Chapter Three
Travels and Transformations:
Biographies of American Gamelan Tunings

[When it came time to tune Gamelan Son of Lion], I really liked the idea of no two sets of instruments sounding the same. And I was not a disciple of Harry Partch. He made some great musical furniture and stuff, but the whole "just intonation" thing never struck home for me.¹

Introduction

Just as Benary and Schmidt took different approaches in designing and building their respective gamelan instruments, they also took divergent approaches to tuning them. Indonesian gamelan tunings have long perplexed ethnomusicologists, music theorists, composers, and audiences alike, and they remain a subject of great interest and debate for many. Much of this fascination stems from the variation between gamelan intonations in terms of both their absolute pitch and the interval sizes within each lara (scale).

Throughout the twentieth century several studies sought to unravel perceived mysteries of lara pelog and lara slendro, often by analyzing the interval sizes found in various gamelan and inferring a standard reference.²

This common approach to thinking about gamelan tunings, however, is

¹ Barbara Benary, interview with the author, April 2, 2015.
notably detached from Javanese discourses about tuning, which usually evaluate interval size by feeling and musical context as opposed to a standardized theoretical framework based on numerical tone measurements. In light of this incongruity in the literature, ethnomusicologist Roger Vetter convincingly argues for the consideration of pelog and slendro as "models" as opposed to "scales" in the Western sense, thereby leaving space for all of the extant variations of pelog and slendro while decentering those variations as the object of study. This way of thinking about pelog and slendro considers each gamelan to be exhibiting one possible "realization" of those models, and raises new questions about the tuners themselves.3

Even as scholarly understandings of gamelan scales changed, the fact of gamelan's intonation diversity still constitutes a substantial conundrum for American composers working cross-culturally. In his writing about what he termed "Slippery Slendro," Lou Harrison expressed his own paradoxical feelings on the issue: "This is a liberating and fascinating doctrine which, in its turn, brings up terrifying problems for a composer hoping that his own interval expression might be observed."4 Many American composers for gamelan composed their works with specific interval sizes in mind, generally in reference to a specific tuning that they anticipated would sound the piece. These compositional intentions would be thwarted, however, if any attempt

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was made to transfer such a composition to another gamelan.\(^5\) This complication influenced both the ways American instrument builders tuned their gamelan as well as how composers wrote music for gamelan.

When choosing their Javanese-inspired scales, Benary and Schmidt found themselves working within a complex of tuning questions stemming from Euro-American discourses as well as Javanese examples and practices. They admittedly operated with limited knowledge about how tuning is approached in Java, and they had few examples from which to formulate their own tunings. As Schmidt recalls, he and Harrison only had Gamelan Khyai Udan Mas at UC Berkeley as a readily available example. Characterizing their early efforts Schmidt quipped: "We didn't have a good system of going up to a gamelan and measuring its tuning. I mean we were screwing around; it was the dark ages of American gamelan!"\(^6\) In addition to their limited knowledge, Benary, Schmidt, and other American gamelan tuners had to contend with the contexts in which their tunings would be played. Similar to their instruments' physical design, their respective tunings reflect their gamelan's purposes as well as their personal interests, tastes, and imaginations; if the gamelan was meant to play with equal tempered

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\(^5\) In 2016 I participated in a performance of Daniel Goode's *Western Sieve* (2014) for piano and gamelan ensemble at UC Santa Cruz in celebration of that composer's eightieth birthday. In this piece the piano plays a series of cadences in the style of Anton Bruckner, interpolated by gamelan imitations of those cadences while the players sing the word "capitalism" in unison. At the dress rehearsal Goode was surprised by the difference in intonation between the UCSC gamelan and that of Gamelan Son of Lion, for which the piece was composed. Since the interval sizes and absolute pitch differed so dramatically, the imitative quality of the gamelan cadences did not reflect those of the piano in the manner Goode envisioned.

\(^6\) Daniel Schmidt, interview with the author, February 7, 2018.
instruments, for example, that would need to be addressed somehow in the
gamelan's tuning.

