, making sure that every piece of wood is maximally responsive, thus fitting the requirements of a great variety of instruments. In addition to this, he has a very personal, intuitive, and artistic approach to the craft. He also strives, as a preliminary

basis in his work, to respect the principles of historical stringing, which made him the ideal candidate to undertake the co-creation and construction of this instrument. In the summer of 2017, he and I worked intensively at his workshop located in A Coruña, Spain, completing the instrument in the fall of that year. This bass violin, inspired by the larger historical predecessors to the modern cello, has a deep, profound sonority that should serve as a benchmark for future instrument makers wishing to explore the acoustic capacity of pure, unwound gut strings in the bass register. It has additionally enriched my experience as a performer, in helping me to further understand and realize a lost sound.

Throughout the entire building process, I was able to gain valuable firsthand experience addressing various challenges not typically encountered in violin making schools, not to diminish the rigor of these institutions. In this paper, I hope to present a documentation of my journey into the world of violin making and designing historically inspired instruments, organized into three chapters. In Chapter 1, I address some of the issues facing current violin making tradition, as well as the challenges these issues present for makers producing period instruments. Moreover, what is the mindset that a violin maker must have in order to create a successful instrument, the characteristics and manner of which may be chronologically distant from us now? How do we, being a product of our own time, begin to enter such a mindset? Chapter 2 draws more directly on my time spent working with Mr. Tabor, and discusses some of the technical decisions related to our experience designing the bass violin. How did we grapple with the critical variables of instrument design, along with the specific acoustic challenges presented by the bass violin, in order to ensure our creation would be an optimal expressive tool once in a musician's hands? I emphasize the importance of form and shape in this chapter, elaborating on the virtues of creating original designs versus the inherent problems associated with producing supposed copies. In this regard, I discuss the pros and cons of the methods employed by Nate and myself, while also presenting

relevant primary sources and historically informed design principles imparted to me by other mentors, notably Dmitry Badiarov. Chapter 3 serves as a brief reflection on the history, current practice, and future of violin making, as well as the preservation of the hidden knowledge of the past, and its place within culture for coming generations.

I would like to thank the Stedman Foundation for funding this project, Professors Lena Weman, Eleanor Stubley, Susie Napper, Hank Knox, Tom Beghin, and Vittorio Ghielmi for their support, and violin makers William Monical, Gabriela Guadalajara, Dmitry Badiarov, Corinna Metz, and Dirk Jacob Hamoen for generously sharing their precious time and knowledge. A very special thanks goes to Nate Tabor, for enthusiastically taking me under his wing and sharing in the toil of life, craft, and humble service of music.

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CHAPTER 1

Violin Making in Context: The Current State of the Craft in Modern and HIP Circles[1]

1.1 Reverence and Innovation: The Fuel of Inspiration

Leonardo Da Vinci, addressing young painters, advised, "that nobody ought ever to imitate another's manner, because he will be called a grandson and not a son of nature, with respect to art. Since natural things exist in such great abundance, we wish and we ought to resort to nature rather than to those masters who have learned from her."[2] Aesthetically speaking, it is only sensible to believe that no art form can subsist in an intrinsically valuable way if the only source of inspiration is the body of works already created by previous masters. So much about how we revere great composers or painters of the past has to do with what great innovators or inventors they were and the cultural impact of their works. Through the strength and rigorous honing of their craft, these artists paid reverence to their own masters, not only by

1 The historically informed performance movement, or more colloquialy, HIP, is largely focused on rediscovering what it feels like to play on period-specific instruments and bows. The presence of HIP has grown from being relatively marginal within the larger sphere of classical music, to exerting influence on a mainstream scale, with increasing numbers of musicians exploring instruments set up with gut strings. See Corinna da Fonseca-Wollheim, "Unleashing the Potential of the Strings," *The New York Times*, August 30, 2013, https://www.nytimes.com/2013/09/01/arts/music/more-musicians-are-trying-period-instruments.html. Because of the importance placed on period instruments, there is now also increasing demand for violin dealers, restorers, and makers to adapt to the needs of HIP specialists. These demands require violin makers to delve beyond the modern standards handed to us from the modern tradition and market. With the predictability and expectations of exacting modern standards taken away, historical immersion becomes the principal guide for makers working within this context. Realizing that the purpose of period instruments is not to merely supply musicians with a "different" sound, we must then suppose that the construction of any instrument is an infinitely creative process, the success of which is rooted in experimentation, vision or intent, and an intimate acquaintance with musical and cultural context. These ideas permeate the background of this chapter: a comprehensive overview of the violin maker's responsibilities and endeavors in the quest to preserve our continuing tradition's connection with the past.

2 Leonardo Da Vinci, *Treatise on Painting [Codex Urbinas Latinas],* trans. Philip McMahon (Princeton: Princeton University Press, 1956), p.51. Hessel Miedema, "On Mannerism and Maniera," *Simiolus: Netherlands Quarterly for the History of Art* 10, no. 1 (1978-1979): p.35, https://www.jstor.org/stable/3780561. remarks that although *maniera* has been interpreted as "style," the term may be preferably and more broadly suited to "working method."

emulating, but by pushing the creative envelope. This relationship between reverence and innovation is how the classical bowed string instruments born of Renaissance and Baroque Europe, viols and violins, were conceived. Instrument makers embraced the philosophical knowledge and used the musical science of their time to craft truly magnificent objects, which not only functioned as tools for working musicians, but survived hundreds of years and became iconic for their ability to encapsulate so much of the music and culture they so humbly served.

Many facets of the classical music field today, however, suffer from a pervasive sense of disconnect between living artists, or craftsmen, and the great masters who, arguably, we should be seeking to emulate. It is difficult to describe, with singular conviction, what modern classical music culture is. Since much of our current classical music culture is comprised of performing old works, it is a particularly pressing matter to ask how well the behavior of modern instrument makers or composers, for instance, parallels that of old masters. Bruce Haynes points out that modern composers are "involved with inventing a system, a style as it were, for every new piece," when composers like Bach and Vivaldi composed their pieces "within the conditions of a shared convention."[3] This observation, coupled with the fact that the output of modern composers seems puny in scope compared to that of baroque composers, indicates that we have perhaps lost sight of the meaning of creativity as past masters may have seen it. For Bach and Vivaldi, creativity, and thus the quality of craftsmanship would have been defined by how well they could simultaneously abide and twist the convention, providing opportunities for the musicians to invoke passion and affect. This stands in stark contrast to the arbitrary abandonment of convention or rules; an action which more often seems intended for shock value alone than creating a work of real substance.

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3 Bruce Haynes, *The End of Early Music* (New York: Oxford University Press, 2007), p.210.

One may consider then, that as a side effect of the current state of modern music, performers within the classical tradition seem stuck playing old music for aging audiences in ways that seem detached from the spirit of the music itself. Of course, there is nothing wrong with performing old music, but the danger lies within the obvious necessity to keep audiences interested without truly seeking an inherent connection to the living tradition of those works. In the worst case scenario, this leads to the cut-throat working environment common in the experience of many classical musicians, who must frequently rely on corporate subsidies to survive. For performers, this manifests as a feeling of powerlessness in their ability to directly generate new interest among the audiences who they work so hard to inspire. Speaking of the way classical music is taught within conservatory culture, the great cellist and pedagogue Janos Starker remarked that he doesn't like the term "master class," stating, "That's when an old master, when a young master plays, says, 'I like my way better.' I don't think that's productive."[4] One of the principle objectives of the historically informed performance movement is to respect the cultural context of a piece of music, with corresponding use of appropriate techniques. This serves in part to ward off the looming threat of artistic stagnation among particular bodies of works, and even lead to new, refreshing possibilities in composition and music making. For players of violin family instruments, HIP applies mainly to the seventeenth and eighteenth centuries, the Baroque Period, a time which, of course, also bears significance by representing what many violin makers call the golden age of violin making.

Despite this refreshing outlook, there remains a danger within HIP, especially among the educated, amateur circles largely responsible for the continuing life of the arts, of fostering a vision of performance practice that is dogmatic and reactionary, in rebellion against the so-called modern school. In the words of Richard Taruskin, "It is

4 Chris Palses, "A String of Insights," *Los Angeles Times* (Los Angeles, CA), Mar. 05, 1999, http://articles.latimes.com/1999/mar/05/entertainment/ca-14063.

the academic mind, not the performer's, that is trained to generalize and to seek normative procedures- even when this means elbowing off the table the difficulties and ambiguities that surround, for a notable example, the Renaissance mensural system. Edgard Varèse once gloomily predicted that 'it will not be long before some musical mortician begins embalming electronic music with rules.'"[5] On the other hand, renowned viol player Vittorio Ghielmi prefers to seek the true value of music through living culture. Speaking of his collaboration with Sardinian guttural singers, he stresses the importance of rediscovering the sounds preserved in the unbroken musical traditions of marginal areas, which, either because of political or geographical reasons, were able to survive many generations. He advises young players to seek the lost sounds of past times by observing these unbroken traditions, as the search for pure, essential inspiration on a deeply personal level is missing in conservatory education. He goes on to draw a historical parallel, saying that Georg Phillip Telemann "got more musical ideas watching the traditional musicians he encountered in the dive bars in Poland and Moravia than from studying the more refined European ways of music making."[6] Through a similar lens, Ghielmi reflects on the importance and influence that his contact with a great many traditional musicians has had on his own musicianship, stating, "The music and the quality of its sound is the spiritual image of a culture; We cannot fake it. This journey with my Sardinian friends has taught me once again that music is always produced through a *way of being*. How better to share our *way of being* than to sit together joking around, while we wait for our pizza… even though the pizza never came?"[7]

As performing artists occupied mainly with playing old music, or violin makers replicating old instruments, how do we then ensure that our work is inspired, having

5 Richard Taruskin, *Text and Act : Essays on Music and Performance* (Cary: Oxford University Press, Incorporated, 1995), p.97.

6 *The Heart of Sound – A Musical Journey with Vittorio Ghielmi* (2012; Salzburg-Hollywood: BFMI), https://vimeo.com/62847925.

7 Ibid.

drawn on elements from past masterpieces, while remaining fully creative, vibrant, and present? A discussion about the violin making craft may hold several answers to this question. For a craftsman whose ultimate goal is to create a quality instrument, it is helpful to enter this discussion with a blank slate mentality, putting aside all the meticulously learned, technical details; perhaps the best measure of fundamental artistic inspiration lies in the power of our basic instincts, usually exhibited by those who admit they have little formal education in the arts. This discussion must begin with a comparison of empirical tradition and the rediscovery of historical imagination, the balance which lead the great old masters towards a working process which allowed them to create within a realm of natural laws they had laid out for themselves, without having to resort to complete fantasy.

1.2 Imagination and the Veil of Tradition and Empiricism

How exactly does violin making fit into this picture? The idea of unbroken tradition is central to the current state of the craft, with overwhelming popular propagation of the idea that old, Italian violins, especially those made by Stradivari or perhaps Guarneri in seventeenth and eighteenth century Cremona, are somehow superior to those made any other time and place in history. The exact reason and historical background behind this Cremonese obsession is unclear, and could very well be the subject of a book, although it is almost certainly related to the nineteenth century romantic concept of the cult of genius. George Hart, in his seminal c1875 work, *The Violin: Its Famous Makers and Their Imitators*, echoes this sentiment. He states, along with numerous affirmations that the design of the violin was "perfected" by the Cremonese, that, "… it [the true study of the violin] needs, equally with these arts [poetry, etc.] in order to produce proficiency, that spark commonly known as genius, without which cultivation, strictly speaking, is impossible, there being nothing to

cultivate."[8] A certain Stradivari mythos is certainly perpetuated in mainstream media. This mythos is the common underlying theme in a vast number of reports from recent decades, which contain all manners of eccentric theories, each claiming that scientists have found the secret to what makes those violins so great, ranging from chemical or mineral treatment of wood materials, to apparent discoveries of a holy grail varnish and even the possibility of a miniature ice-age in Europe having produced growing conditions for the most optimal tonewood.[9]

Without discounting the fact that a great portion of these old Italian violins are indeed some of the most elegantly designed and tonally sophisticated of all time, none of these theories, including the supposition of genius, elucidate a credible, logical, reliable process by which these fantastic results were achieved. Samuel Hugo Bergman, addressing Søren Kierkegaard's position on Romanticism in his 1841 dissertation, comments on the idea of genius: "The subjectivity of the genius, they [Romanticists] argued, breaks every aesthetic and moral law and acquires the right to total capriciousness, or complete independence from objective laws. Life becomes an aesthetic game for them."[10] The theme of objectivity and natural law, is, for the violin maker, an important crossroad in developing a working method. Likewise, the popular, sensational notion that the success of the great instruments of the past can be reduced to a single component, or magic bullet, devalues the rigorous craftsmanship and empirical advancement of the violin making craft. According to violin and viol maker Charles Riché, "…the success of the whole does not depend on the details or miraculous design of a bridge or barring, but on the vision of the ensemble. A clear plan must be established from the beginning and proportions decided upon. Each piece of the puzzle

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8 George Hart, *The Violin: Its Famous Makers and Their Imitators* (London: Dulau, 1881; Boston: Longwood Press, 1977), p.9. Citation of the 1977 reprint.

9 Emma Saunders, "What makes the Stradivarius violin so special?," *BBC News*, Jun. 21, 2011, https://www.bbc.com/news/entertainment-arts-13856203.

10 Samuel Hugo Bergman, *Dialogical Philosophy from Kierkegaard to Buber: Extending Chinese Philosophy in a Comparative Context* (Albany: SUNY Press, 1991), p.35.

has a place and importance in the complex final equilibrium. This, I believe, would have been the approach of builders in the seventeenth and eighteenth centuries."[11]

As modern violin makers wanting to learn what exactly makes great instruments, we are left with the challenge of interpreting Riché's statements. We can infer that, because many of the great makers of the seventeenth and eighteenth centuries worked in such concentrated proximity to one another for several generations, among family businesses sometimes all working on the same street, they were able to benefit from trial and error at a highly accelerated rate, compared to an individual maker learning from scratch nowadays.[12] The level of consistently phenomenal quality, as well as the unequaled volume of output by the old masters, therefore, may have been attained in a similar manner as the development of culinary tradition; cooks would have created and experimented, and passed their knowledge of which ingredients work well together, and which processes work and do not work, down to generation after generation, until that knowledge simply became part of a collective culture. This observation has lead the majority of modern violin makers to arrive, justifiably, at the conclusion that the biggest secret of the old masters is that there is no secret. There should not have been anything particularly special about their methods, just as there should not be anything special about the methods employed by modern makers, so long as all the steps to constructing an instrument are followed, and measures taken by the individual to refine his or her craft.

The philosophical dissonance produced by this attitude, which may be called modern traditionalism, is, however, that even though the presumed absence of anything special in the methodology creates the illusion of an undisturbed tradition of

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11 Charles Riché, "The Restoration of a Bass Viol by Nicolas Bertrand," in *A Viola da Gamba Miscellanea: Articles from and Inspired by Viol Symposiums Organized by the Ensemble Baroque de Limoges, France*, ed. Susan Orlando (Limoges: Pulim, 2005), p.211.

12 Roger Hargrave, "Cremonese Kaleidoscope," *The Strad* 101, no. 1206 (1990): p.789.

violin making from the seventeenth century until now, modern makers still live largely in the shadow of the golden age makers. Violin making schools teach students how to assemble violin parts, and many spend considerable portions of their careers producing dimensional copies of old instruments, either from photographs in the worst case, or from real antiques at best. The musical results of these copies range from bad to excellent, which, for makers, may seem a dismal reality when their instruments are judged by how well they are able to support strong players under highest standards of musicianship. Consistency of musically successful output as well as the associated element of chance, remain uphill battles for many makers today. For example, violin maker Martin McClean said of his own work, before and after learning of historically inspired methods from violin designer and researcher Geary Baese, "After years of producing 'hit and miss' dimensional copies which sometimes worked reasonably well, I now have the knowledge and ability to reliably and repeatedly create instruments which embody harmony, sonority, strength, sweetness and an extraordinary dynamic range."[13]

This is not to say, however, that modern violins are in any way fundamentally inferior to ones made by the old masters. In fact, numerous reports hold evidence that some modern instruments can equal or even be preferred to the old instruments. These reports include blind tests in which subjects were unable to tell the difference between a selection of new and old violins, calling into question the various modes of perception used to evaluate sound.[14] Additionally, modern makers such as Howard Needham have been increasingly lauded in recent news, after one of his violins beat every instrument except for a million-dollar Guadagnini in a violin shootout, featuring a selection of new

13 Martin McClean, "Method," Martin McClean – violin maker, accessed Jan 29, 2019, http://martinmcclean.com/concert-instruments/method.

14 Joseph Curtin et al, "Player preferences among new and old violins," *Proceedings of the National Academy of Sciences* 109, no. 3 (2012): pp.760-763, www.pnas.org/cgi/doi/10.1073/pnas.1114999109.

and old instruments, all considered to be the best of the best.[15] More to the point, the biggest problem with the current state of violin making is not that excellent results are impossible to achieve; this is the manifesto of the magic bullet or holy grail secret of Stradivari, a non-existent and therefore impossible path for today's makers to follow. Instead, a great portion of living makers is left suspended in a void of uncertainty and unfulfillment, unable to find the answers to the *why* and *how* of their craft, not at least without encountering some scoffing, and laboring prodigiously to integrate the various pieces of the puzzle. The traditional attitude has long eschewed the unequivocal notion of a unified, underlying logical approach to designing instruments from scratch, instead focusing on the significance of an instrument's many details and component parts. These details, while definitely important on an individual basis as elements of the final product, do not, however, explain the quintessential nature of the violin.