Benary the ethnomusicologist and leader of a university's world music
ensemble didn't anticipate such a need. She accordingly "copied" her tuning
from a recording of a Javanese built gamelan, acquiring much of its
intonational character, or *embarat* as it is called in Central Java. Schmidt,
thinking primarily as a composer and instrument builder, found his solution
by way of the practice of just intonation.7 Both composers' creations may be
heard as realizations of the pelog and slendro models, even though they came
about through divergent methods. In an important study of Central Javanese
gamelan tunings led by Wasito Surjodiningrat at Gadjah Mada University,
multiple well-regarded gamelan tunings were measured and compared
showing much of the diversity possible as well as common features. This
monograph circulated widely throughout the United States in the late 1970s
and 1980s, and Benary, Schmidt, and other Americans consulted it regarding
their gamelan tuning practices. The average tone measures as well as the
range of possibilities documented in this study demonstrate the adherence of
Benary and Schmidt's tunings to these Central Javanese models, though
neither perfectly matches any one example presented in the study.8 Over time

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7 Just intonation, sometimes referred to as "rational" tuning, may be defined as "any system of
tuning in which all of the intervals can be represented by whole-number frequency ratios,
with a strongly implied preference for the simplest ratios compatible with a given musical
purpose." David Doty, *The Just Intonation Primer* (San Francisco, Just Intonation Network,

8 See Wasito Surjodiningrat, et al., *Tone Measurements of Outstanding Javanese Gamelan in
each of these tunings gradually changed by various means as the instruments aged and other tuners altered the intonation. With each such change these tunings gathered new meanings within their respective communities and transformed in ways that are sometimes subtle, and other times radical. Their trajectories constitute a fascinating site in which some of the complex processes and mechanisms of gamelan's internationalization are partially revealed.

Towards a Biographical Approach to Gamelan Tunings

In this chapter I focus less on the technical elements of tuning and intonation, instead pursuing a biographical approach that traces changes to each gamelan tuning. In choosing this approach I aim to highlight the implicit ideas behind the tunings, the various transformations to them, and their transferences to other contexts. As archeologists Chris Gosden and Yvonne Marshall have argued, "as people and objects gather time, movement and change, they are constantly transformed, and these transformations of person and object are tied up with each other." Though tunings are not "objects" in the physical sense, their intangible affective qualities are certainly perceptible, and humans may interact with them reciprocally influencing the tuning and being influenced by it. It is possible to document changes in each tuning’s forms and uses over time, and doing so in the context of the North American gamelan subculture demonstrates how competing ideas about tuning shaped

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its sonic landscape. Using biography as my principal metaphor, I trace the histories of the Gamelan Son of Lion tuning (hereafter referred to with the shorthand Lion Tuning) and the Berkeley Gamelan tuning (hereafter Berkeley Tuning) as they gradually changed over the last four decades. By focusing on the reasons for and actors behind these changes, I show how new ideas became entangled with each tuning, resulting in new forms, meanings, and musical contexts.

This approach to writing about tuning, though unusual, is not without some precedent. Ethnomusicologist Marc Perlman demonstrates how particular tuning practices carry with them their cultural heritage by examining the place of just intonation in American-made gamelan instruments. Perlman deftly locates just intonation within Euro-American theoretical discourses spanning millennia. He refers to this expansive discursive network as "intonational naturalism" for the historical prevalence of mimetic narratives linking just tunings to both nature itself and "natural" human perception, rather than considering it to be culturally constituted. Just intonation reemerged with new vigor among American experimental composers in the twentieth century, bringing with it the discourses of

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10 I have adopted these short hand forms for the tunings and use them as proper names reflecting my biographical approach. I chose "Lion Tuning" drawing on Nick Didkovsky’s usage discussed later in this chapter, and Berkeley Tuning mirroring the way Schmidt referred to it in our conversations.