Mastery over the sheer, seemingly infinite number of factors, the pieces of the puzzle, is an inhumanly difficult task, especially for young makers. Dirk Jacob Hamoen, headmaster at the Dutch School of Violin Making in Makkum, states that violin making students are at particular risk of feeling insecure over whether the outcome of their work will match their hardscrabble efforts. Examples of this worry include the incessant question of "What will happen to the sound if I do…," as well as the fear that any slight deviation from perfect craftsmanship or the dimensions of a famous instrument while making a supposed bench copy, will ruin the sound of their instruments.[16] Richard Gagliardi, a violin restorer and dealer in New Jersey, has also remarked on the distinct challenges faced by young craftsmen who work primarily on building new instruments, as opposed to restoration. Early on in pursuing my interest

15 Amanda Abrams, "For violin maker Howard Needham, a rarefied world," *Washington Post*, Sept. 7, 2012, https://www.washingtonpost.com/lifestyle/magazine/for-violin-maker-howard-needham-a-rarefied-world/2012/09/07/b7075b10-e7e7-11e1-a3d2-2a05679928ef_story.html?.noredirect=on&utm_term=.b845efc73c5c.

16 Dirk Jakob Hamoen, "Origin and methods of the DSVM," The Dutch School of Violin Making, accessed 2019, http://www.dutchschoolofviolinmaking.nl/dsvmorigin.htm.

in violin making, Gagliardi made a particular point to tell me that because new making competes in a market that primarily deals in copies of Stradivari or Guarneri instruments, he often wonders what value the herculean efforts undertaken by an individual have, in an age when such copies can easily be produced in a factory.[17] Hamoen, contrasting the nature of violin making in seventeenth century Italy, versus our modern tradition, infers that violin making tradition, as we know it, may in actuality be much more broken and interrupted than we usually consider it to be. We may then suppose that a clearer picture of violin making can be gained through historical immersion, by paying attention to a few of Hamoen's inferences, which I have paraphrased through the following questions: Just how is it then, that the violin, in its nearly complete classical form, with its characteristic shape and sound projecting capability, seems to have emerged from out of nowhere, or been invented in a candlelit, sixteenth century workshop by a likely semi-illiterate Italian craftsman using relatively primitive tools? How were the old masters, able to work so quickly and confidently, significantly varying their models while producing hundreds of consistently excellent instruments? And how were they able to achieve all this before the invention of the hertz or the decibel?[18]

On a large, mainstream scale, young, innovative makers have neither the encouragement nor the constructive criticism from the modern school of violin making motivating them to seek out the answers to these questions, and are left in a conundrum. In my experience observing a fair number of different makers as a relative newcomer to the field, I have quickly noticed, for example, the following different camps, all of which have their own merits, as well as their particular vices against the ways of the others. For the uninitiated, a quick survey of the makers forum on maestronet.com would probably reflect this. Squarish traditionalists, for example, have

17 Richard Gagliardi (violin maker/restorer), personal interaction with the author, 2009.
18 Dirk Jacob Hamoen, "Forum," Hamoen Violins, archived Mar 29, 2016, https://web.archive.org/web/20160329094417/http://hamoen-violins.nl/forum-e.htm.

come to define the standards of quality in the trade using empirical knowledge gained over several generations, but many of them become too set in their ways to explore or teach other methods. This is a problem especially if their primary focus has been copying, as is the common practice in most lutherie schools. Acoustic scientists who employ computer technology may be lead to believe they have uncovered the secrets of successful instruments, achieving their results by measuring various modal resonances, or by looking for patterns in glitter sprinkled on free violin plates suspended over a loudspeaker. Computer technology, while providing intriguing acoustic analyses as study material, is of little practical use on its own for most makers. Frequency graphs, for example have little to do with actual perception of sound, and does little to explain how early makers were able to achieve monumental acoustical results with their seemingly limited technology. In reality, computer assisted methods haven't necessarily lead to a level of quality much different than what good traditional workshops have reached through their own means.[19] Even still, there are some makers who tend to lean more on the side of arcane mysticism, eluding the possibility for a logical, organized working method that can be replicated or taught.[20] Despite the reasonably accurate characterization of these camps, there is still much overlap and individuality to the art of violin making, and it is a messy, futile exercise to categorize every individual maker as having singular allegiance to specific schools of thought. Allowed to be at odds with one another, however, they resemble factions of a fallen and once great single nation.

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19 Joseph Curtin, "Some Principles of Violin Setup," *Journal of the Violin Society of America* 15, no. 1 (1996): p.122, referring to bridge tuning, says, "We use Aubert blanks and more or less cut them to identical dimensions. I must say, they all come remarkably close in the kind of tuning I've been discussing, so very little tuning is necessary. This suggests that, by and large, workshop specs over the years have developed designs that work."

20 Roger Hargrave, "Making a Double Bass," 2014, p.58, https://roger-hargrave.de/PDF/Bass/Bass_Making_Part_12_150.pdf, remarks that there certain elusive topics in instrument making, such as bracing, in that nobody really knows how they work. "...we mainly really on tradition and make every effort to hide our inability to produce a rational explanation, by introducing a strong mystical element."

Nineteenth century Austrian physician and luthier Franjo Kresnik criticized the then budding field of modern acoustic science, and instead favored a purely structural understanding, echoing a small slice of today's sentiments quite clearly:

> "Violin construction is, first of all, a technical/structural problem. Acoustics play a minor role in this regard, because the acoustic phenomena that appear in the violin and in its sound are the result of its mechanical construction. Hence, the quality and the excellence of a violin depend *only* on its mechanical construction. So all those who believe that violin construction is an acoustic problem have got it wrong, because they confuse the effect with its cause."[21]

Kresnik wisely states that a successful approach to the art and craft of violin making must consist of prioritization and structure; a robust, systematic organization of causes all working together to achieve clearly defined, desired effects. Thus, it is possible, throughout the course of any instrument building project, to freely embrace aspects from each of these camps in an ordered fashion, finding the ways in which they harmonize with one another, rather than chaotically oppose each other, as is so often reflected by the violin making scene.

Ironically, tradition tends to cloud our vision of the past, making balanced, free, confident working patterns difficult to attain. Tradition, though a noble sentinel of our craft, potentially leads us to mistakenly conflate the serious study of ancient design principles with mere marketing ploys, or to dismissively pass it off as a trend claiming to have found the holy grail. Such prosaic endeavors would certainly precipitate the downfall of a rich and fascinating art, especially as the mainstream modern world surrounding us continues to devalue handcrafted objects. On the contrary, we should aspire to develop a working process which, first and foremost, draws on historical design methods as primary inspiration, seeking to rediscover the spirit and cultural

21 Matej Santi, "Methods of a Maverick," *The Strad* 129, no. 1536 (2018): p.56.

context in which the layouts of early violins were invented. Most importantly, this search would breath vital cultural value back into our current tradition and conserve it for future generations. Subsequently, we must acknowledge what tradition has taught us about the mechanical structure of the instruments, and reconcile this knowledge by discovering how it both arises from and reinforces the harmony of the design, tying into the final acoustical result. Finally, the role of modern technology must be defined so that it may be properly utilized. For instance, rather than letting acoustic laboratories create our instruments for us as in various plate-tuning approaches, we should instead develop and rely on our hands, eyes, and ears, using today's technological advancements only to verify and clarify the methods that have been gathered from studying ancient techniques and primary sources. One might equate this seemingly antagonistic combination of approaches to a harmonious cohabitation of different world religions, which themselves are not unlike different rivers that all flow into the same ocean.

We shall now explore how making period instruments, in the context of HIP, offers a few key insights as to how instruments may have been created. Perhaps even more intrinsically important than producing consistently superior results or elevating the craft itself, is the capacity a historical approach has to teach instrument makers the value of rediscovery, that is, of the violin as a cultural object. Primarily, we gain access to the intimate linkage between instruments, performers, and music, which has evolved throughout history and forms the framework through which expressive, interactive dialogue is transmitted. In practice, a historically inspired violin maker uses information gathered through careful listening to this dialogue, and is able to steer the results towards a desired goal in perfect accordance with specific musical conventions or the characteristics of an individual player. The true art of the violin maker is thus no more than a crystallization of imagination, that is, the ability to find creative ways of uniting natural principles which guided art, architecture, sculpture,

mathematics, and music for thousands of years, with the musical sensibilities unique to the musicians playing the instruments. By crafting original works in this way, violin makers can empower the musicians, enabling them to connect more directly with the phenomenon of musical sound, the source of all inspiration and invention during performance.

1.3 Problems Revealed by the Period Instrument Movement

According to modern-day humanist, musicologist, and luthier Luc Breton, modern organological research has three principal objectives:

> "- to define the use of the instrument being studied
> - to understand the technology that was available at the time and the difference between it and the much superior technology available to us today
> - to reproduce to the best of our abilities the instrument in question, to minimalise approximations concerning its sonorous qualities and to compare these reproductions to our modern instruments"[22]

In the practical case of many luthiers who have likely been through the rigorous training of the modern violin making school, these "comparisons" and "differences" between period instruments and the modern standards which have arisen through trial and tradition, is merely a difference of measurements. In technical terms, this may come down to a few millimeters of variation regarding arching height and plate thicknessing in relation to modern standards, along with the common misconceptions that instruments are automatically deemed "baroque" if they exhibit a few centimeters less length and/or depth of a bass bar, or a few degrees less neck angle than what is

22 Luc Breton, "The System and Proportions of Barring on Viols," in *The Italian viola da gamba: proceedings of the International Symposium on the Italian Viola da Gamba : Christophe Coin & Susan Orlando, directors : Magnano, Italy, 29 April -1 May 2000*, ed. Susan Orlando (Ensemble Baroque de Limoges, 2002), p.193.

familiar to us today. A different design of bridge, and of course, the use of gut strings, are also factors in this supposed authenticity of a period instrument.

Although it is admirable that many makers have developed genuine interest in period instruments suitable for HIP, thinking of these various attributes only in relation to standard measurements, which rightly resembles the optimization of a manufacturing process in other industries, devalues the importance of first forming a very clear conception of sound unified with the musical gestures imposed on the instrument by the musician. Moreover, there is an inherent risk in building an instrument without the unified conception of sound, music, and player, because the ability to hear what is happening throughout the working process and evaluate how closely the work in progress matches this internalized vision or goal, is of paramount importance. Akin to what might unfortunately result from cooking by following a recipe without tasting the food, we risk detaching the process from the result, mainly by taking an eye-oriented approach to produce something that should be ear-oriented.

Likewise, if we remain stuck within the framework of what we expect to hear from modern instruments, focus too much on what period instruments aren't, rather than conceiving them from the ground up, we will never develop the intuition required to make instruments which perfectly satisfy certain repertories and certain players, in addition to being inherently satisfying to play on their own. The world of period string instruments, considering the vast diversity of both model and sound, in comparison to today, proves to be especially problematic, as it is extremely difficult to arrive at any singular definition of objective quality. In past times, this objectivity in judging musical instruments would have been reached through the natural means of developing personal models and refining them, according to the global principals governing instrument design as well as the specific requirements of the music. To phrase this as a

question, how do we know what is good if we do not know what to listen for? Keith Hill states:

> "Since peoples from earlier times traveled at great risk and discomfort to themselves, most instrument makers were obliged to develop their acoustical craft regionally. All the makers in a given city would do things similarly. Makers from different cities did things quite differently. And makers from different countries did things completely differently. But they each did their utmost to enhance the sounds of the instruments they made to the maximum degree of which they were capable."[23]

Taking this great variability into account, it would seem that producing supposed copies of baroque instruments, with reasonably objective ways of determining their musical success, is an uphill battle for todays makers. This is because makers, just as well as performers, have been accustomed to a "one size fits all" mentality in terms of the expectations of their craft, and are suddenly faced with the prospect of imitating a great number of contrasting historical works. Even with adequate understanding of how different models were intended to serve music in different ways, violin makers find themselves, perhaps uncomfortably, extracted from the natural pace of developing a personal style, simply due to the number of possible outcomes, particularly when making copies is the primary approach.

A classic example of how this problem manifests is when a musician, wanting to become more familiar with HIP, takes a violin, viola, or cello to a luthier to have it "converted" into a baroque instrument. Most of the time, this doesn't work because the nature of bowing on gut strings is significantly different than what the instrument was optimally adjusted for in its previous state, in terms such as articulation, sound projection, tonal sculptability, and ease of play. Specifically, the different relative

23 Keith Hill, "Acoustical Technology Training," Keith Hill – Instrument Maker, accessed January 2019, http://keithhillharpsichords.com/acoustical-technology-training.

tensions and elasticity of the strings translates into a markedly contrasting way in which the player and instrument interact. In sequence, the player activates the strings with the bow, which, in turn, activates the entire instrument through a sort of signal path that contains the instrument's various components. All the while, in real time, the player subconsciously adjusts his/her musical sensibilities relative to how that instrument reacts, in order to divine a sound already conceived of within the mind. However, when so many components of an instrument are altered all at once, the variable factors that influence the final result become severely crowded when looked at as an empirical experiment, as far as method and order are concerned. Firstly, steel strings tend to smooth over many of the irregularities of response and tonal anomalies of an instrument, both of which relate to the processes of feeling and listening. When this factor is compounded with other alterations common to these baroque conversion operations, regarding fittings or components such as tailpieces, bridges, sound posts, and even bass bars, there are simply too many factors to consider when trying to isolate exactly which change caused which specific change in the sound. Because of the chaotic nature of such an overhaul, the resulting sound is often tepid, scratchy, unfocused, dead, and utterly unmanageable for the player.

An operation of this nature is possible to do successfully, but remains an almost insurmountably uphill challenge even for the most skilled luthiers with the sharpest ears, because every factor related to the design and function of an instrument affects the other factors. The worst scenario, which is an unfortunately more common occurrence than one might expect, is if the luthier, out of lack of education or awareness, tells a similarly unaware musician that the musical problems with the newly converted instrument are just because of the gut strings, and are just to be expected and accepted. The musician is turned off and bewildered, left with a headache inducing, uninspiring instrument. Approaching this problem analytically reveals that the success or failure of the result, manifested in the instrument/player interaction,

depends purely on the luthier's ability to recognize musical intent, and incorporate that vision of intent with decisions and actions. For restorers and setup specialists faced with optimizing existing instruments, this means having a comprehensive understanding of the mechanical elements, as well as diagnostic skills necessary to enhance musical quality, described further in chapter 3. The same principles would apply, perhaps with even more significance to newly made instruments, wherein a very clear conception of gesture and tone must be decided upon very early in the building process. Whether creating new instruments or adapting existing instruments for enhanced playability, the essential guidelines are the same: Our actions must perfectly mirror a deep understanding of music making and sound, and not rely solely on the measures of a few millimeters here and there. The difference of a few millimeters, therefore, does not constitute the difference between good and bad, nor does it delineate any genuine distinction between modern and baroque.

1.4 A Phenomenology of Musical Dialogue

We must think critically then, and ask ourselves if a more inventive, genuine instrument design process can be reached by adopting a mindset more aligned with total historical immersion, rather than allowing our actions and decisions to remain stuck within the framework of a modern lens. One might say that we too often look at the past as though it were behind a glass case; a sort of "museum effect." It is also useful to draw a parallel to the way historically informed performance is taught in music schools. One of HIP's pitfalls, especially as it gains popularity within modern conservatories, is that the focus becomes prowess-oriented, that is, centered on technical mastery, stylized to fit the aesthetics of the artistic movement, instead of focusing on the reasons behind those musical decisions, which are themselves intimately tied to the culture of arousing the passions through musical communication. Continuing our parallel observations of instrument making and performance, Nikolaus

Harnoncourt once said, there is "no historically correct or authentic version- that is impossible, an illusion or charlatanism," and that a musician who wishes to, "can play with a modern instrument far 'more baroque' than with a baroque violin."[24] How is this possible, and how do genuine musical behaviors transcend the technical mastery, or surface imitation of a style? In the words of Bruce Haynes, musicians simply do what feels right:

> "To the extent that the arts embody concepts of reality, they offer insight into how the world was perceived at the time they were made. And for that reason, if we are able to understand what the arts of the past have to say, they are very effective tools for studying human history. Many of our choices as musicians are made without great thought; they simply 'feel right.' And the results of those choices have produced the art we see, hear, and think about today. So to revive a historical artform, a knowledge of the assumptions and beliefs that were available in a given period is essential for making choices that do indeed 'feel right' for that period."[25]

This concept may also be extrapolated to the work of the instrument maker; instruments serve as the media by which a musician may propagate a particular vision of what feels right, meaning that on the visceral level of a performance, this vision must also be in accordance to what feels right on that particular instrument. Presuming that this "feeling right," or right feeling, rather, constitutes a major part of instrument's quality, or musical success, how do we get there? How does a maker know when we have arrived at the point where this musical synergy between performer and object is allowed to take place? In a purely pragmatic sense, Chris Thile, for example, strongly recommends that players work with luthiers who play very well, stating that "It makes a big difference."[26] In a more abstract sense, it may do us good to analyze the

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24 Paul Laird, *The Baroque Cello Revival: An Oral History* (Lanham: Scarecrow Press, 2004), p.103.

25 Geoffrey Burgess and Bruce Haynes, *The Pathetick Musician: moving an audience in the Age of Eloquence* (New York: Oxford University Press, 2016), p.5.

26 Chris Thile, interview by Mandolin Cafe, *Mandolin Cafe,* October 26, 2006.

bare elements of performance within the context of artistic decision making, as well as those micro-decisions made in the heat of the moment, that, one might say, account for every performance and every player sounding completely unique. According to Peter Walls in a chapter titled "Escaping tradition, embracing history," however, this kind of analysis is not so easily quantifiable as illustrated by his flow chart concept:

> "The expression, 'definitive performance,' can only ever be rhetorical. It might be possible in theory to create a kind of 'flow chart' for performers who aspire to be historically informed. It would begin with the most basic decisions they must make (which bow to take out of the violin case, for instance) and follow through with the consequences of that to the next level of conscious choice (how do you hold that bow?) and so on through all the other contingent options. One could imagine (impossibly) the flow chart converging in identical higher-level decisions about the specific musical features of the work to be performed but nevertheless pointing to utterly distinctive performances because of the 'decisions' that preceded and followed that band of agreement. The flow chart would necessarily stop, or at least become too complicated, where the mostly unconscious, intangible aspects of musicality- there in every single performance (including bad ones)- take over."[27]

Instrument makers, like performers, should, therefore, seek a historically immersed mindset by means of a more organic process.