12 Composer and proponent of just intonation David Doty, for example, claims that just intonation "transcends the musical practices of any particular culture," though the vast majority of historical documents on the subject are from European sources. Doty, The Just Intonation Primer, 2.
intonational naturalism. Perlman contrasts this discursive history with how tuning is conceptualized and practiced in Central Java, specifically in relation to the notion of embat, which is often translated as "intervallic structure," but has deeper associations than that technical description implies. Perlman’s gamelan teacher Suhardi, for example, describes embat as a highly individual, inalienable personal attribute of both gamelan ensembles and, in a very different but interrelated way, human beings. Perlman’s article shows in great detail a particular subset of North American gamelan subculture that composer Jarrad Powell succinctly summarized: "Gamelan tunings are fascinating, partly because they’re irrational in a way. We [Westerners] naturally want to rationalize them, but that’s not how the Javanese seem to think of it." In other words, American understandings of Javanese tuning practices are framed through another, high-powered cultural lens. As those understandings change, so do the tunings.

Perlman’s approach to writing about tuning centers the discourses encircling intonation as opposed to the mathematical and analytical

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13 Mostly following the lead of composer-instrument builder Harry Partch, many composers like Henry Cowell, David Doty, Ellen Fullman, Lou Harrison, Ben Johnston, Pauline Oliveros, Larry Polansky, Terry Riley, Henry Rosenthal, and James Tenney, among others are prominent twentieth century figures who have worked extensively—or exclusively—in just intonation.


15 Joan Suyenaga, another student of Suhardi’s, explained to me Suhardi’s tendency to retune his gender once a month for performances with singers because his preferred tuning was incongruent with the singers’ embat. Suyenaga described the half-moon shaped gaps on the ends of the keys where they had been filed away over the course of years of regularly retuning. Joan Suyenaga, personal communication, August 18, 2017.

16 Jarrad Powell, interview with the author, February 6, 2018.
approaches taken by most scholars prior to his article. His deep investigation
of the ideological underpinnings of specific tuning methods reveals how
those ideologies become inscribed into musical instruments, further showing
how scholars might be able to read those meanings at a deeper level than is
revealed by tone measurements alone. His approach is all the more intriguing
given the flexibility of slendro and pelog as a system of tuning. As Larry
Polansky et al. have observed:

Tuning systems are neither static nor rigid. Although most musical
cultures need some agreed-upon standard for musicians to tune their
instruments and sing to, tuning systems evolve and fluctuate over time
and in space (i.e., historically and geographically) and vary stylistically
within musical practice.17

Roger Vetter's suggestion to consider gamelan tunings as "realizations" of an
inherited model reinforces this definition of tuning systems. But one might go
a step further and consider how one specific tuning has changed over the
course of its existence. What might be revealed by closely examining how and
why changes to a given tuning occurred? How do musicians respond to such
changes?

Considering a given tuning to be a single entity in spite of changes to
its intervallic structure may seem eccentric to those anticipating a more
technical approach. Conventional wisdom would sooner dismiss such
changes in intonation as the instruments "going out of tune." But even that
view reflects a particular cultural attitude that seeks to prevent such changes.

17 Larry Polansky, Daniel Rockmore, Micah K. Johnson, Douglas Repetto, and Wei Pan, "A
Mathematical Model for Optimal Tuning Systems," Perspectives of New Music 47, No. 1
(Winter, 2009): 70.
The reality of the tunings discussed in this chapter is that they were allowed to change, and these changes occurred for specific reasons that reflect the complex intercultural context that produced them. Considering tunings in this fluid way has a number of concrete advantages in the present study, namely in revealing otherwise undetectable aspects of each gamelan’s story and the attitudes of the communities that use them. Anthropologist Igor Kopytoff and others have argued for this kind biographical documentation of specific objects. Kopytoff stands out for his proposition that this approach may be particularly fruitful in studying cross-cultural encounters. Kopytoff proposes:

Biographies of things can make salient what might otherwise remain obscure. For example, in situations of cultural contact, they can show what anthropologists have so often stressed: that what is significant about the adoption of alien objects—as of alien ideas—is not the fact that they are adopted, but the way they are culturally redefined and put to use.