In practice, a maker wanting to create a baroque violin, for instance, should observe the immensely variable characteristics present in the historical record of instruments produced in seventeenth and eighteenth century as a reflection, or manifestation of the totally baroque behavior of adapting the instruments to the demands of the best players in each particular city. Keith Hill, in his article "What Exactly is a Baroque Violin?," takes particular note that there is no such thing as a singular baroque setup, because there would have been hundreds of "ways" to set up, or

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27 Peter Walls, *History, Imagination, and the Performance of Music* (Woodbridge: The Boydell Press, 2003), pp.26-27.

play a violin in the eighteenth century, with the added observation of an approximately fifty year delay for setup or construction tendencies to settle into the norm of specific regions.[28] He states:

> "People back then did what was expedient according to what they wanted and didn't care one whit what we in the 21st century might think about it. When they wanted to learn pieces that required the higher notes on the E and A strings, they opted to have the longer fingerboards installed. That is a totally Baroque behavior. Similarly, when players were complaining about the lack of focus on the lower strings, such complaints might have stimulated Mr. Stradivari or Mr. Guarneri or Mr. Guadagnini to place taller bass bars into the instruments for those players. Then, liking the effect themselves, they could have kept doing that."[29]

This adaptive aspect observed in historical instrument making shows a deep and intuitive understanding of musical gesture and sound production, as well as purely concrete, technical demands such as neck shape. The greatest instrument makers have been those who could play themselves; they clearly weren't furniture makers simply working to dimension. In accordance with this idea, it is interesting to note, as a side observation, the original Mantuan violin by Balestrieri cataloged on page 60 of William Monical's *Shapes of the Baroque: The Historical Development of Bowed String Instruments.* This instrument, from 1777, already exhibits great advancement, as its supposed original form features what we have come to know as the modern neck, set an even steeper angle than what is considered the standard measurement today.[30] Of course, such technical adaptations involving string angles, bridge geometry, etc. have immense bearing on the dynamic response of the instrument, affecting the sound and feel greatly. These varied geometric factors are especially a given, when dealing with

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28 Keith Hill, "What exactly is a baroque violin?," Keith Hill – Instrument Maker, Articles on Violins, http://keithhillharpsichords.com/new-page-3/

29 Ibid.

30 William Monical, *Shapes of the Barouqe: The Historical Evolution of Bowed String Instruments* (Philadelphia: The American Federation of Violin and Bow Makers, 1989), p.60.

period instruments of larger size, such as the bass violin, viola da gamba, or baroque cello.

Speaking of her past apprenticeship with Monical, Sarah Peck remarked that she was shocked on her first day of study with him, as there was no talk of woodworking whatsoever. Instead, he turned on the stereo and they listened to music for several hours, paying special attention to horizontal and vertical motion, and different ways the bow is used to draw sound out of the instruments. "At first I thought he was insane," she said.[31] Monical's efforts to lay the grounds necessary to develop musical sensitivity in his students was a testimony, before his retirement from the workbench in 2013, to his seemingly telepathic ability to diagnose musical problems with their corresponding solutions without even touching the instrument. Although such amazingly intuitive abilities are rare in violin makers nowadays, one might speculate that they were much more common in the time before modern instruments were so standardized; they are indeed what enabled Monical to become such a successful and influential figure in the revival of early instruments and historical performance practice. Gabriela Guadalajara, a maker of baroque instruments and another former Monical apprentice, said, "Working with Bill was interesting because his thinking didn't always follow what you'd learn in luthier school. He went around through the back door."[32]

The mere notion of shock among today's attitude, as well as delightfully questioning the sanity of Monical's methods, illustrates the challenges with immersing ourselves in history, which requires a certain degree of disassociation with what we have been accustomed to knowing as correct and standard. Hoping to provide solutions to this challenge, I would like to highlight an approach to instrument making that

31 Sarah Peck (instrument restorer), personal interaction with the author, September 2013.
32 Gabriela Guadalajara (violin and viol maker), personal interaction with the author, 2018.

respects the value of historical immersion in two distinct ways: Firstly, we should adopt a mindset that accepts the philosophical and metaphysical beliefs of the ancients as truth, recognizing that the only way to replicate the essential qualities of a historical object is to attempt to enter the mindset in which they were conceived theoretically, and crafted physically. Luc Breton says:

> "… goals in musical practise have changed over the centuries and modern musicology tends to draw radical conclusions to rapidly concerning essence and style. However, there is good reason to believe that a change occurred during the nineteenth century abandoning the vision of the Universe which had been the principal objective of the ancients. This objective had reigned until at least the first half of the eighteenth century and was intrinsically allied to artistic practise. One must begin by being convinced of the validity of this vision and not allow it to be ridiculed by modern science."[33]

This universal vision relating to the function and design of bowed string instruments will be expounded upon in chapters 2 and 3. Secondly, we must implement this vision in practice by understanding the complex processes that take place from the time a luthier constructs the design, to when the instrument is strung up and adjusted, to when the musician picks it up and bows the strings.

Bruce Ellis Benson refers to this process as a phenomenology, or improvisation of musical dialogue, because it involves the union of many parties all listening and adapting in their own unique way during any music-making activity. He asks the question, "What do musicians actually *do*?" The answer to this question is deceptive:

> "… my concern is explicitly with what composers, performers, and listeners *do.* I have been continually goaded by the question that fellow musician often asked when I was improvising at the piano: 'What are you *doing?*' While he was primarily referring to the

33 Breton, "The System and Proportions of Barring on Viols," p.193.

> harmonic and structural changes that was making, his question left me wonder what musicians really do. I still do not have a complete answer to that question. And perhaps that is all for the best: for music making is a wonderfully complex activity that resists precise definition."[34]

Furthermore, he identifies a problem in that the dialogue between composer, performer, and listener is "fundamentally ethical in nature," because none of these parties should be "so dominant that the other voices are simply forgotten."[35] He adds the notion of responsibility to explain this relationship:

> "As a performer, I have a responsibility (perhaps an equal responsibility) to those with whom I perform. And I have a responsibility to those who listen. Both of these relationships must *also* be taken seriously. Yet, even this formulation is not complex enough. For, if present performances have an effect on future performances (and it would be hard to argue the contrary, especially in the age of the CD), the I as performer have a responsibility to future listeners- and even future composers (who are also future listeners).[36]

If we, as instrument makers, factor ourselves into the equation by asking "What do instruments actually do?," there is no escape from the responsibility that we carry, if we consider that our instruments will potentially survive for hundreds of years after our own deaths. If we are to go further, and claim that those instruments that we create are intended for such a specific purpose as being "appropriate" or "accurate" for performing music of an already past time (baroque music), then there is even greater weight to that responsibility. Being aware of this responsibility, in all its details and relation to musical quality, ensures that the principles of design are employed successfully. The success or failure of the design is manifested in the capacity the

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34 Bruce Ellis Benson, preface to *The Improvisation of Musical Dialogue: A Phenomenology of Music* (New York: Cambridge University Press, 2003), x.
35 Ellis Benson, *The Improvisation of Musical Dialogue: A Phenomenology of Music*, p.164.
36 Ibid., p.173.

instrument has to inspire and ignite a musician's soul in performance, or contrarily suppress and even degrade it. Any musician who has experienced playing in different spaces would say that even "playing the room" is of utmost importance when trying to uncover the essence of a musical work.

1.5 Escaping the Hierarchy of the Dialogue

Because the dialogue between composer, musician, instrument, and audience, appears to be so fraught in regard to giving equal weight to each party, it may prove useful for violin makers to define the role of their creations in more concrete terms. Baroque cellist Bruno Cocset is known for playing on a plethora of different instruments depending on the repertoire, and seems to commission sets of instruments every time he has a new recording project- a sort of exploration of a sound-world offered by the union of a particular music with a particular instrument. He refers to the nature of playing on various instruments strung with gut, implying that the gut brings out the maximal character of each instrument, and that this character is intrinsically tied to the idealized gesture in the player's mind in relation to the gesture that the instrument supports in reality. He states that with the bow, the player can only "propose" to the instrument, and then the instrument will either "accept or reject" the proposal:

> "Pendant les études, il y a une frustration qui naît de l'écart entre le geste qu'on voudrait idéalisé et celui qu'on produit dans la réalité. Les cordes en boyau sont exigeantes, du fait de la difficulté du contact et du dosage de la pression exercée par l'archet. Ces cordes ne pardonnent rien et de façon générale, il ne faut jamais imposer quelque chose, mais proposer à l'instrument; puis la proposition est ou non acceptée. Tout est question d'apprivoisement, de dialogue, de jeu, d'interaction, de poids et contrepoids, de balancement, d'oscillation… oui, il s'agit bien d'un chemin de vie!"[37]

37 Bruno Cocset, interview by Viet-Linh Nguyen, *Muse Baroque*, December 4, 2011.

In this way, the instrument can be seen as a kind of guide, which teaches one how to play. For Cocset, the teaching ability contained within each instrument is linked exclusively to a sound-world offered by the choices and sound capacities either enhanced or suppressed by the instrument in question.

The exploration of multiple instruments of contrasting character is exciting for players and makers, especially in the age of recording, whereas certain players, have expressed a slightly different interpretation of the instrument's teaching ability. William Monical has, for example, described famed cellist Anner Bylsma as "a chameleon who has the ability to let an individual instrument teach him how to play it."[38] However, Bylsma has expressed distaste in changing instrument for every kind of repertoire, instead opting to keep his choice of instrument to a minimum. Paul Laird notes:

> "He [Bylsma] clearly believes that it is the way one plays the cello that is most important, not the instrument's fittings or the way it is set. He knows that he cannot have a cello that specifically fits all the music that he plays: 'Whatever you do, it will always be a compromise, and also to have the original instrument, Goffriller as he made it in 1693, you would only use it for bass playing. You would never play thumb position in the Boccherinis, for example, because the strings would be too far apart. If you want to travel the world with seven instruments...'"[39]

For Bylsma, the merit of his often singular choice of instrument (a consistent dedication to the 1693 Goffriller, in his case), is apparent when considering an instrument's power to influence and take over one's soul, in effect merging with the player's sensibilities, perhaps over the course of a lifetime or performing career. The excitement for instrument makers, in this regard, lies in the prospect of creating an

38 Laird, *The Baroque Cello Revival*, p.26.
39 Ibid., p.67.

instrument intended for a specific personality and playing style, complete with a vision that takes into account the potential for mutual growth between musician and instrument. Along with attempting to visualize and divine a specific tone, there is a certain degree of attempting to create the ultimate instrument when building with this approach. Therefore, the instrument maker understands that there will still necessarily be numerous trade-offs involved with the design process, with those various compromises between sound characteristics such as power and resonance, contributing to the final acoustic result.

Even though the choices of Cocset and Bylsma have manifested in what would seem diametrically polarized ways, they share a commonality in that the instrument should support the player according to the technique, passions, and intellectual ideas within the musician. One could simply say that one of these approaches to instruments is repertoire oriented, new-school, and more relevant to craftsmen involved with new building, and that the other is individual oriented, old-school, and more applicable to the restoration trade. Both sides, however, demand a heightened awareness of the global and local musical elements doubtlessly bound to the success of that instrument's capacity support the player. These elements, which correspond to loosely definitive categories such as sound quality, expression, and comfort, are perhaps more useful As an instrument maker in training, I have taken William Monical's words that "our job is simply to make the musician's job easy," in earnest.[40] With his advice in mind, I have constructed the following list of guiding questions, in adopting a personal approach to instrument making:[41]

40 William Monical, personal interaction with the author, September 2013.

41 This list originates from a set of parameters given an interview of William Monical, paraphrased in Laird, *The Baroque Cello Revival*, p.22. Since Monical's primary objective was outlining the system he uses in outfitting a baroque cellist from a restorer, or instrument dealer's perspective, I felt it necessary to augment these parameters with a secondary set of questions which relate better to the process of designing and building new instruments from scratch. In the case of the restoration trade, the goal of equipping a musician is largely pragmatic, mostly dealing with musical requirements and problems directly within reach of, or local to the musician's control. As the creation of new instruments, on the other hand, deals with design principles derived from [note continued p.28]

sound

- How does the musician want the instrument to sound to the audience? (local)

- Is this a character of sound that is attractive? OR: Does the design of the instrument follow the imperative of the maker's vision of tone, such that the results are both predictable and acoustically sound? (global)

expression

- Does this sound amplify the musician's intellectual ideas of phrasing and style without a tremendous amount of perspiration? OR: How can the maker match the instrument to a specific style of play, making musical delivery feel effortless? (local)

- What repertory would the musician like to play? OR: Does the design of the instrument mirror the historical use of certain instruments for certain repertories? What can we learn about performing this repertory if we consider the music was composed with a certain type of instrument in mind? (global)

comfort

- How can one make the instrument comfortable to hold for an extended period of time? (local)

- How can the maker ensure that the design of the instrument is balanced? The design must uphold maximal levels of sound capacity and structural integrity, whilst optimizing comfort and ease of play specific to an individual? (global)

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natural laws, I have chosen to refer to my additions as 'global elements.'

Critical examination of these elements, when organized as such, reveals to the instrument builder a systematic approach to creativity and productivity, of which the the design principles behind the instrument may be seen as the *x*-axis, the musical dialogue between musician, instrument, audience, and repertoire the *y*-axis, the instruments themselves being the *z*-axis. Having organized the characteristics of the instrument as a collection of local and global elements, how do we know that this model of the working process is useful? The answer may lie in the instrument's natural way of embodying a unified relationship between the universal and human aspects of music. This relationship can be illustrated by comparing two famous quotes of Johann Mattheson and Ludwig van Beethoven, which are highly contrasting and sometimes used by HIP specialists to highlight the difference between baroque and romantic performance approaches:

> "A composer must utilize his experiences, whether past or present. Thus he will find the best example of affect in himself and be, therefore, best able to express it musically."[42]
> - Johann Mattheson

> "Music is the one incorporeal entrance into the higher world of knowledge which comprehends mankind but which mankind cannot comprehend."[43]
> -Ludwig van Beethoven

Strangely, Beethoven's statement evokes an ideal that is reminiscent of the cosmic musical science common to pre-Monteverdian and certainly pre-Matthesonian theory and composition. Contrary to the popular chronological disposition of these seemingly contrasting ideologies, both of them share more common ground than one

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42 Johann Mattheson, *Der vollkommene Capellmeister* (Hamburg: Christian Herold, 1739), p.16. Translation given by Rachel Taylor, MUPP 693 – Early Music Today, McGill University, Winter 2014.

43 Ludwig van Beethoven, according to a letter from Elizabeth Brentano to Goethe, May 28, 1810, quoted in Oscar Sonneck, *Beethoven: Impressions by His Contemporaries* (New York: Dover Publications, 1967), p.81.

might immediately think. In the case of understanding and recreating baroque instruments, for instance, this commonality is found when we immerse ourselves within the scope of humanist philosophy, taking special note of how the rhetorical ethos of HIP allows us to translate the language of the universe into meaning, in the form of affects, colors, and passions. Bruce Haynes remarks on this particular aspect of Humanism, putting forth the notion that the evolution of musical communication in baroque Europe was characterized in particular by a crossroads between the virtues of both science and of human expression.[44] The historical significance of the violins, therefore, rests in their designs, which, being born of humanist and neo-platonic intellectualism, provide an architecture that houses the metaphysical, mystical correspondence between the human and the nature of sound.

I shall now elaborate on some of the key design factors, as well as the challenges surrounding the creation of the bass violin by Nate Tabor and myself in 2017. The construction process of our instrument will serve as a vehicle to further examine the design principles that marry artistic creativity to the underlying acoustic architecture of bowed instruments. One may imagine this process as a stepping stone towards understanding the intuition of the old masters, capturing their spirit of innovation and experimentation.

CHAPTER 2

Methodologies for Creating Bowed String Instruments

2.1 Formation of a Bass Violin

For violin maker Nate Tabor and myself, coming up with a plan for a bass violin was not an easy task. Because the type of instrument we were commissioned to build in

44 Burgess and Haynes, *The Pathetick Musician,* p.19.

summer 2017 was historically a close relative, as well as direct predecessor of the modern cello, our choice of extant instruments in original condition for us to model after was severely limited. Because of its visibly damaged painted decorations, "The King," made by Andrea Amati in 1538, is perhaps the most obvious and famous example, among many, of the bass violins that were transformed into smaller instruments over the centuries[45]. As Tabor humorously puts it, these instruments were, "as if hunted beasts," altered, and now remain as butchered remnants of their former selves.

Bass violin, "The King," Andrea Amati 1538, pictured in its current state (left) and speculated original state (right); images courtesy of José Vazquez and Roland Houel.[46]

45 See Laird, *The Baroque Cello Revival*, pp.6-9 for an introductory overview of several famous bass violins. One of these is the famous 'King' Amati, although it was drastically reduced in size in the nineteenth century, destroying its painted decorations in the process. This instrument remains notable as one of the most obvious examples illustrative of other similar instruments suffering similar fates.

46 Jose Vazquez and Roland Houel, "Violoncello after 'The King' Violoncello Cremona, after 1538." The Orpheon Foundation. 2007. http://www.orpheon.org/OldSite/Seiten/Instruments/violoncello/vc_Houel.htm

Even with its surface similarities to the modern cello, having four strings tuned in fifths, there are still many unanswered questions about what a bass violin, in the seventeenth century, would have actually sounded like or felt like in the sixteenth and seventeenth centuries. Our lack of familiarity and concrete reference points in the twenty-first century, outside the modern cello, adds to the complexity of reconstructing this type of instrument. For violin makers, these reference points obviously concern the measurements of overall dimensions, as well as those having to do with the more minute aspects of stringing, string spacing at the nut and bridge, the geometry of the bridge and fingerboard themselves, the angle of neck set, the calculation of tensions and static and dynamic forces exerted upon the instrument, and so on. Ironically, the reasons and historical knowledge behind most of these geometrical landmarks has been obscured, not clarified by the advent of modern standardization. All of this has a great combined bearing upon the final manifestation of ergonomic comfort and, of course, sound, in the finished instrument.

On top of these obvious geometrical obscurities, the instrument we envisioned was to be mounted entirely with high twist, pure, unwound gut strings similar to what would have been used in the seventeenth century. In short, we needed to come up with a balanced design for an instrument large enough to support the type of stringing appropriate for the period before the invention of wound gut strings, but not so large as to become totally unmanageable to a musician. Grappling with this fundamental nature of stringed instruments was, for us, a replication of precisely the same challenges faced by violin makers in the seventeenth century, challenges that force the maker to make intuitive compromises between sonority and versatility.[47] We also felt

47 Stephen Bonta, "From Violone to Violoncello: a Question of Strings?" Journal of the American Musical Instrument Society 3 (1977): pp.90-98 examines in detail the historical challenges of creating bass instruments, the designs of which needed to balance the limits imposed by the human body, and the acoustic limitations caused by the physics of gut strings in the low register. Specifically, Bonta helps to summarize the problem on by defining the relationship between frequency, tension, length, and density according to Mersenne's law, stating, "For the violin maker one of these variables was nonexistent, since all four strings, even though separated in pitch by almost two [note continued p.33]

these circumstances to be a good opportunity to take advantage of relatively recent breakthroughs in the historically informed manufacture of thick, highly twisted gut strings, with firms such as Real Guts and Pure Corde producing convincing examples with very positive, well documented results.[48] It is worth noting here, that although one may argue that the disparity between sonority and playability was solved with the use of wound strings from the later half of the seventeenth century onwards, there is always something that incidentally gets lost, accompanying technological progress. Because period instruments themselves are in some ways the best teachers of how to play past music, we knew that our ability to accurately qualify our finished instrument as successful/acceptable, while still accepting that it would probably be different relative to what we'd expect when judging more familiar instruments, was to be very tricky, yet of paramount importance.

To further put the seriousness of the task before us into perspective, Tabor had never built an instrument exactly like this before, and I had never applied any research in such a hands-on situation before. I would like to argue in favor of the notion that even non-luthiers should realize how obviously inadequate the modern method of copying or relying on dimensional standards would be for creating such an

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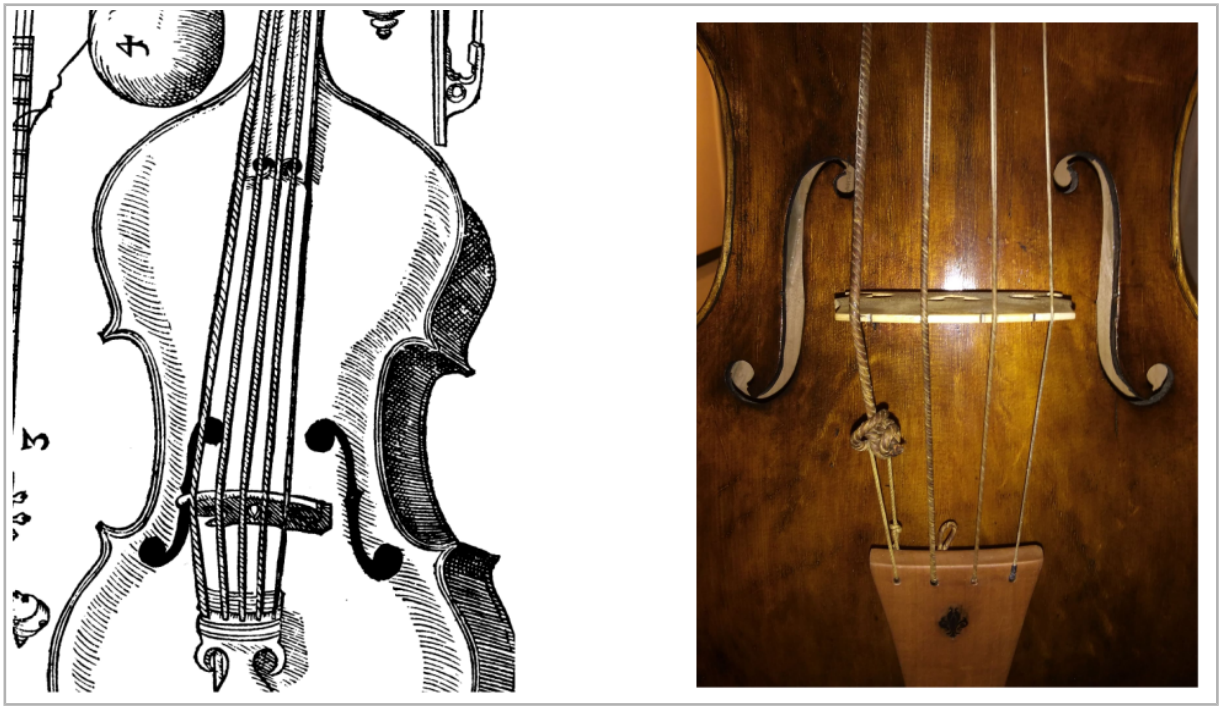
octaves, were of the same length." (p.92) and "We have no data on string tension in the seventeenth century, but it is clear from modern practice (and from seventeenth century practice with gut strings on the lute) that the intent is not to have too great a variation in tension between the top and bottom strings." (p.93) On the nature of the strings themselves, Bonta correctly notes, "...increase in density will also increase the diameter of the string, and a new factor will come into play, the flexural stiffness of the string… This is the problem that confronted the early violin maker, not solely for the lowest string on the violin, but for the lowest string on all members of the violin family: how does one get a bottom string of sufficient density, yet small enough in diameter, to produce a decent sound at the proper pitch?" Directly referencing the issue of the size of the bass violin, Bonta states, "The bass violin from its beginnings posed a critical problem as to its proper size. In order for the lowest string to produce a reasonable sound, the instrument had to be large. On the other hand, it was difficult to accommodate with ease the rapidly developing violin technique on such a large instrument." (p.98)

48 See Oliver Webber, "Real Gut Strings: Some New Experiments in Historical Stringing," in *The Italian viola da gamba: proceedings of the International Symposium on the Italian Viola da Gamba : Christophe Coin & Susan Orlando, directors : Magnano, Italy, 29 April - 1 May 2000*, ed. Susan Orlando (Ensemble baroque de Limoges, 2002), pp.161-180.

instrument under our circumstances. Even the most basic question of size seemed like a shot in the dark in the very early stages of our process. We knew the bass violin was to be larger than a "normal" cello, in order for our all-gut string setup to work, but how much bigger?[49] In order to work with some semblance of order and principle to our decisions, we therefore attempted to design this instrument from the ground up, hoping to capture the spirit of experimentation and creating an original instead of a copy, as seen in the work of the old masters. How and where to start going about doing this? Seeing how critical our choice of strings was as a design factor, we thought it appropriate to delve deeper into the literature dealing with the co-evolution of instruments and string technology, as well as the available research about gut strings themselves- the very source of all sound vibrations, overtones, resonance, and expression.



Visual similarities between bass strings pictured in *Theatrum Instrumentorum* by Michael Praetorius and the strings on our instrument made by Pure Corde in 2017, highlighting the size, proportionality, and degree of twist/flexibility, of the strings[50]

49 See note 47, above.

50 Michael Praetorius, *Theatrum Instrumentorum* (Wolfenbüttel: 1620), plate V.

Thanks to William Monical's seminal 1989 exhibition and catalog, *Shapes of the Baroque: The Historical Evolution of Bowed String Instruments,* many of today's instrument makers have benefited from a few key observations about original violins and viols from the seventeenth and eighteenth centuries. Most importantly, we now have clearly organized evidence that the variation in size and shape among antique instruments is comparatively huge, when looked at in relation to the rather narrow confines of modern standards. This variation is embodied by the characteristically charming asymmetry and sprezzatura common to many antique instruments, although it is evident, according to Monical's work, that the creative forces behind this diversity and charm also appear to have operated under a set of governing acoustic principles, rather than being subject to complete artistic fantasy. Monical, whose experience as an instrument restorer and tonal specialist have lead him to understand the multifarious nature of acoustic optimization, argues that the historical development of string technology was responsible for the vast array of features observable in antique instruments. As stated previously, a well appointed luthier must be intimately acquainted with the delicate balance between each of the instrument's features. Starting with the strings, each feature affects every other, and in turn, the final tonal result.

For example, in observance of Dr. Bonta's research on strings, one can recognize clear trends in Monical's catalog that confirm the coincidental implementation of wire-wound gut strings with marked experimentation revolving especially around the geometry of bass violins, a category of instruments which includes loosely defined, yet still distinct subgroups of large, medium, and small violoncellos[51]. In the *Shapes of the*

51 Bonta, "From Violone to Violoncello," p.98 distinguishes two sizes of bass violin in the seventeenth century, tailored to the requirements of sound versus versatility. Gyongy Iren Erodi, "The Sixteenth-Century Basse De Violon: Fact or Fiction? Identification of the Bass Violin (1535-1635)," Master's thesis, University of North Texas, 2009, pp.46-63 likewise identifies two sizes of bass violin according to various historical and iconographic data. Laird, *The Baroque Cello Revival*, p.14 reports that Robin Aitchison has observed at least three sizes of violoncello among the output of Goffriller and other makers of the Venetian school.

Baroque catalog, Monical highlights this experimentation with his documentation of the 1701 "Servais" Stradivari cello in the Smithsonian, an instrument of smaller stature than earlier bass violins, but still slightly larger than 4/4 cellos conforming to modern standards. He conjectures that this instrument represents an effort, on Stradivari's part, to study the relationships of sound, internal air volume, arching geometry, and wound strings, presumably to create a cello capable of projecting a bass register with a presence and gravitas more commonly associated with instruments of considerably larger size:

> "In this cello he combined the highest ribs of any known Stradivari instrument with an extremely low arching. The result was a concentration and focus of sound in the lower register that is unique in depth and power. With this instrument (and possibly others that have not survived) he realized new musical potential with lower archings. His next cello does not appear until 6 years later in 1707. It was of reduced size and string length which developed into the famous "B" form of which the 'Duport', of 1711 and the 'Piatti', of 1720 are outstanding examples."[52]

The primary implications of these highly influential observations, for makers interested in creating new instruments in the manner of the old masters, are best summarized in the words of New York violin maker James McKean:

> "William Monical is, in a word, the dean of Baroque instruments. …his 1989 exhibit at the Library at Lincoln Center, Shapes of the Baroque, wrought an epochal change in the way all violinmakers thought, not just those interested in early music: not only demonstrating how fluid and diverse instrument making had been, Bill made a clear and convincing case that string technology was what had driven the evolution of design. He made us see that what we were building was not a cello with strings attached; it was an amplifier, whose sole purpose was to make the vibrating string audible. Start with the string, and work outward from there. A few years ago, realizing I couldn't even remember the last time I had cracked open

52 Monical, *Shapes of the Baroque*, 82-83.

> any but a few of the hundred or so violin books in the library I had built up over the years, I sold them. I kept fewer than half a dozen that I considered indispensable – and the catalog for his show was one of them."[53]

The message Tabor and I gathered from the sentiments above was clear: how could we build an effective amplifier, in the form of an instrument whose features are otherwise unfamiliar to us, save for a few key characteristics of the strings? We figured that with a little forethought about stringing and an imagination about how our instrument should sound and feel like to play, all our decisions about wood selection, air volume, form, and geometry would naturally follow. In hindsight, I find that this organic approach allowed us to uncover the character of the instrument more and more every step of the way. Each stage of graduating the front and back plates down towards final thickness, for example, was a revelation of whether our work so far was correct or not, and what we needed to do to maintain a sense of focus in the sound, avoiding boomy, hollow sonority in such a large corpus instrument.

We first had to decide on a well rounded, versatile vibrating string length which would ideally suit our criteria. In order to define the physical and acoustic boundaries of our strings, we turned to the research of Mimmo Peruffo, head of Aquila Corde, one of the largest gut string manufacturers in Europe. According to Aquila's website, the "working index" of a gut string is the range between two major parameters: the "breaking index," or highest pitch at which the string will break, and the "acoustical lower limit," or string length which indicates the maximum string diameter "able to produce an acoustic performance which is generally regarded as still acceptable to our ears."[54] These parameters are defined by a simple calculation of the product of the

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53 McKean, "Carter Brey: The Bach Cello Suites," James McKean Violin Maker, accessed November 2018, http://mckeanviolins.com/carter-brey-the-bach-suites.

54 See Mimmo Peruffo, "F.A.Q.," *Aquila Corde Armoniche, a*ccessed November 2017, https://aquilacorde.com/f-a-q/?lang=en.

string's intended length in meters, multiplied by its intended frequency in Hertz.[55] This calculation, length x Hz, gives a number which may serve as a guideline for creating an instrument or optimizing the response of an existing instrument, in simpler words, finding a size at which the highest string won't break and the lowest string will still sound good before having to switch to a wound gut string. Peruffo indexes this number accordingly in the following chart, although he adds that while this may serve as a general example, the functionality of the string is depended on a confluence of relevant factors including the flexibility of the string, working tension, quality of the instrument, and whether the string is bowed or plucked:

- Higher than 260, the string will break immediately or within a few minutes
- Between 250 and 260, the string may break within a few hours or days, especially in high humidity
- Around 240, stable
- Below 100, gut string begins to lose its acoustical quality
- Below 80, wound strings are needed[56]

Investing our faith in the great flexibility and suppleness of our recently acquired strings from Pure Corde in Germany, we settled on a string length of approximately 80cm.[57] Although this is substantially longer than the typical cello range of 68.5-70cm, we still felt this size versatile enough to support left hand agility during rapid passages, and finally, a comfortable sense of "home," so as to ensure intonation stability while playing bass lines in the lower positions. We also felt this size to be reasonable for switching between the C-tuning and Bb-tuning indicated by Praetorius and Mersenne, satisfying the diverse musical requirements of an instrument used in a

55 Ibid. This mathematical expression is based upon the empirical condition that an average 1 meter long gut string will always break at around 260 Hz, no matter what gauge.

56 Ibid.

57 We found that our Pure Corde strings offered a slightly more forgiving acoustical lower limits than the numeric indications provided by Peruffo, who in his experiments probably used strings that were less flexible than ours at low pitch.

university setting, all the while falling within a range in which a variety of string gauges could be tested in order to achieve relatively equal tension, feeling, and predictable response across all registers.[58]

For the sound and feel that we envisioned, there were a few baseline criteria to consider. First of all, we did not want the overall character of tone to be too bright and laser-like, so instead aimed for a dark, earthy, brooding, more malleable tone that would remain clear, punchy, and ready to project all manners of dramatic affects. As Mr. Tabor proclaimed in the early stages of our process, "We do not want a laser! It should sound almost EVIL!" Metaphors aside, the technical reason for aiming towards this darker sonority is quite simple from the perspective of color flexibility, or modulation of tone. When the default sound quality of an instrument is too brilliant, there is less that a player can do with the bow to roll back the strident tendency of brightness without diluting the tone with too much airiness. While such an instrument might however be advantageous for playing concertante pieces, where a bright, penetrating tone is desirable, the palette of available tone colors is also somewhat limited because of this. This effect may be analogous to the way compression behaves in audio engineering; too much, and the comparative lack of dynamic range begins to sound lifeless and fatiguing to the ear.

Tabor recognizes that to make a projecting, brilliant sounding instrument takes skill; every part of the instrument must be working together very efficiently, with minimally excessive weight or anything else that would otherwise dampen, mute, or

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58 For more historical data on the tuning of the bass violin, see Erodi, "The Sixteenth-Century Basse De Violon," p.51. Monical, *Shapes of the Baroque*, p.2, mentions the necessity of consistent string tension across all registers, stating that "without an even resistance from one string to the next, a musician would have to make constant bow pressure adjustments in executing even simple melodic passages involving string crossings." Although the viability of equal tension versus equal feel has been the subject of great debate and semantic uncertainty, Webber, "Real Gut Strings," p.177 argues convincingly that the progressively increasing degree of twist towards the larger strings in an equal tension setup, made possible by wet-rope manufacturing, does indeed coincide with equal feel.

impede the vibrations coming from the strings. On the other hand, he argues that as a maker, achieving a musically successful dark instrument is a more difficult and elusive challenge. It is a common misfortune that the imagined character of darkness within the maker's mind results in muddiness and total lack of clarity, in actuality. Interestingly, muddiness is exactly what happens when one tries to cover, or "fix" the sound of an inherently bright instrument. The refined knowledge and subtle skill of the violin maker therefore determines where on the instrument, and to what degree, to maintain the natural damping characteristics of the wood materials as they are carved away, become lighter, and naturally tend towards progressively brighter sonority. This level of awareness and monitoring helps to ensure that the vision of a deep, dark voiced instrument still results in a sound that is clear, quick-speaking, resonant, and powerful in spite of its inherent darkness. In practice, an instrument with these qualities precisely matches our concept of tonal malleability, in that an excellent dark instrument does not throw all of its sound out all at once, when we may not necessarily want it to. Contrariwise, it should retain a certain capacity to become brighter and according to the player's touch. This requires a very careful and purposeful conception of how the string energies are dispersed and how quickly and sensitively the power curves of that string energy are diffused.