Historian Q. Edward Wang demonstrates the tenacity of this approach in his cultural history of chopsticks. Wang traces the travels of these utensils around the globe and the ways in which their forms, uses, and meanings have transformed due to the different material, culinary, and social contexts of the

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various cultures that have adopted them. He also demonstrates how chopsticks in turn changed the culinary tendencies of those cultures. Similarly, by tracing individual American gamelan tunings and accounting for the people, ideas, music, and instruments that contributed to their life stories this chapter seeks to expose the process by which gamelan tunings were adopted, imagined, and transformed by the particular settings in which they operated and how they resonated within those contexts. Such an approach seeks to expose some of the underpinnings of the musical and cultural syncretism of the North American gamelan subculture and its often-unexpected twists and turns that would otherwise remain hidden.

The Origins and Trajectories of "Lion Tuning"

Benary tuned her instruments by referencing a commercially available recording of a Central Javanese gamelan. By doing so she connected her gamelan instruments with an existing ensemble, albeit in a mediated fashion. This kind of practice occurs in Java as well, particularly in reference to well-regarded or famous sets of instruments. In tuning Roger Vetter’s gamelan, for example, the gamelan tuner Raden Riyo Mangkuasmara began with a recording of the gamelan used at Radio Republic Indonesia (RRI) as an initial point of reference. Mangkuasmara soon set the recording aside, however, after choosing a suitable gong ageng and a compatible pitch 6. He then tuned the rest of the instruments without further referencing the recording. Benary,

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on the other hand, was not yet an experienced gamelan tuner and relied more heavily on the recording she chose throughout the process of tuning her instruments. She recalls:

For Son of Lion we tuned first with an album made by Khyai Mendung, the UCLA gamelan that was one of the earliest recordings that was circulating. And I basically got a tuning machine and copied the tuning . . . it was sort of standard Central Javanese tuning.\textsuperscript{21}

Benary doesn’t recall what kind of "tuning machine" she used at the time, but the specific device she used to take her measurements had an effect on the data she used to turn her instruments, and another device would likely have produced different results and thus a different tuning. The additional factors of the taking measurements from a recording, rather than measuring individual instruments in a controlled setting, and the manner in which that recording was made also contribute to the data Benary gathered.

The recording Benary used is \textit{Music of the Venerable Dark Cloud: The Javanese Gamelan Khjai Mendung}.\textsuperscript{22} The choice of this particular tuning and recording is fitting given the intended purpose of Benary’s gamelan. Khyai Mendung was the first gamelan brought to the United States to support Mantle Hood’s vision of bi-musicality, and the key role of those instruments in sparking the American gamelan subculture is significant. This particular recording served as a kind supporting evidence for Hood’s assertion that ethnomusicologists can and should learn to play the music of other cultures. Combined with her instruments’ Javanese design, Benary’s choice of this

\textsuperscript{21} Barbara Benary, interview with the author, April 2, 2015.

\textsuperscript{22} This title uses older mid-twentieth century orthography for transliterating the Javanese language into English, exhibited by "Khjai" instead of "Khyai."
tuning as opposed to one of her own creation further entangles her instruments with ethnomusicological discourses and the context of university world music ensembles. Her aim favored "authentic" representation of Java over her own creative practice. Beyond the academic context imbued by this tuning choice, Khyai Mendung itself has an intricate history that extends into the story Gamelan Son of Lion.

Hood purchased Khyai Mendung in 1958 from an unnamed wealthy Chinese businessman living in Surakarta (commonly called Solo). The appraisal of the instruments at the time of purchase estimated their age to be one hundred and twenty years old, and conflicting reports indicated that the set might be either a copy of one of the gamelan of the Solonese Mangkunegaran palace, or even the actual instruments of that institution. In either case the tuning of these instruments would be highly esteemed in that context. Hood also commissioned additional instruments to be built at the time of purchase to enable the UCLA group to play in either Solonese or Yogyanese styles, probably due to Hardja Susilo's renowned expertise in the latter.

The recording of these instruments that Benary used is itself a meaningful factor in this milieu. This LP marks the first recording of Javanese music as played by American students, making it a prime-supporting document for Hood's concept of bi-musicality. It also became one of the most

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highly circulated recordings of Javanese music available in the United States at the time. This album also incited considerable controversy surrounding the appropriateness of Americans playing and recording Javanese music, and some even raised questions about whether Americans were even capable of playing it at all.\(^\text{24}\) Gamelan Son of Lion’s tuning may be considered an extension of Khyai Mendung’s that is necessarily different because of the change of instruments, but still connected to it historically. Though mediated by the recording technology, playback, as well as human perception and understanding, Benary arrived at the Son of Lion tuning by way of Khyai Mendung, as opposed to another gamelan. Had she used another recording as her model, even of the same instruments, she probably would have arrived at a different tuning. Both the gamelan itself and its mediation were integral to producing Lion Tuning.

Unfortunately no record of the precise tuning Benary derived from that recording is presently available. The closest such surviving document takes the form of a comparative graphic Benary included in a "composers guide" she disseminated in 1976 when the ensemble began focusing on new music, three years after building the instruments. At the suggestion of Philip Corner, Benary sent this guide to John Cage to solicit a new composition for the budding composers’ collective. Benary provided Cage with information about each instrument, the overall range of the ensemble, the preferred

notation systems of the group, and a chart that juxtaposes the pelog and slendro scales with the chromatic scale of twelve-tone equal temperament (which Benary labels "Piano"). Though she omits precise frequency and cents measurements, Benary's graphic provides a fairly good indication of her intonation's deviation from one familiar to Cage.

![Figure 3.1 Gamelan Son of Lion tuning chart in a letter to John Cage. Used with permission of Barbara Benary](image)

A composition by Cage for Gamelan Son of Lion never materialized, though the influence of that composer on others in the ensemble is evident in the works of several Son of Lion composers (see Chapter Four). Cage's influence can also be observed in the next major change that occurred in Son of Lion's tuning. This tuning is already shown to have made a tremendous journey from Mangkunegaran, to UCLA, to the purview of the New York School of composers, and still it continued to transform and acquire new meanings. After several years of performing in New York, the intonation of Son of Lion gradually changed, eventually becoming so noticeable that Benary was compelled to retune the instruments. Remarkably Benary applied

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25 Correspondence from Barbara Benary to John Cage, October 1976, Box: 22, Folder: 8, Sleeve: 15. John Cage Correspondence, Northwestern University Music Library.
a patently different technique than she did when she initially tuned the
gamelan that bears some similarity to both Cage's music philosophy as well
as Javanese tuning practices:

[The Son of Lion tuning] was sort of a standard Central Javanese
tuning [at first]. But then ... I kind of let it drift. These iron
instruments, you bang on 'em long enough, they go out of tune. And
so, finally when I started retuning, instead of going back to the exact
measurements I had started with, I let it drift. I had three saron in three
slightly different tunings, so I just picked the one I liked best and
tuned 'em all to that one. I've never been inspired to try and make
them any more uniform than that.26

Benary's acceptance of the natural changes of her gamelan's materials is
striking compared with other composers like Lou Harrison, who chose their
tunings quite carefully. In choosing to re-tune the instruments in this manner,
Benary placed her tastes in collaboration with the incidental changes of the
physical instruments, rather than asserting her own ideas about what the
tuning should be.

This method of tuning a gamelan is reminiscent of the procedure of
tuning practiced in Central Java. Following the initial forging and tuning of
the gamelan, the intonation of the instruments soon begins to shift over a
period of several years due to the natural aging of bronze after it is forged.27
During this gradual process, each bronze component of the gamelan changes
its pitch independently of the others, though all tones generally rise in
frequency because the metal cools and becomes denser. Eventually the set
must be retuned, at which point a new interpretation of the pelog and slendro

26 Benary, interview with the author, April 2, 2015.

27 Roger Vetter, "A Retrospect on a Century of Gamelan Tone Measurements,"
*Ethnomusicology* 33, No. 2 (Spring–Summer, 1989): 220.
models may be introduced, either by the same tuner or a different individual. The new tuning will often come about in regards to the general tessitura to which the tuning drifted, as opposed to simply retuning the instruments to the original intervallic structure and range.\textsuperscript{28} Though Benary’s instruments are made out of hot rolled steel instead of bronze, she experienced a comparable kind of settling process and used a similar technique to retune the instruments.