The sensation, to the player, is being able to sink the bow into the string with great depth. Consequently, this implies a sense of ease in modulating the instrument's projected vowel coloration by varying the bow contact point closer and further from the bridge, and an ideal response time that allows for substantially audible articulatory rubato, that is, being able to willfully and effortlessly choose either short, long, soft or hard consonants when initiating a bow stroke. In this manner, an instrument able to imitate the speaking qualities of the human voice and all its affects, is perfectly suited for roles such as basso continuo playing in baroque music. The dramatic character and rhetorical delivery of this music is the basis of the primary intended role of our bass

violin, which is to sustain, enhance the foundation, and add inflection to bass lines within the harmonic texture of accompanying plucked or keyboard instruments. For those concerning themselves with having a general, discerning factor between so called "baroque" and "modern" instruments, the following comment about William Monical's opinion regarding color complexity as a specific, defining quality, may be the most fitting. Paul Laird states:

> "Monical cites the growing importance of lamb and sheep gut as the optimal material for string manufacture because of its rapid response, the complex sound it produces, and its ability to bring sudden juxtapositions of different timbres. Whereas the modern cellist wants to know whata cello sounds like and then use technical means to influence the instrument's volume and projection, the period performer seeks a broader palette of colors, a goal linked largely to gut strings."[59]

Although I disagree with the notion that the essence of period instrument performance is all about "different sound," Monical's observation remains ever relevant in a pragmatic sense, as the instruments that we make and play have always been a reflection of living attitudes and current trends. Our testimony to the living state of historical performance, with its multiple avenues of interpretation, lead us to discover that building a baroque instrument is not merely the difference of a few centimeters here and there, but a journey that transforms pieces of string and wood into a tool that makes perfect sense for its intended purpose and setting.

Mr. Tabor and I agreed that the heightened degree of color complexity that we were pursuing would be enhanced primarily by our significantly long string length and use of unwound lower strings. In retrospect, our intuition was correct; I find that the great length of the strings offers very fine, nuanced control over color when varying the bow contact point, and the lower strings are especially sensitive to minute changes in

59 Laird, *The Baroque Cello Revival,* p.22.

bow pressure, speed, and contact point, more so than wound strings of shorter length. In this way, these strings are musically unforgiving, always requiring an immediate release of pressure after initiating the consonant, or attack of the bow stroke. Because their responsiveness is so direct, the player is forced to make absolute sure to think about a certain tone or affect before moving the bow, or otherwise risk spoiling the "first impression" of the stroke.[60] With such direct responsiveness, there is little room to play "on autopilot," or hide mistakes and reckless playing as easily as one can on strings that aren't as expressive. As much as our 80cm string length helps enhance directness of response and tonal modulation, it is clearly not without inherent challenges, both physically and in the way the projected tone is perceived.

William Monical references the historical practices of tuning the upper strings to their breaking point, as well as experimenting with bridge placement, both as a means of balancing the instruments of a consort and adding tension to the lower strings in order to concentrate their sound.[61] Compared to a typical modern cello, whose highest string is very far from the breaking index, our bass violin exhibits a step towards the configuration described by Monical, as is the case of the violin, whose top string is tuned to a high e, and relatively much closer to its breaking point because of its specific length to frequency relationship. During his annual summer violin making course in Makkum, The Netherlands, Dirk Jacob Hamoen spoke to me about his experience making bass violins. He said that the closer the top string of an instrument is to the

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60 One of the richest sources describing expression through bowing technique is Etienne Loulié's 1690 treatise on viol playing, in which he refers to the initiation of the bow stroke as the "first impression," after which follows an immediate release. For detailed description of Loulié's bowing instructions, please refer to John Hsu, *A Handbook of French Baroque Viol Technique (*New York: Broude Brothers Limited, 1981), p.3. John Hsu, *The Viola da Gamba Society of America presents John Hsu In a Course on French Baroque Viol Playing,* VHS, (1992), says that this "first impression" is directly analogous to the initial consonant of a word in spoken poetic verse, emphasizing the musical importance of adequate preparation time in the split seconds preceding the stroke.

61 Monical, *Shapes of the Baroque*, p.3, cites Silvestro Ganassi's *Regola Rubertina* (1542) and John Playford's *Introduction to the Skill of Musick (1674)* in support of his opinion that historical setups are essentially a battle between acoustic concentration and the limitations of unwound gut strings.

breaking point, meaning the longer it is, the more tendency it will have to impart a "screamy" quality to the final sound result.[62] He added that this happens independently of the working tension of the string, or force that the string exerts on the instrument defined by its diameter/gauge, because it is rather the internal stress within the string itself that affects its voice. Indeed, instruments such as the violin, viola da gamba, and five string cello, each possess a top string that tends to stand out from all the others, challenging the maker who wishes to avoid metallic or overbearing, shrill sonority in the upper register. This exact challenge proved to be one of the most prominently critical considerations in building the bass violin. We knew that if were unaware of this, we may have been inclined by familiarity to build our bass violin as though we were making a cello and neglect this factor, and thus robbing ourselves of the opportunity to fully enjoy the instrument's a vastly colorful lower register along with a complimentary, not excessively domineering upper register. It is important, however, to distinguish the difference between overpowering and pleasantly contrasting. Early sources on the violin indicate, and even embrace the acoustic quality of clearly contrasting registers on an instrument. In 1533, Giovanni Maria Lanfranco, for example, refers to each of the bass violin's four strings by names corresponding to different vocal parts: canto, mezzana, basso, and sotobasso.[63] Viola bastarda players in the late sixteenth and early seventeenth centuries would have likewise imitated the interaction of multiple singers "in dialogo," and thus exploited the range of the viola da gamba in order to highlight the contrast between masculine and feminine voice, denoted by corresponding changes in clef and register.[64] As instrument makers, we walked a fine line when it came to creating a bass violin that fulfilled these qualities, and sounded bold, yet without offending the ear.

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62 Dirk Jacob Hamoen (violin maker/musicologist/teacher), personal interaction with the author, 2016.
63 Giovanni Maria Lanfranco, *Scintille di Musica* (Brescia: Lodovico Britannico, 1533), pp.138-142.
64 See Jason Paras, *The Music for Viola Bastarda* (Bloomington: Indiana University Press, 1986), pp.30-32.

Before discussing the route we chose to overcome these challenges, we first had to consider a couple of other important features that we had planned for this instrument, weighing each of their possible impacts and thus gauging the compromises we would need to make to approach our imagination of sound. Physically, we wanted our instrument to be able to accept a high level of bow pressure before the sound "cracks" under the bow. The objective behind this was to create a power response curve that requires, at minimum, quite a bit of muscle from the player to control the tone, but gives the sensation of limitless depth and clear articulation. The great length of the strings meant that they would supply quite a lot of tension, and therefore a robust sense of resistance in just the way we had planned. In spite of this, we wished not to shy away from using typical violoncello string gauges and go too thin for fear of imparting too much reediness to the sound. We chose to maintain the use of a high string of around 1.2mm in diameter with the objective of promoting a punchy, robust sound with lots of headroom to really dig into the string.[65] These decisions would certainly have very large bearing on how strongly arched and thicknessed our front and back plates would be in the end, a subject that shall be discussed shortly.

In addition to our already high tension stringing, we planned to give our bass violin's bridge quite a generous height. The main reason for this was to eliminate any possibility of hitting the sides of the instrument, giving the player a sense of confidence and security when digging heavily into the string. We also hoped to benefit acoustically from a few supposed secondary effects of high bridges. Our primary concern here was the angle at which the vibrating part of the string meets the front face of the bridge (the side facing the fingerboard). Of course, given a specific corpus length, arching height, and bridge placement along the length of the instrument, a higher bridge will

65 Daniel Larson, head of the largest gut string manufacturer in North America, published a simple guide highlighting some general, but very useful acoustic considerations of string selection, in which he refers to long, thin strings as sounding reedy. See Daniel Larson, "Optimum Lengths for Gut Strings," Gamut Music Incorporated, accessed April 2019, https://www.gamutmusic.com/gut-strings-lengths-1.

yield a sharper angle between the back of the bridge (the side facing the tailpiece) and the non vibrating part of the string.[66] If the neck is set sensibly, this angle should be the same on the vibrating side so that the static forces acting on the bridge are balanced, such that it does not pull forward and warp.[67] The degree of this angle obviously affects the static down-bearing force on the instrument, influencing the arching and thickness of the plates, but how does this affect the dynamic forces acting on the instrument once the strings are set into vibration? According to Joseph Curtin, due to the longitudinal lengthening and shortening of the vibrating string, a sharper angle will transfer the energy from this lengthwise vibration more intensely down into the instrument body than a shallower angle. He also adds that this force increases exponentially relative to the speed and pressure of the bow, magnifying the shift in tone color depending on how loudly the instrument is played, and making this aspect of setup a major factor in shaping the instrument's dynamic response.[68]

Bear in mind that the geometry of this string angle is a function of combined bridge and arching height. The discretion and principles employed by the maker therefore influence the exact proportion that the bridge and arching heights will have in relation to one another, comprising the projection of their combined height. In avoidance of a disproportionately short bridge in relation to its width, we knew that our arching height would have to be low enough to allow for our theoretically ideal bridge height.[69]

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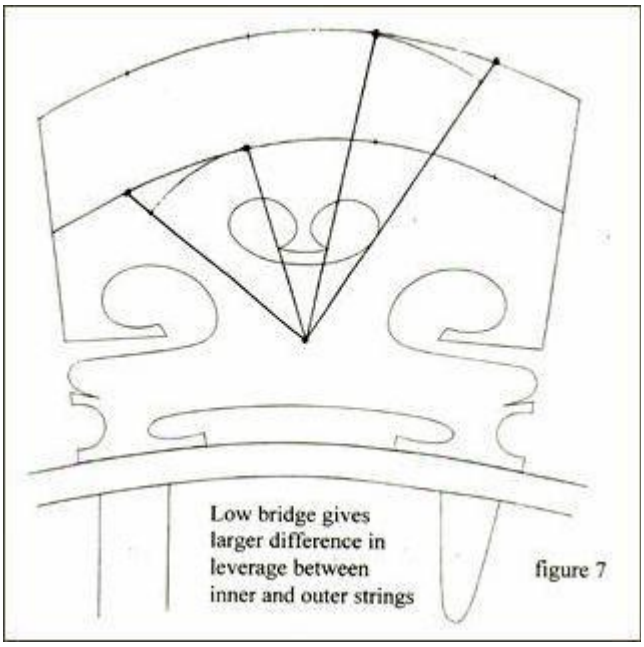
66 The size and shape of the instrument's outline has huge implications on the geometry of the string angles over the bridge. One can easily visualize, for instance, that a smaller instrument will have a sharper angle on the tailpiece side than a larger instrument equipped with a bridge of the same height. The proportional relationship between these parts is a design principle we will discuss in the context of deriving the shape of the instrument.

67 See Damian Dlugolecki, "Some Thoughts on Baroque Set-up," Damian Dlugolecki – String Maker, accessed August 2013, http://www.damianstrings.com/baroque%20set-up.htm.

68 Curtin, "Some Principles of Violin Setup," pp.119-120.

69 Ibid. pp.119,121. Curtin shows how theoretical ideal bridge height is a fine balance between bridge stability versus mobility, as well as between the inner and outer strings, explained by the geometric l evering capacity exerted by each string upon a fixed fulcrum point near the bridge center.



Curtin's theoretical illustration of string vibrations acting as levers on a fulcrum located between the upper and lower portions of the bridge; the higher bridge is shown to minimize the difference in lever length between the inner and outer string positions, translating accordingly towards more balanced intensity of sound produced by each respective string.[70]

We felt the best choice we had, respecting these parameters, was to therefore use a sound board with medium-low arching height, and most of its bearing capacity deriving from unusually thick graduations. As a rule of thumb while working the plate thickness, the wood should be just strong enough to resist perpetual collapse, but structurally delicate enough to be activated vibrationally by the strings. This idea is reflected in the observations of William Monical, who has seen "examples of early bass-bars ranging from 'broom handles' to 'toothpicks.'"[71] Laird notes:

> "The height or thickness of a bass-bar is related to thickness of graduations on the inside of a belly. Monical has found that northern Italian makers seem to have been far more interested than other luthiers in how they graduated their tops. He has seen small bass-bars accompanied by high arching and graduations that are thicker than he would have

70 Ibid. p.121.
71 Laird, *The Baroque Cello Revival,* p.28.

> anticipated, meaning that makers might have believed that the bass-bar needs to be strong enough to support the top. With a thicker top, the bass-bar could have been smaller."[72]

Imagining what an unaltered bass violin might have been like based on this reasoning, we were inspired to explore the effects of thick plates matched with a smallish bass bar that would help the wood really sing, and thus wound up with a thickness of over 11mm at the sound post. To put that into perspective, a thickness that great is nearly unheard of in the cello world, where measurements closer to 4mm for average plate thickness, with upper limits of around 5-6mm at the sound post area, would be considered normal. We figured that thick graduations in this configuration would foster the earthy sonority we wanted to achieve, dampening the laser-like qualities of high tension stringing while allowing us to benefit from its responsiveness and intensity of color. It was for the same reason that we chose to make the back out of willow instead of the now ubiquitous flamed maple. Willow is a creamy wood that is soft and very light compared to maple. As Mr. Tabor has extensive experience working with willow, he notes that when used as a back, it does indeed accentuate the supple, dark, rounded qualities of the sound, with great speed of response owing to its lightness. The back of the instrument, we figured, functions both as a reflector for the vibrations coming from the soundboard, and as a radiator of vibrations transmitted from the treble foot of the bridge via the sound post. If we accept for the moment the theory that the maker can control the anisotropic properties of a bridge, then a willow back would certainly have a pleasant softening effect on the timbre of the high string, without destroying its speaking quality, and giving an expansiveness to the sound rarely found in maple instruments of smaller size.[73]

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72 Ibid.

73 Breton, "The System and Proportions of Barring on Viols," pp.184-186, explains the phenomenon of bridges functioning with or without chiasma, or the diagonal vibrating effect by which string vibrations emanating from an extreme end of the bridge will be directed either to the foot opposite or to the foot directly under that string's lateral position. Breton suggests that one of the defining features of a so called renaissance or baroque bridge is its ability to function, through the design of its cutouts, without diagonal vibration. The most easily verifiable demonstration of [note continued p.48]

Preparation of wood materials and the beginnings of an outline at the atelier of my mentor, Nate Tabor; A Coruña, Galicia, Spain; Summer 2017.

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this effect is an instrument that sounds well in its extreme registers with a sound post placed directly underneath the treble side of the bridge, but not in a setup where the order of the strings is reversed, and vice-versa. My own experiments with this type of sound post placement have shown that awareness of chiasma effect, though often neglected, can be a very useful tool in being able to associate specific areas of the instrument with vibrations originating from certain strings, even if the extreme example illustrated by Breton isn't the intended goal.

By now, one probably sees what a complex, messy, and convoluted process the design of an instrument can be in the practical sense. It is an almost inhuman feat to juggle so many parameters when each is dissected at such an analytical level, though I hope that describing a few aspects of the instrument in this way has demonstrated what a useful exercise that having an analytical mindset can be, especially if one wishes to not rely on computers or other modern machinery. In light of this apparent chaos, I propose an ordered approach to thinking about all of the instrument's features. I call this a "signal chain" model, in respect to the concept familiar to audio and communications engineers. With this analogy, we have a clear root: the sound and tactile sensation within the imagination, which guides the direction of every subsequent decision. More importantly, with this we can ask ourselves a question: what actually happens as the imagined sound is translated into what we, or audience actually hears when a player picks up the instrument and bows on it? A very basic schematic of this model can be represented as follows:

> sound and tactile feeling in the imagination of the player (root)

> > the tension and elasticity of the strings, how they support that feeling as they react to the bow

> > > the energy of the string transferred to the bridge

> > > > the dampening, filtering, transmission, and direction of sound energies from the bridge into the various components and vibrating areas of the corpus

> > > > > > >etc. (we can extend this chain to an infinity of detail of what happens once the instrument is set into motion, the spreading of vibrations along the length of the sound board via the bass bar, the transmission of vibrations to the back via the sound post, the resonance wooden materials and coupling of vibrating systems, and the flow of the air volume inside the sound box, for example)

Following the model of a chain, the design of the entire instrument is essentially a chain reaction, or series of reactions to every former aspect of design. The answers on how to arch and thickness a plate, or how to cut a bridge, and so forth, reveal themselves over the course of this chain reaction, if we constantly examine our available options and evaluate them by asking the question: does this support the root intentions of the project, and could this work with the current design decisions we've made thus far? The design in the making might very well disintegrate at some point in the process, and might require some very informed "guesses," such as how sharp the string angle must be or how much tension should be exerted on the corpus. Still, this is better than trying to scrounge up a design out of a scattered mess of ideas, as it is often difficult to see which features are consequences of which. In a successful instrument, they simply seem to exist as one, having come into being as a team. And, there are often multiple avenues to achieve a successful, but different result, as well as an equal number of ways to mess up the functionality of the design!

For makers like Nate Tabor, who is largely self taught, this process of constant evaluation and coming up with solutions, often takes the form of very sensitive intuition rather than strict analysis. This is why the true hidden craft of instrument making, the part outside of the purely mechanical tasks, is so difficult to teach, or write about for that matter. It is also why, during the time I have spent working with Mr. Tabor, many of the intricacies of the craft have often times resembled religion; if he has a clear sound ideal in mind, one gets the impression that he will always achieve results in the end that match that ideal, almost without it even mattering what he actually does, or whether or not he could even articulate what exactly he does. Of course, much of this intuition is invested in the creation of form, or actual shape of the instrument. This underlying sense of structure is the foundation of every geometric feature and acoustical implication within the design of the instrument. When faced with the question of how to come up with this shape out of seemingly thin air, we are able to get

a glimpse into the epicenter of thought that drove the old masters in their work; much like the signal chain analogy guides us in everyday practice. Were there systems in place that helped these old makers invent the basic shape of the instrument, and reflected the ethos of the musical science of the day?

In the next section, I will explore the background behind some of the methods used to construct the form, namely copying and mathematical tracing with compasses, along with the technical problems they present. As an alternative, I will introduce the similarity between instrument making and historically valid architectural principles. I will expand on this idea with various primary sources representative of the habits and attitudes of the craftsmen of the past. Hopefully, these insights will lead to a better understanding of the ancient craftsman's mindset and world view, which appears to straddle the boundary between faith and reason. Throughout this exploration, I will also draw anecdotally upon my experience working with Nate Tabor, as well as advice I have received about instrument design from Dmitry Badiarov. The following quote from Arthur Koestler's 1968 preface to *The Sleepwalkers: A History of Man's Changing Vision of the Universe* mirrors my search as a musician and craftsman:

> "Firstly, there are the twin threads of science and religion, starting with the undistinguishable unity of the mystic and the savant in the Pythagorean Brotherhood, falling apart and reuniting again, now tied up in knots, now running on parallel courses, and ending in the polite and deadly 'divided house of faith and reason' of our day, where, on both sides, symbols have hardened into dogmas, and the common source of inspiration is lost from view. A study of the evolution of cosmic awareness in the past may help to find out whether a new departure is at least conceivable, and on what lines."[74]

74 Arthur Koestler, Preface to *The Sleepwalkers: A History of Man's Changing Vision of the Universe* (London: Hutchinson, 1959; London: Penguin 2017), ix. Citation of the 2017 reprint.