In the context of Benary’s retuning endeavor, one is also reminded of Cage’s sentiment that, “tuning is another form of government,” reflecting his personal affinity for the writings of Henry David Thoreau as well as Cage’s own ideas about indeterminacy in music.\textsuperscript{29} This choice of tuning method could be interpreted as Benary’s response to the contemporaneous Cagean ethos of accepting sounds outside of the composers control and admitting them into musical performance.\textsuperscript{30} Such attitudes pervaded the New York music scene in the 1970s and 1980s, though it is remarkable to find them manifested in a gamelan tuning. Both Cagean readings of Benary’s action situate it within discourses of New York experimentalism that were already shaping Gamelan Son of Lion in other ways by this time (see Chapter Four).


\textsuperscript{30} Cage’s now famous ideas about sound spread most widely due to the publication of his book \textit{Silence} in the early 1960s, though the ideas emerged much earlier than that, and the book’s resonance continues to grow. See John Cage, \textit{Silence: Lectures and Writings} (Middletown, CT: Wesleyan University Press, 1961).
Despite the drifting of its tones, the tuning of Gamelan Son of Lion didn’t change enough to move it outside the models of the pelog and slendro scales. The intervals sizes drifted somewhat, and the tessitura sharpened noticeably—as would be expected—but overall the intonation remained within the range expectations indicated by the Gadjah Mada study. Benary also maintained Son of Lion’s tumbuk 6, as well as the uniform 5¢ octave stretch. Using the "Composers' Guide" Benary sent to Cage as a model, I created a tuning chart shown in Figure 3.2 that shows the drift of the tuning from 1976, when she sent that guide to Cage, to the new tuning as it appeared in an updated "Composers' Guide" on the Gamelan Son of Lion webpage in 2016.31 Since the new guide does include cents deviations, I label them here for reference. Admittedly, the 1976 tuning is an approximation of Benary’s tuning, but this comparison still shows how much the tuning drifted, marking the contribution of the physical materials to the tuning’s character. This chart also highlights the coincidences and near coincidences between the slendro/pelog pairs, as well as those between the gamelan scales and the chromatic scale (labeled 12tet, for 12-tone equal temperament), which are important to composers seeking to combine the gamelan with equal tempered instruments.32

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32 My sincerest thanks are owed to Erik LaDue who spent considerable time with me to create this graphic.
Son of Lion Tuning Drift
Demung Octave

Key:
Coincidences: _ _ _ _ _ _
Near Coincidences: _ _ _ _ _ _
The new tuning expressed in this graphic has remained relatively stable from Benary's retuning efforts to the present, though Benary mentioned her desire to retune them again during our conversations. The difference between these tunings is subtle, but perceptible when one compares commercially available Gamelan Son of Lion recordings. The 1979 Smithsonian LP, *Gamelan in the New World*, as well as the 1984 New Wilderness Audiographics cassettes are some of the earliest records of the Gamelan's tuning. By 1995 when Son of Lion released its first compact disc recording, *New Gamelan/New York* the drifted tuning is plainly evident. It is worth reiterating that Gamelan Son of Lion was the first and only active Javanese-style gamelan ensemble to perform in New York City, thereby providing the only live sonic examples of pelog and slendro in that city for several years. This situation continued until Deena Burton (1948–2005), founder of the Bali-Java Dance Theater and frequent Gamelan Son of Lion collaborator, encouraged the Indonesian consulate in New York to sponsor a new gamelan group using the instruments already residing there because of the 1964 World's Fair. Led by artistic director I.M Harjito, who also directs the Wesleyan gamelan ensemble, Gamelan Kusuma Laras has focused on the performance of Central Javanese karawitan since its founding in 1983.

Kusuma Laras' location on East 141 Street, however, is still distant from the

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33 In fact the ensemble doesn't use two of its saron instruments because their tuning is thought to be too far deviated from that of the rest of the instruments in the ensemble.

downtown community where Son of Lion chiefly operates, and Gamelan Son of Lion’s tuning had a distinct resonance in the new music scene, eventually transcending the instruments and taking on new forms altogether.

One composer affiliated with Gamelan Son of Lion found the tuning of the instruments particularly appealing, and devised a way to use it in his non-gamelan music. Nick Didkovsky (b. 1958) is not generally known for his work with gamelan, though he played with Gamelan Son of Lion from 1984 to 1991. Didkovsky is best known as a composer and guitarist, and he is also the leader of the experimental rock band Doctor Nerve, which he founded in 1983. He is also known for his work with computer-assisted composition, especially as the creator of Java Music Specification Language (JMSL) in 1997. During his time playing with Gamelan Son of Lion, Didkovsky became interested in the instruments’ tuning, which eventually played a surprising role in the creation of JMSL. JMSL is "a Java Application Program Interface (API) for music composition, interactive performance, and intelligent instrument design." The program uses the Java programming language, and its overall philosophy, functionality, and data structures is based on the previously developed real-time music performance and composition language "Hierarchical Music Specification Language (HMSL), written in Forth by Phil Burk, Larry Polansky, and David Rosenboom at Mills College in

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the 1980s. In particular, JMSL draws on HMLS’s object-oriented design, and its multi-threading capabilities. Didkovsky’s JMSL is a Java port to HMSL, updating its technology and language from Forth to Java to make it compatible with newer operating systems.

For Didkovsky, the tuning of Benary’s gamelan resonated in such a way that it became his “default” tuning that he uses in many of his compositions, unless he is writing for a specific ensemble that determines another tuning. When programming the tuning interface of JMSL, Didkovsky knew he would personally want to use this tuning in his own compositions and included it in JMSL’s code. He went a step further by using Lion Tuning as a model for one of JMSL’s tuning classes. He explains:

[The Son of Lion tuning] helped to define a tuning class in JMSL, because I needed to have a few basic definitions. I had to have an octave stretch value that’s calculated in there, [for example]. If you can design a template to instantiate the Gamelan Son of Lion tuning, and make that generalizable, you’ve actually addressed a lot of really interesting tuning issues. … [So] you could do some really wacked out pieces [in JMSL] just by playing morphologically with the tunings. And Gamelan Son of Lion’s tuning is the prototype for it.

Because of this design, JMSL users are highly likely to encounter Lion Tuning by virtue of using the programming environment. The abstract tuning class in JMSL has two fully defined subclasses, one of which defaults to 12tet

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36 Phil Burk also helped Didkovsky in creating JMSL. For more information on HMSL, see Larry Polansky, Phil Burk, and David Rosenboom, "HMSL (Hierarchical Music Specification Language): A theoretical Overview," *Perspectives of New Music* 28, No. 2 (1990): 136–178.

37 Nick Didkovsky, interview with the author, December 10, 2015.

38 For more about HMSL and JMSL’s capabilities regarding tuning, see Larry Polansky, "HMSL Intonation Environment," *1/13*, No. 1 (Winter, 1987): 4–15;

39 Didkovsky, interview with the author, December 10, 2015.
(TuningET), and another called "TuningTable" that defaults to Lion Tuning with its 5¢ octave stretch parameter. Users can alternatively assign their own table of frequencies in lieu of the Lion Tuning default.\(^\text{40}\) It is unclear how many composers may have knowingly or unknowingly used this gamelan tuning their JMSL compositions. Those new to JMSL—such as students at New York University where Didkovsky regularly teaches—are especially likely to encounter the tuning through their initial experiments with programming environment.