2.2 The Architectural Key

Violin makers would be wise to ponder the significance of the word *shape* in the chosen title of Monical's *Shapes of the Baroque.* Because form and shape are such fundamental yet enigmatic aspects of instrument design, we must consider shape as one of the most important benchmarks, or as a key starting point having to do with the inseparable relationship between sound and design. Furthermore, if an instrument has so many features that must be balanced in order to achieve the intended musical result, how is it then that a principled foundation for shape may or lay the grounds from which a harmonious functionality arises between all other geometric, structural, and musical features? Equally importantly, if we are to accept the linkage between this key element of shape and the historical influence of string technology, as espoused by Monical and Bonta, we are able construct the following list, highlighting several criteria applicable to the search for a historically valid instrument design process:

- The process must produce a logical and robust acoustical structure.

- This structure must adhere to principles of proportion common to the music and architecture in the Renaissance and Baroque periods.

- The process must allow for flexibility in both proportion and in adherence of outline to those proportions, reflecting the various models and visual idiosyncrasies present in the historical record. In other words, what is it that many original instruments, though appearing different, have in common?

- The process must be easy to teach, so much that apprentices or even young children may learn, remember, and implement its principles in a rapid and efficient manner.

- The process should employ the use of only simple tools and minimize the number of those required to produce elegant curved shapes, while also allowing for a feeling of spontaneity and freedom of expression within reason, therefore avoiding any overbearing reliance on unnecessarily complex mathematical calculations.

- The process must give rise to a unity between the physical form, the mechanical functions, and the musical functions of the instrument, such that every component or feature corresponds to a harmonious whole as in a well-oiled machine.

- The process should allow the maker to design instruments intended to perfectly fit an individual player's body, while preserving musically concordant global proportions.

- The process should facilitate the ease of tuning the wood materials throughout the instrument, enhancing resonance without simply leaving the maximal musical potential of the materials up to total chance.

The above criteria, when realized within a practical system of designing forms and constructing instruments, should serve to eliminate guesswork in creating non-standardized instruments, as well as ensure that no single design aspect detracts from the co-contribution of all parts towards the maker's vision of sound and playability. Perhaps most importantly, these criteria offer key insights as to the value of the instrument making craft as a cultural product, opening hidden passageways that lead to ways of thinking which may have been obvious in the past, but may not, for reasons of cultural transformation, be so obvious to today's mainstream. Before

arguing in support of this hypothetical design process, it is first necessary, however, to provide some background, drawing attention to a few subtle, yet very contentious issues surrounding two methods that have predominated violin making tradition since the nineteenth century: copying old instruments and modern mathematical analysis.

Violin makers and researchers have long sought a mathematical system that can be used to analyze the geometry of old master instruments, and devise logical design processes to create models that resemble the work of frequently celebrated old masters, such as the Amatis, Stradivari, and Guarneri del Gesu. Throughout the nineteenth and twentieth centuries, until relatively recently, our vision of how the old masters derived their forms had remained mostly clouded. The makers of these superlatively esteemed instruments left behind no clear instructions or treatises, and it isn't until the relatively late publication of Antonio Bagatella's *Regole per la Costruzione de' Violini, Viole, Violoncelli e Violoni* in 1786 that we have had a text which specifically and exclusively deals with violin making. Bagatella's work proved to be very influential throughout Europe, involving a system of dividing the violin corpus into seventy-two equal parts, and subsequently using this division as a mathematical guide to trace, using simple tools, the various curves present within his interpretation of the modern violin form, as developed by Nicolò Amati and Stradivari.

Many of those whose own work echo Bagatella's design principles were also pedagogues, among them Edward Heron-Allen, who just over one century later published *Violin Making as it was and is*. Heron-Allen relates a tedious and convoluted process for drawing a mathematically derived outline using the seventy-two point system, along with a pre-determined desired body length. Notably, the prescribed manner in which he writes is rather disheartening, considering that the only other

possibility for creating outlines in his extensive manual consists of copying an old master's model by tracing the outer perimeter of an existing instrument's plates[75]. These methods, though impressive and historically significant in that they indicate the mindset of their time, fail to address several aspects relating to the original conception of many baroque instruments, taking into account the variations and flexibilities possible with both shape and final setup details. For example, it is dubious, following such instructions, as to how a luthier, drawing compass arcs, may easily account for adjustments that he may wish to make, insofar as choosing different proportions for the instrument's principal dimensions while maintaining that the said curves flow into each other harmoniously.

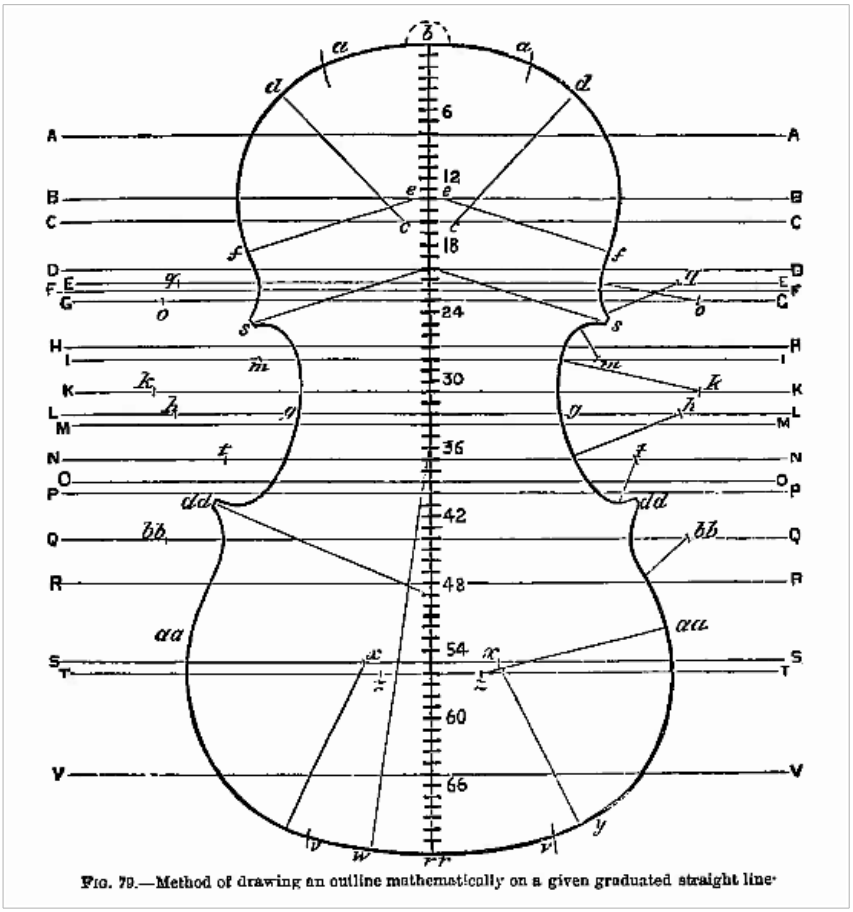


FIG. 79.—Method of drawing an outline mathematically on a given graduated straight line.

System of drawing a violin outline using compass arcs with divisions of a given length of corpus[76]

75 Edward Heron-Allen, *Violin Making as it was and is* (London: Ward, Lock & Co., 1885; Ottawa: Algrove Publishing, 2000), pp.135-139. Citation of the 2000 reprint.

76 Ibid. p.137.

Secondly, the working order necessitated by a method that supposes an outline and body length before deciding on a string length, ignores the more sensible virtues of many of the older sources we shall discuss shortly, those principally dealing with the internal acoustic structure based on the properties of the vibrating string. This working order is backwards because it operates on the deceptive notion that the instrument is merely a box with strings attached, rather than an amplifier whose purpose is to make the vibrating string audible, the string being the primary point of contact through which the player and instrument are interfaced. Thus, critical elements such as vibrating string length, placement of the bridge, and arching geometry are left resting upon a musically ambiguous foundation, in spite of the supposed mathematical logic behind creating the instrument's outer shape using such a method.

Additionally, the process of copying the outlines of existing antique instruments, whether from blueprints, direct tracings, or poster photographs, as is commonly practiced today, subjects the results to a few potentially deleterious effects. The expression, "making a photocopy from a photocopy," is especially relevant here. In the case of photographs, many makers are unaware of how drastic the distortion imparted by a lens can be. Dmitry Badiarov demonstrated this clearly in a violin design course given in October-November 2017, in which it was seen how unintentional, even minor deviations from a theoretically "correct" model, arising from lens distortion, would have negatively impacted the outcome according to the acoustical conception of the old masters. Badiarov stated convincingly that even the human eye, being a lens, does not perceive proportions accurately. He also warned anecdotally that in some of the most extreme instances he has observed of error resulting from using posters to copy, the discrepancies between the copy and original instrument may even exceed the huge

threshold of several centimeters, and the maker may not even realize that photographic sources can exhibit such misrepresentation.[77]

Badiarov demonstrates the distortion that occurs when photographing the same instrument from a given distance, relative to the optical centers of 70mm, 50mm, and 35mm lenses, respectively.[78]

Most of the time, careful instrument makers are observant enough to avoid such big discrepancies, especially if the instrument being made conforms to mostly standard measurements or reliable plans. That being said, even direct measurements or tracings from existing instruments must be taken with scrutiny. The reason for this is twofold. First, instruments almost always exhibit idiosyncrasies, interpretive tendencies, and

77 Dmitry Badiarov, "Dmitry Badiarov's Mentoring and Mastermind Group for Violin Designers," (Webinar series, Badiarov Violins, The Hague, The Netherlands, October 26 – November 18, 2017).
78 Ibid.

subtle deviations from perfect architectural theory that are suited to the sensibilities of the original maker, or in other words, where and how that maker decided to "bend the rules." Copying these idiosyncrasies while being unaware of their weight in relation to the maker's underlying theory of form holds little value. Secondly, wood distorts, shrinks, and wears over the course of many years, particularly around edges and the widest parts of top and back plates, mainly due to physical exposure and wood grain orientation, respectively. Copying an instrument that has been subject to these effects, no matter how accurately, makes little sense if the goal is to capture those underlying principles which inspired the original design. The same can be said of mathematically analyzing these objects to the tenth of a millimeter. This is especially true considering that many copyists use the original plate edges as a reference point in creating outlines, when these are the points subject to the most wear, in addition to possibly exhibiting varying degrees of uneven edge to rib overhang. The result is that the internal rib structure, having to conform to the outlines in order to achieve proper gluing surface, becomes skewed in accordance with those distortions. One wonders what these supposed exact copies will look like in another three hundred years, and how distorted they will be relative to the original makers' concept of form. It is therefore more likely that old masters used a more robust primary reference point for their proportionally based dimensions, such as the inside or outside surfaces of the rib garland. For makers using internal molds, for instance, these proportions are instead determined directly by the form of the mold, minus the rib thickness if measuring the dimensions from the exterior rib surface.

On top of all this is that copying, at its core, removes much of the maker's individual potential to self-express through the form. This happens by assuming that the makers of the past designed their models only by copying and modifying the work of their predecessors, rather than creating a new synthesis from existing ideas. In the best case copying scenario, the most intelligent "copyists" will always exert a

significant degree of personal interpretation of original outlines, but then it is debatable whether or not these makers are truly copyists or if the attachment of a big name, as in “Stradivari model” or “Guarneri model,” is done only out of marketing necessity; I suspect that this practice has become so customary that most makers would find it difficult to get away from. This distinction is possible only on a case by case basis depending on the style of each individual maker’s working habits. In the worst case, the obsession with copying imposes the consequential view that instruments are a commodity, since a replica, by definition, is something easily mass produced. The cultural root of the craft is thus stripped away, which does a great disservice to the continuing value of classical music for current and future generations. No matter the particular manner of copying, the starting point is always the same; one must rely on a pre-existing outline.

By now, the curious craftsman is hungry to get to the bottom of things. What alternatives do we have in creating an outline? Perhaps the most obvious, direct, and most extreme option is to decide on a corpus size and totally freehand the outline until a satisfying shape is reached. Incidentally, this is one of Nate Tabor’s favorite methods, although he is familiar with many. During my first week of training with him, he handed me a piece of paper and told me to draw a violin the way I wanted, while watching him do the same. In a stupefyingly refreshing vein, observing Mr. Tabor at work was a revelatory experience- a total contrast to the rampant stagnation within the greater violin industry. This exercise proved fruitful in that I was immediately forced to develop intuition, drawing only from pure instinct and creativity without any guidelines. Sometimes, my mistakes were immediately visible; the wrongness or excessive weirdness of the shape had the effect of raising my hairs similar to when one watches maggots squirming around, or gets a taste of stew that is just starting to go bad. Other times, the mistakes would only become apparent once I was forced to imagine, or diagram my design in a more complete form, with strings and setup. In this

latter way, the problems at hand would doubtlessly be acoustically relevant. Slowly but surely, I began to see how shape was intrinsically connected to many of the structural elements integral to sound radiation throughout the instrument.

Nate Tabor drawing the outline of the bass violin. A Coruña, Spain 2017. Note that here, the line represents the contour of the ribs, in order to provide a model for shaping the corner blocks upon which the rib garland is constructed and glued. The shape from the overhanging plate edges are consequential to this model. We prepared a great many sketches before refining a more or less final outline that was used as a template to form the curves of our top, bottom, and corner blocks.

For instance, what if the outline were too narrow in a particular section of the instrument where the arching geometry would be better off rising gently, rather than

abruptly?[79] Certainly, one becomes increasingly aware of these issues with practice and experience, the takeaway being that shape, being the conglomeration of boundaries that either permit or restrict the vibration of the plates, is inseparable from sound. To illustrate a greatly simplified yet understandable example: it is easy to conceptualize that the area of a top plate between the lower bouts, being broad and supple, would more easily amplify the instrument's lower range, while the slightly more rigid upper bout would correspond to the middle range, and therefore much of the intstrument's overall quality of voice is contingent on the harmonic relationship between these areas.

Tabor's approach is artistic, free, and spontaneous, yet empirically based on his own collective evaluation and transformation of his own past work, which is something that I currently lack. In his output, this manifests as an extreme variety and uniqueness of every single instrument, making the freehand drawing of a successful design a near impossibly difficult skill to teach. Stemming from my ironic, initial frustration with total freedom, I wondered if the old masters had a more systematic way of creating an acoustically sound shape, while preserving substantial room for interpretation and expression. The answer, I felt, might lie in the numerous sources that relate music and musical instruments to architecture, instead of looking at instrument making as a direct analog to fine art or sculpture.

Remy Gug, in his article, "Geometry, Lutherie, and the Art of Historiography," warns heavily against taking results obtained through modern numerical analysis at face value, mostly in reference to one of the most significant twentieth century

79 McKean, "Carter Brey: The Bach Cello Suites," talks about his riveting experience preparing two cellos with a baroque setup at an almost frantic pace, and seeking the advice of William Monical when the initial attempt was unsuccessful: "A quick glance was enough for him [Monical] to decide that the Guadagnini was not the proper instrument of the two for a Baroque setup; the model, arching and f-hole placement were not right for the lesser tension of gut strings. While I had duplicated the string length, both overall and in the division between neck and body, I had used my own pattern in making the cello. The waist and spacing between the f-holes was wider, and the arch more gradual and springy; it would respond better to the different setup."

contributions to the geometry of musical instruments: *Geometry, Proportion, and the Art of Lutherie*, by Kevin Coates. In particular, Gug criticizes Coates' ignorance of historical metrology:

> "Coates built up his analyses using decimal numbers, for the measurements and for the proportion (2.236, 3.262 and so on…) - a 20th century tradition. The precision obtained by these modern methods is not absolutely the best way leading to reality build up with other methods."[80]

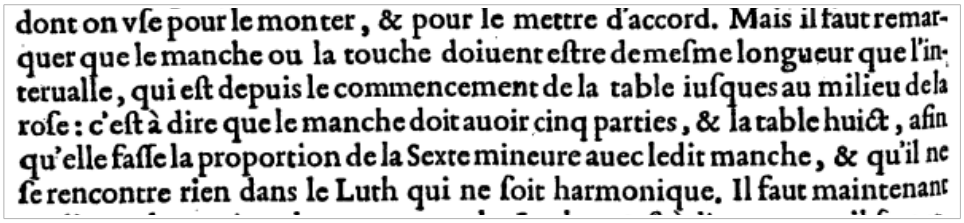
The above quote of Gug makes a clear argument in favor of finding the exact methods used to derive the various parts of the instrument, rather than imposing the mathematical overcomplexity introduced by a modern measurement system, which, being anachronistic and deceptive, does little to go beyond analysis and into the actively constructive. Gug makes an additional, very important statement:

> "By this total black-out on historical metrology, Coates could not benefit from a valuable key in that great puzzle."[81]

This valuable key, according to Gug, is the connection between structural dimensions and musical intervals, gathered from the correspondence of simple whole number measurements to historical units. Such a connection is easily overlooked and lost in what Gug refers to as the "decimal points mirage."[82] Gug notes, that upon closer examination of the treble viol by Giovanni Maria da Brescia c.1575, the proportion between string length and body length is easily delineated by simple divisions of the string into first 3, 9, and finally 18 equal parts, and deriving the body from 20 of these parts. The clever maker will recognize this ratio of 20:18, or 10:9 as the musical interval of a narrow whole tone, as it manifests in the overtone series. The practice of

80 Remy Gug, "Geometry, Lutherie and the Art of Historiography," *FoMRHI Quarterly* 59, (1990): p.58.
81 Ibid. p.44.
82 Ibid. p.60.

creating harmonic relationships between complimentary structures was a tradition explicitly mentioned on numerous counts by Marin Mersenne, perhaps most famously in the following passage from his 1636 *Harmonie Universelle* about the lute:


dont on vſe pour le monter, & pour le mettre d'accord. Mais il faut remarquer que le manche ou la touche doiuent eſtre de meſme longueur que l'interualle, qui eſt depuis le commencement de la table iuſques au milieu de la roſe: c'eſt à dire que le manche doit auoir cinq parties, & la table huict, afin qu'elle faſſe la proportion de la Sexte mineure auec ledit manche, & qu'il ne ſe rencontre rien dans le Luth qui ne ſoit harmonique. Il faut maintenant

> "… it is to say that the neck must have five parts, and the table eight, such that it stays in the proportion of minor sixth with the neck, and that one finds nothing in the Lute that is not harmonic."[83]

Andrew Dipper, speaking on the string to body proportion in the forward to his annotated edition of an eighteenth century manuscript of anonymous authorship titled *Librem Segreti di Buttegha*, goes on to state that, "The proportional relationship between string length and body length is important since the tone color of the overtones of the instrument are born of this relationship."[84] The musical implication within geometric design is clear. In order to understand more fully this notion introduced by Dipper, we must continue constructing a design method centered on harmonic relationships. How would one go about elaborating the instrument in this manner, and how would the process reflect the ideas present in further primary sources?

The association between music, specifically harmonic relationship, and structure, actually goes back at least several thousand years. In the fourth century BC,

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83 Marin Mersenne, *Harmonie Universelle*, (Paris: 1636), Livre Second, p.50.

84 Andrew Dipper, introduction to *Librem segreti de buttegha: A Book of Workshop Secrets : The Violin and its Fabrication, in Italy, circa 1725-1790: "phonic rules principles and formulas for the use of luthiers and violin enthusiasts"* (Minneapolis: Dipper Press, 2013), p.24, note 3.

the Pythagorean philosopher Plato attempted to explain the nature of the universe in terms of the physical realm being governed by a "world soul" created by a god/demiurge, which consequently manifested itself within the moral essence and behaviors of man:

> "God did not of course contrive the soul later the body, as it appears in the narrative we are attempting; for when he put them together he would never have allowed the older to be ruled by the younger. There is in us a large element of the contingent and the random, and we speak correspondingly. But god created the soul before the body and gave it precedence both in time and value, and made it the dominating and controlling partner."[85]

As if it were a great machine, or a kind of musical instrument, this celestial architect divided the material of this "soul" into a series of circles, or strips upon which the motions of the sun, moon, and planets were given a harmonious structure described by Plato as corresponding to the ratios 3/2, 4/3, and 9/8, or perfect fifth, perfect fourth, and greater whole tone.[86] This is all clearly very abstract, but nonetheless solidifies the concept of an organized, non-random arrangement of all musical things.

In the first century BC, the Roman architect Vitruvius dedicated an entire section of his *Ten Books on Architecture* to the design and construction of a perfectly sounding theater in which the human voice could be projected, even amplified with great clarity. In order to do so, he defined the boundaries of natural vocal modulation through a series of tetrachords that would change depending on the modal inflection of the speech. Speaking about the intervals formed by these tetrachords, Vitruvius makes no less than two references to musical instruments:

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85 Plato, *Timaeus,* trans. Desmond Lee (London: Penguin Classics, 2008), p.24.
86 Ibid. p.25.

> "Now then, these intervals of tones and semitones of the tetrachord are a division introduced by nature in the case of the voice, and she has defined their limits by measures according to the magnitude of the intervals, and determines their characteristics in certain different ways. These natural laws are followed by the skilled workmen who fashion musical instruments, in bringing them to the perfection of their proper concords."[87]

> "...just as musical instruments are brought to perfection of clearness in the sound of their strings by means of bronze plates or horn, so the ancients devised methods of increasing the power of the voice in theatres though the application of harmonics."[88]

> "...there can be no consonancies either in the case of the notes of stringed instruments or of the singing voice, between two intervals or between three or six or seven... it is only the harmonies of the fourth, the fifth, and so on up to the double octave, that have boundaries naturally corresponding to those of the voice: and these concords are produced by the union of the notes."[89]

One of Vitruvius' solutions for the theater was to place a series of bronze or copper resonating vases inside cavities at various points around the theater, and tune them to match the limits of the compass of speech. It remains an enigma as to what exactly the effect of these vases actually sounded like, or what the inflection of public speech at the time would have required. In each case, the discriminatory treatment of different intervals demonstrates an intention of enhance certain aspects of the sound while perhaps also suppressing others, in effect giving organization, voice, and color to the perceived resonance of the space. It is also clear that in examining these sources so far, the musical instruments existing at the time are in no way treated as dissimilar to the compass and declamation of the human voice.

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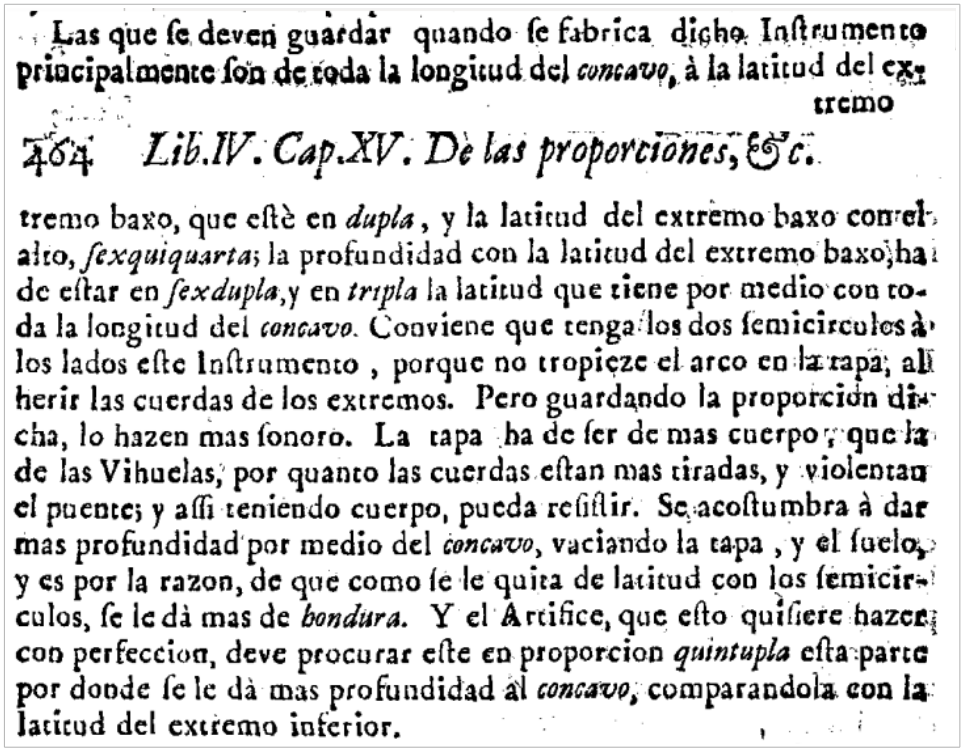
87 Marcus Vitruvius Pollio, *The Ten Books on Architecture*, trans. Morris Hickey Morgan (Cambridge: Harvard University Press, 1914), p.141.
88 Ibid. p.139
89 Ibid. p.142.

It is not so much of a stretch then, to imagine what the humanist mind interpreting these ancient works might have imagined as to how these principles applied to stringed instruments from 1400-1750. In 1485, Leone Batista Alberti advised architects to "borrow all our rules for finishing our proportions, from the musicians, who are the greatest masters of this sort of numbers," confirming the continuity of the intertwined state of music and structure.[90] As we are left with no dedicated violin making treatises from this time period, I know of only one source in which the violin, along with many other instruments, is explicitly discussed in the context of its harmonic construction. Brought to my attention by master luthier Dmitry Badiarov, Pablo Nassarre's *Escuela Musica Segun la Practica Moderna*, although relatively unknown today, contains an entire chapter on this subject within its four massive volumes. Nassarre states:



Las que ſe deven guardar quando ſe fabrica dicho Inſtrumento principalmente ſon de toda la longitud del *concavo*, à la latitud del extremo

464 *Lib.IV. Cap.XV. Dè las proporciones, &c.*

tremo baxo, que eſtè en *dupla*, y la latitud del extremo baxo con el alto, *ſexquiquarta*; la profundidad con la latitud del extremo baxo, ha de eſtar en *ſexdupla*, y en *tripla* la latitud que tiene por medio con toda la longitud del *concavo*. Conviene que tenga los dos ſemicirculos à los lados eſte Inſtrumento, porque no tropieze el arco en la tapa, al herir las cuerdas de los extremos. Pero guardando la proporcion dicha, lo hazen mas ſonoro. La tapa ha de ſer de mas cuerpo, que la de las Vihuelas, por quanto las cuerdas eſtan mas tiradas, y violentan el puente; y aſſi teniendo cuerpo, pueda reſiſtir. Se acoſtumbra à dar mas profundidad por medio del *concavo*, vaciando la tapa, y el ſuelo, y es por la razon, de que como ſe le quita de latitud con los ſemicirculos, ſe le dà mas de *bondura*. Y el Artifice, que eſto quiſiere hazer con perfeccion, deve procurar eſte en proporcion *quintupla* eſta parte por donde ſe le dà mas profundidad al *concavo*, comparandola con la latitud del extremo inferior.

90 Leone Batista Alberti, *Ten Books on Architecture,* Trans. James Leoni, Ed. Joseph Rykwert (London: Alec Tiranti, 1965), p.197.

> "The [proportions] that must be maintained when making the said instruments are principally: the total length of the body* to the width of the lowest part** are in *dupla* 1/2: octave), and the width of the lower bouts with the upper bouts are in *sexquiquarta* (4/5: major third); the depth with the width of the upper bouts are in *sexdupla* (1/6: superoctave of the perfect fifth), and in *tripla* (1/3: octave of the perfect fifth) is the center bout in relation to the total length of the body*. It is convenient that the instrument has two semicircles at the sides so that the bow does not hit the soundboard when playing the outer strings. But, the said proportions must be preserved in order to make the instrument more sonorous."[91]
>
> *Badiarov supposes that Nassarre made a mistake in using string length and body length interchangeably. If, on the other had, we replace the word *concavo* with *cuerda,*we end up with a description of the violin in classic proportions observable in the work of Amati, etc. In following Dipper and Gug's observations on the whole tone ratio of string length to body length, we can confirm that Badiarov's interpretation of Nassarre's text, as well as the features present in original instruments, reflect a harmonic relationship of unison between the string and the distance between the upper and lower blocks of the corpus.
>
> ** Badiarov has also noted that Nassarre is looking at the violin upside-down here, with the wider bouts pointing upwards.

What does this all mean? As we can see in Nassarre's description of the violin, we can derive all of the principal dimensions of a classical violin form by measuring a given string length at a given pitch, and then measuring another length of string at the same relative tension for all the indicated harmonic intervals. The key here is that the string length is the starting basis for all of the other measurements, which makes sense as the string is also the source of vibration on an instrument in use. It should be no surprise then that among the harmonic proportions mentioned by Nassarre (aside from the unison relationship of string and body length between the upper and lower

91 Pablo Nassarre, *Escuela Music, Segun la Practica Moderna, Dividida en Primera,y Segunda Parte,* (Zaragosa: Diego de Larumbe, 1724), book IV, pp. 463-464.

blocks) at least two of them are also lower members of the natural overtone series. The major third relationship between the width of the upper and lower bouts demonstrates nothing other than an intention, according to the musical theory of the time, to imbue an instrument, right from the start while forming its shape, with the capacity to amplify the strings in a natural way and project a complex, resonant sound.

How can a violin maker do this in an elegant way without having to fuss with numerical calculations? We can gather a very important clue from the writings of sixteenth century architect and schoolmaster, Philibert de l'Orme. Distinguishing between theoretical and practical knowledge, and favoring pragmatism above everything, de l'Orme states:

> "I shall fully explain the art of tracing,that I shall describe with all details and in the simplest possible manner, avoiding the method and plenty of fine demonstrations, the learned teachers of geometry and other parts of mathematics use to employ. Thus, we shall choose in the best possible way, the terms, the language and the methods in order for the craftsmen to understand what we want to say."[92]

Resourceful violin makers will find that a monochord with two strings and a movable bridge is the simplest, most useful tool for this, providing results more genuine and accurate than even the most exact arithmetical computations. The reason why this is beneficial for the continuing craft of instrument making is that using an ear-oriented tool to create the structure reintroduces a basis of musicality to every task, starting with the invention of form and shape, and leaves a surprising amount of room for expression and interpretation. In fact, it is possible to memorize the form of an instrument as a melody this way, allowing the maker to explore intriguing new avenues in discovering a personal language in the craft.

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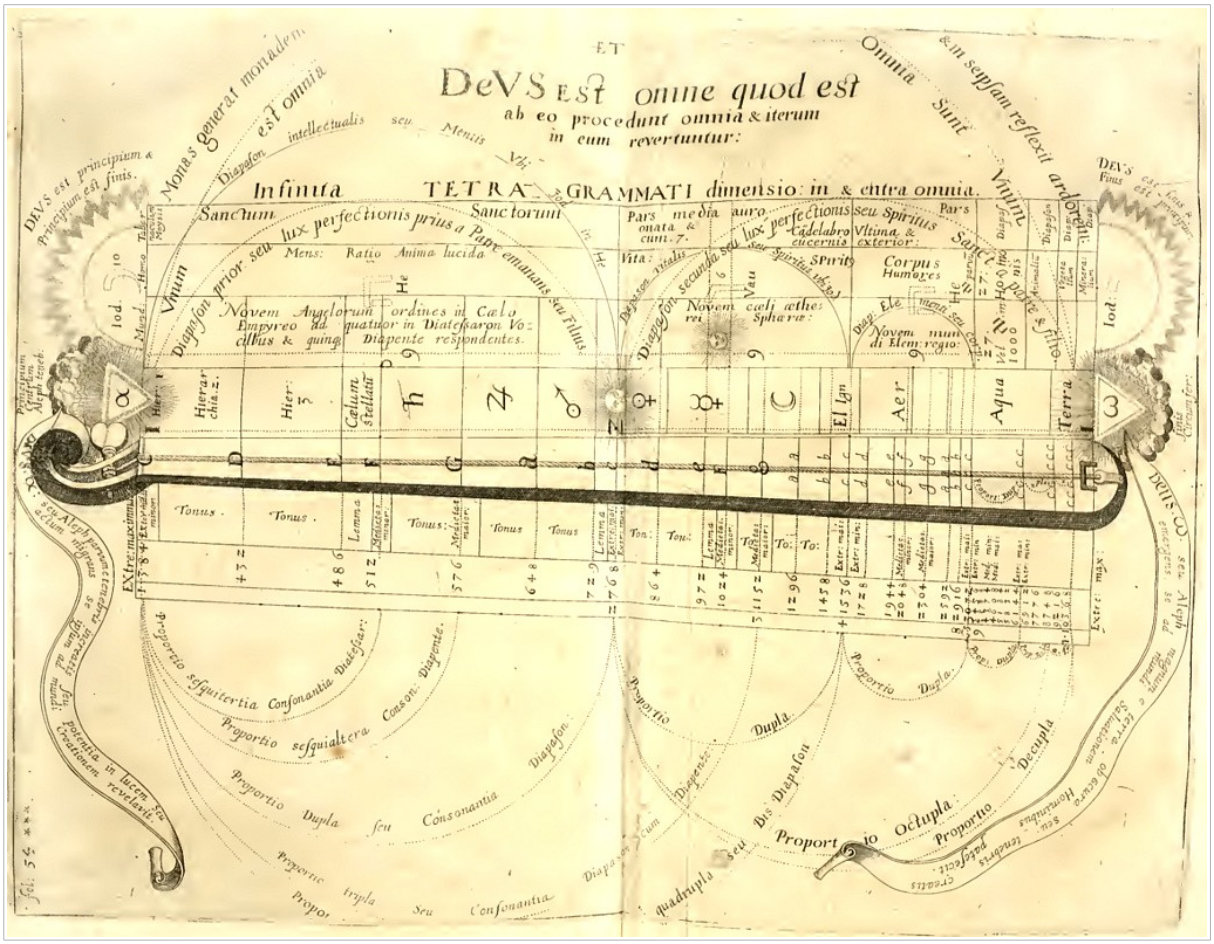
92 Philibert de l'Orme, *Premier Tome de l'Architecture* (Paris: Federic Morel, 1567), p.74. Translation by Gug, "Geometry, Lutherie and the Art of Historiography," p.53.



Robert Fludd's celestial monochord, 1623, illustrating what the modern translations would be for the original Latin names used by Nassarre for all the harmonic proportions[93]

The maker may, within reason, choose any proportions he pleases, as long as the harmonic relationships between the various parts remain at the disposal of sensibility, and that no part of the instrument becomes ergonomically unwieldy. For instance, a maker may design short violins intended for small handed players, with wider proportions in order to maintain deepness of sonority, or design long bass violins with narrower proportions in the lower bout so as not to make the instrument to difficult to hold between the legs; this was our choice when designing our bass violin. Furthermore, the maker may introduce slight asymmetries and idiosyncrasies to non-

93 Robert Fludd, *Celestial Monochord,* 1623, photograph courtesy of University of Glasgow Library, Flickr accessed November 2018, https://www.flickr.com/photos/uofglibrary/11868696885.

principal or non-vibrating parts. For example, the four corners at the center bouts, according to Tabor, help to define the "face" or look of the instrument, as the recognizable work of a particular individual, preserving a certain degree of artistic charm, liberty, and integrity. Temperament is also an interesting notion here, and it would be an interesting study to survey a selection of antique violins to see if there are any consistencies of wider/narrower thirds, sixths, fourths, and fifths manifested in the dimensions of different national schools, time periods, etc.

Remy Gug suggests using a grid system, or exterior scaffolding to guide the actual drawing of the internal harmonic structure of the instrument, citing the following quote from de l'Orme:[94]

> "Nevertheless, a perpendicular in the middle is the simplest and easiest way in all cases you can encounter, not only when dealing with buildings, but also with different kinds of figures of Geometry and architectural ornaments; also for perspective, <u>music</u>* 'theorique', military engines and all other possible things…, in all cases always begin with a perpendicular put on a straight line, which represents the sign of a Cross."[95] *(emphasis added)

This way, the shape of the interior mold, if this be the method employed to mount the corner blocks and fit the bent ribs, can be drawn completely freehand within the robust harmonic framework provided by the scaffolding, identifiable by the rectangular, segmented constructions of each principle section of the instrument.

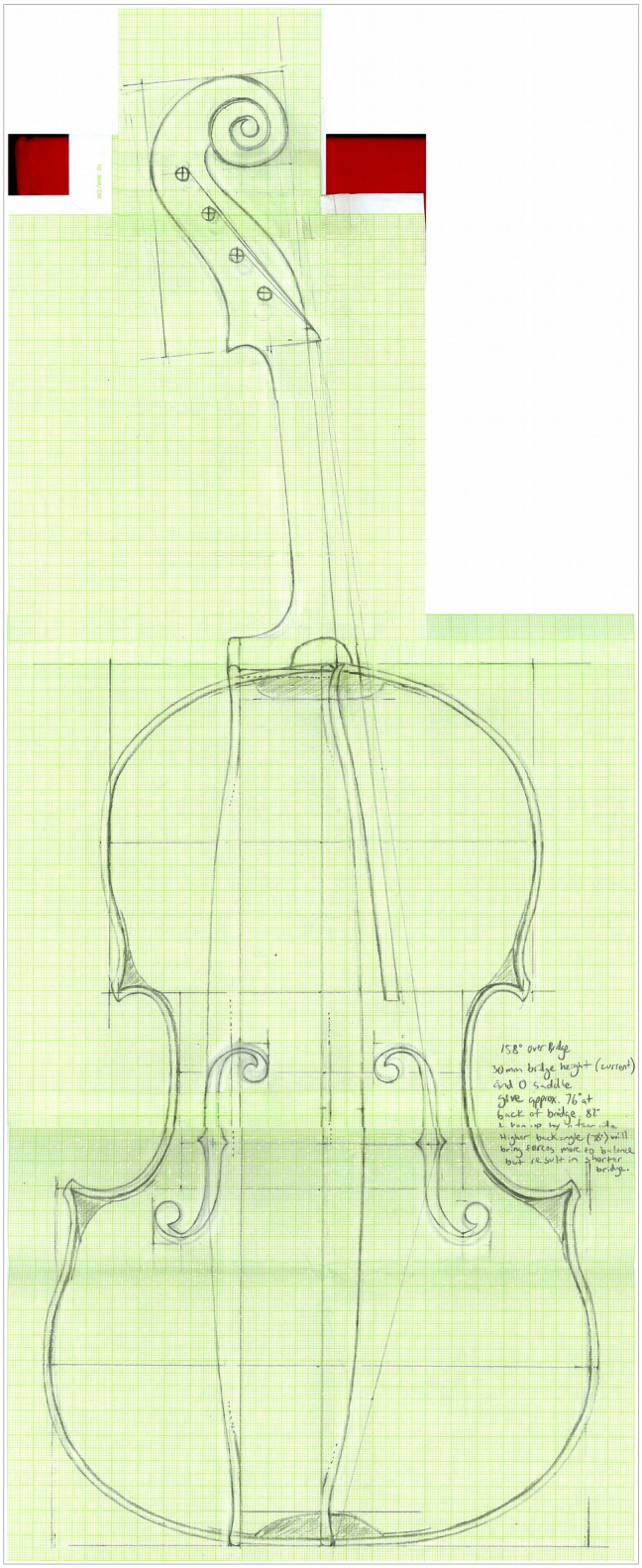
Pictured on p.72 is a plan for a violin of my own design using such a harmonically proportioned scaffolding. It was created in completion of a webinar course on instrument design led by Dmitry Badiarov, in the Fall of 2017. This model features a barely visible asymmetry in the upper treble side, giving the left hand more clearance

94 See Gug, "Geometry, Lutherie and the Art of Historiography," pp.50-58, for detailed instructions on how to employ the scaffolding style system.

95 de l'Orme, "Premier Tome de l'Architecture," p.32. Trasnlation by Gug, "Geometry," pp.54-55.

during shifting. Note that the proportion of the upper bout's maximal width remains intact; only the shape of the curve is slightly more compact than on the bass side. I attempted to retain some of Tabor's influence in this design, especially in the slight asymmetries throughout the corpus, the ornamental parts of the sound holes, and square curves of the center and lower bouts. Every part of this instrument, including the bouts, scroll, sound holes, corner placement, arching height, rib depth, and bridge position, were determined using musical proportions of varying dissonance and concordance, using primary sources as a guide. I am indebted to maestro Dmitry Badiarov for his generosity in sharing his deep knowledge of designing instruments in this way. I would highly encourage anyone interested in learning the precise details of this method and implementing these theories in the construction of actual instruments, to urgently seek his help and expertise.

What better way to make an instrument than to start with a design that physically represents the structure of sound itself? This very question opens a portal to plethora of renewed pathways of discovery, of how to unleash the creative mindset that has arguably been suppressed within this craft for so long. My experiences with the methods discussed so far have led me to ponder and reflect heavily upon how they may be implemented in a future workshop, and how, when combined with my experience as a musician, they might help to ensure that handcrafted instruments remain relevant and valuable henceforth.



The harmonic architecture of a violin, drafted in 2017 in completion of a seminar led by Dmitry Badiarov.

CHAPTER 3

Reflections on Workshop Philosophy and Conclusion

"It could simply be that the restaurants in Montreal just don't know *what* a good pizza is."[96] This was my father's explanation of that ever puzzling phenomenon faced by visitors to the True North who happen to be born and raised in New York or New Jersey. What seems here to be merely a disagreeable matter of taste, or lack thereof, might actually have some rational basis; our "bad" judgment of Montréal pizza, being doubtlessly rooted in our perception of human sensory experience, is ultimately a question of history, and the organization of cultural aesthetics on both personal and grand scales.

Dr. Jonathan Sterne, in a 2015 lecture titled "Listening, Culture, and Technology" as part of the McGill seminar PLAI600 – The Art, Study and Practices of Listening, made some very compelling comments on why certain things were invented when they were invented.[97] He said that in theory, most technologies could have been feasibly invented at any point in history, depending on the cultural forces at work, including the necessity and purpose for which the article in question was intended, developments of technology which came before, and even the temperamental nature and personal lives of the individuals directly responsible. These elements alone allow one to comprehend that there is a practically limitless number of factors related to, by extension, the conception and creation of various gustatory products such as good tasting pizzas, or acoustical products, especially within the realm of musical instruments. This idea teaches us that contrary to our assumptions over whether or not something will, or can be created in theory, that thing's actual existence is less often a question of raw, technical ability, instead having more to do with putting

96 Thomas A. Gallagher, personal interaction with the author.

97 Jonathan Sterne, "Listening, Culture, and Technology," (lecture, PLAI600 – The Art, Study, and Practices of Listening, McGill University, Montréal, Québec, Canada, September 25, 2015).

ourselves in a position to thrive in "ways of being," or frames of mind, body, and spirit that naturally give rise to the inventions in question.[98]

Dr. Sterne gave us the example of the stethoscope, which according to his elaboration, clearly shows how technological design is deeply rooted in function and form, always serving exclusively to amplify or enhance human perception and intention in the best way that we know how. In this case, the invention of the stethoscope was driven by the sheer necessity of its historical purpose: to identify the presence of lung infection, by means which a hearing/listening process was the most appropriate and closely related sense towards a solution to the problem at hand. The fact that this invention was born with a hundreds of pages long treatise explaining its purpose and use, is a testimony to not only its importance, but also the importance which society has, in the past, placed on the capacity for human ingenuity – a concept I believe has been lost and utterly disenchanted in the twenty-first century. In contemplating Dr. Sterne's words, and the idea that invention and technology are so related to our bare senses, I cannot help but consider that the classical bowed instruments of European music are an undeniable result of Pythagorean musical philosophy, the acoustic science of its day, combined with perhaps just a touch of Italian superstition and madness.

For this reason, I find it appropriate to say that I do not wish for any of the methods I have explored to nullify modern acoustical research, or reduce or replace the value of the skills and knowledge taught to us by tradition. Whether the organic, free approach of Nate Tabor, or the harmonically sound architecture of the ancients, these methodologies serve first and foremost as a starting point, or foundation from which creative, vivacious makers can expand. No method, without the ability to fit the pieces of the puzzle together, will guarantee good sound; such a claim only cheapens these

98 See p.4, on how Vittorio Ghielmi's work with traditional musicians has helped him rediscover insights and lost sounds of ancient music.

explorations to the level of one of the so-called "holy grail" discoveries discussed in chapter 1. Because of this, the magic of great instruments, and the mystique that goes into producing them is excruciatingly difficult to explain. For now, with the intended scope of this paper in mind, I must settle with a quote from Keith Hill, from which we must suppose that even if one were to follow Pablo Nassarre's proportions to a tee, the instrument is nothing more than a fancy piece of furniture, if not every subsequent action after initial design intuitively reinforces an original, refined sense of beauty in sound, which is the principle objective of the form in the first place:

> "It is not enough for an instrument maker to dimension a piece of wood or metal as if making a piece of furniture and then consider the job done. On the contrary, this is where the job begins! If you expect more from a musical instrument than the capability of merely producing a pitch, then musical instrument making begins where furniture making ends."[99]

Just as in martial arts, or chess, for that matter, a single strike or move does little if not followed up with combinations and greater strategy.

This strategy begins with the more practical side of the methods explored in chapter 2, a practicality made possible by the facility and confidence imparted by what I have come to call "principled freedom." For example, it is possible to confidently design an acoustically sound model of an instrument made to fit a musician's body exactly. A violinist might say, "I want first position to feel no bigger than this," showing the spread of his/her left hand, and from this piece of information alone, the maker can gather all the appropriate proportions of the instrument. A cellist might say, "A string length within this range is okay, as long as the lower bout doesn't make the instrument difficult for me to hold." The maker can measure the maximum distance to be held between the legs and figure out a successfully compromised design.

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99 Keith Hill, *Treatise on the True Art of Making Musical Instruments: A Practical Guide to the Hidden Craft of Enhancing Sound,* Philganosis Press, 2018, p.55.

Testing the comfort and fit of the bass violin in its early stages, in the air

Whether the maker decides to modify the shape or proportions later on depends largely on intuition, reflecting an entirely spontaneous Taborian approach, as well as the ability to solve problems on the fly, as can be gathered from the *Librem Segreti de Buttegha:*

> "If it [the balance point] does not fall here [below the half way point], it is because you have failed to thickness the plate properly. The differential can be found by trial and error by balancing the plate on a pivot. When you have found this you should make a timely correction to the balance by diminishing the thickness of the plate from the outside and also make the outline of the upper plate smaller."[100]

100 *Librem segreti de buttegha: A Book of Workshop Secrets: The Violin and its Fabrication, in Italy, circa 1725-1790: "phonic rules principles and formulas for the use of luthiers and violin enthusiasts,"* anonymous: 18th century, translated and edited by Andrew Dipper. Minneapolis: Dipper Press, 2013, p.52.

One of the biggest questions implicit throughout my research is: how "should" a maker operate the workshop, as far as to what degree to to vary the models of specific types of instruments, including violin, viola, and bass violin/cello. I have written much about the importance of being adaptable, and able to achieve sonorous results with a wide array of models, befitting their respective appropriateness to the correspondingly varied musical situations and historical schools of instrument building. Nate Tabor's work is an outstanding example of this, as his instruments are predominately made without the use of templates or internal molds. Therefore, they appear to differ greatly, though remain unified by a standard of quality that only Mr. Tabor can speak for, as to how he developed a style and concept of tone as a maker. His output, defined largely by the non-use of molds, benefits from the relatively blinding speed he gains in being able to skip the time and resources spent preparing the model, rapidly hearing the results of contrasting instruments and acoustic experiments.

The "freestyle" construction of our bass violin directly on the back, without using an internal mold

A Coruña, 2017

However, what does this speedy maximization of versatility have to say about personal progression and refinement of specific models? On the other hand, making the "same" model over and over, making slight changes and improvements, would logically result in the gradual perfection of that model, and the concept of tone originally conceived with it. In other words, should a "baroque instrument maker" focus on imitating all the styles of different makers throughout history, in order to meet the demands of all of today's customers? Or, should this maker focus mainly on developing a strictly personal style with the intention of perfecting that style, thus drawing a specific clientèle who prefers that style of instrument? Assuming the latter, should it therefore be up to every individual maker to work towards achieving each their own version of the "perfect" instrument, and is there any such thing?

The answer to these questions is highly complex and it is probable that both approaches were taken historically, of course with much overlap. It is interesting to note that the ease of assembly and mechanical consistency provided with the use of internal molds, along with their harmonically conceived form, may very well be ironically responsible for the loss of the knowledge on how they were originally created. Dirk Jacob Hamoen supposes that the use of full sized templates and molds, probably allowed the Cremonese workshops of Amati and Stradivari to operate in a much more factory-like manner than we are usually willing to admit.[101] The assembly of the violins could be delegated to apprentices, who would easily be able to execute most preliminary tasks, but who may not have necessarily understood the concept behind the forms. Hamoen accordingly states, "One also gets the impression that not everything was taught to all pupils."[102] Could it be that this is a contributing reason why the instruments of the Cremonese makers are by far the most copied and fetishized, yet still the most mystifying today? I am certain that my thoughts and

101 See Hamoen, "Forum."
102 Ibid.

opinions regarding this issue will ferment and mature throughout my career as I gain practical experience, although more definitive notions may very well take more than one lifetime to figure out.

Speaking of things that take more than a lifetime to figure out, the actions that one takes in every step after constructing the form are personal, mysterious, and beyond the scope of a single paper in respect to how the sound quality of the instruments may be maximized to equal or even surpass those made by the old masters. Keith Hill has attempted to document the many details of this art, putting his experiences into writing with his recent publication of *Treatise on the True Art of Making Musical Instruments, A Practical Guide to the Hidden Craft of Enhancing Sound.* It is up to younger makers like myself to try to implement this knowledge, and synthesize our own working methods by heeding the advice of Hill and other experienced makers who have thought and written extensively about capturing infinitely valuable past mindsets and past visions of the universe, and most importantly, have shown they are able to "walk the talk" through their own instruments.

My present search comes to rest in suspense with the following quote by Luc Breton:

> "Tout musicien sait que les différentes parties d'un instrument remplissent des fonctions particulières, un peu à la manière des organes dans le corps humain. Ainsi, dans le jeu du luth, la main droite attaque les cordes entre la rosace et le chevalet, tandis que la main gauche raccourcit la longueur vibrante des cordes en prenant appui avec le pouce sur la coulisse du manche: aux deux mains correspondent ainsi deux parties distinctes de l'instrument. Et ne parle-ton pas de la tête et du corps d'un violon ou d'un luth? En

> anglais, le manche s'appelle neck, le chevalet, bridge. Les exemples pourraient être multipliés qui démontrent que ces dénominations n'existent guère sans analogie avec autre chose, dont il reste à définir les caractéristiques."[103]

The perfect correspondence between the functions of the instrument and the functions of the human body should provide us with an important clue about what musical instruments really are, and what their underlying purpose is. Far beyond pieces of dead wood, an instrument is an interface between the human and the universal: a medium through which we can express, translated into the human terms of experience, emotion, and affect, the infinity of the cosmos, or "higher world of knowledge which comprehends mankind but which mankind cannot comprehend."[104] This transcendent quality is fitting, for an object whose physical form is constructed to encapsulate the metaphysical structure of sound, the fabric of the universe itself.

As with each passing day our civilization seems to move closer to the edge of an abyssal precipice, I must readily admit that much of the motivation behind my research, stems from a desire for the knowledge of how to create musical instruments in their complete form, from scratch, assuming the sudden disappearance of all my resources and references due to a catastrophic event. History has already demonstrated how thin this thread already is. Knowledge, when applied, shared, and preserved in objects that will probably survive long after I am gone, is something that nothing or nobody can take away. Something like instrument making, no matter how marginal it may seem among even the most dire circumstances, would have served as a stoic exercise in the human capacity to overcome great obstacles against all odds, as well as give great hope to our future, based on the wisdom that comes from studying our past. The recent burning of Notre-Dame de Paris shows how important this

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103 Luc Breton, "À propos du tracé directeur de l'instrument à corde," *Cahiers d'ethnomusicologie* 2 (1989): p.217.

104 See notes 42 and 43, p.29.

preservation is, especially as the loss of know-how over time means that our achievements are becoming increasingly irreplaceable. If an object, or the knowledge of what that object is and how to make it isn't intended to survive, then what is its value at all?

Although the following excerpt from an interview about Notre-Dame was probably meant to be taken more literally, its parallels to music, instruments and the craft of lutherie are intense, numerous, and purposeful, closing the current discussion and giving me substantial food for thought as I continue my journey within the making mind:

> "When a place is no more—or, as we've seen, chunks of that physical site have been destroyed—it becomes a kind of anthropomorphic feeling, as though we lost that part of ourselves: a loss of body parts, to put it bluntly. It's almost as though we're losing part of who we are, if we see ourselves as the French people, primarily. Then, move from that to all the people of the world who have seen that place or know of that place through images or through stories. A loss of something physical relates to how we understand the world.
>
> That connection is really an eternal question: What is it that that physical object does to us that is so powerful? It's much more elaborate when something is destroyed. We do feel a sense of loss, a loss for the physical thing, but more importantly a loss of the symbol that it represents and the part of ourselves in which our memories have been invested. That thing no longer exists. And so, where are our memories?"[105]

105 Shelley Hornstein, "Why the Notre Dame fire is a loss of collective memory," interview by Emily Moon, *Pacific Standard*, April 17, 2019.

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