Didkovsky's computer music that uses "Lion Tuning" often bears no resemblance to gamelan music. His composition *Liminophone* (2009), for example, uses this tuning in a real-time sonification of tidal data collected by the National Oceanic and Atmosphere Administration (NOAA). The interface for this automated composition may be accessed at anytime through an Internet browser that supports Java plug-ins.\(^\text{41}\) The Java code for the composition is printed on the webpage, where the identifier "Lion Tuning" is evident in multiple places. Users can choose from a selection of harbors from which to collect the raw data, and the program reads that information in six-minute windows. The sonification of this data is interpolated every ten seconds within each window. The frequencies within a given window are selected from Lion Tuning, and they gradually morph from the observed water levels to their predicted levels of the next six-minute window. Though

\(^{40}\) Nick Didkovsky, personal communication with the author, April 4, 2018.

rooted in the slendro/pelog scales of a Central Javanese gamelan, nothing about this work’s aesthetics connects it to Central Javanese gamelan music.

When I spoke with Didkovsky about the tuning’s trajectory from Central Java to Benary’s instruments by way of UCLA, he said he was unaware of its intricate history.

That the programming language Didkovsky used for his API shares its name with the place of origin for Lion Tuning is no mere coincidence, but another manifestation of American encounters with Javanese cultural exports. Developed by Sun Microsystems the programming language Java emerged in the early 1990s. A number of different nomenclatures were proposed for this language before the programmers ultimately settled on "Java," a name attributed to developer Chris Warth's penchant for frequent coffee drinking.42

As Henry Spiller notes, coffee’s association with the island of Java dates back to mid-nineteenth century in the United States. Despite Javanese coffee's relatively small share of market representation when coffee was becoming a popular beverage, it still became synonymous with the word "Java."43 Spiller notes how exaggerated depictions of an impossibly far away culture were deployed to market coffee products, helping to shape some of the earliest American imaginings of life in Java. The coupling of Java and coffee continued well into the twentieth-century and eventually became the name of

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the computer language. Lion tuning is notable among American gamelan tunings for its roots in a Javanese tuning, but most other gamelan tunings arrived at slendro and pelog by other means. Unlike Lion Tuning, Schmidt’s tuning for the Berkeley Gamelan did not originate in Java, but rather is firmly rooted in European tuning theory. Since it is initial formulation, however, the Berkeley Tuning has also encountered Javanese tuning models in fascinating ways that illustrate other interesting facets of the North American gamelan subculture.

**Tuning in Dialogues: The Story of the Berkeley Tuning**

Schmidt’s interest in just intonation is rooted in a broader movement that began in the mid-twentieth century. The American composer Harry Partch (1901–1974) is among the most prominent twentieth-century composers to champion this method of tuning. Partch devised a 43-tone-to-the-octave tuning system from which he could derive numerous compositional, harmonic, and scalar subsets. He invented and modified numerous instruments capable of playing his music that used these tunings, such as the *chromelodeon* (modified reed organ) and *diamond marimba* (wooden idiophone with keys arranged in the shape of a time). Partch’s book *Genesis of a Music* (1949) was extremely important to a generation of younger

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44 The extensively recorded popular song *Java Jive* (1940) written by Ben Oakland and Milton Drake, for example, begins with the phrase “I love coffee, I love tea.”
composers, particularly regarding its extensive discussions of tuning theory and practice, especially just intonation.⁴⁵

The composers Lou Harrison and Ben Johnston credit *Genesis of a Music* as the source of their initial interest in rational tunings.⁴⁶ Harrison began writing pieces in just intonation in the 1950s, beginning with *Four Strict Songs for Eight Baritones and Orchestra* (1954). More than twenty years later, Harrison tuned all of his gamelan instruments justly as well.⁴⁷ Harrison and Schmidt developed their just gamelan tunings in conversation with each other, often at the semi-regular brunches Harrison coordinated, beginning in 1975, in which gamelan building was the primary topic of discussion. These informal gatherings took place on a monthly basis, sometimes in the Bay Area, where most of the participants lived, and sometimes in Aptos, California where Harrison and Colvig lived. A regular attendee of the gamelan brunches, Schmidt described them as a "think tank" of gamelan building with each person taking his or her own approaches while benefiting from the collective knowledge exchanged.⁴⁸ In addition to instrument building, just intonation figured prominently in these discussions. Several new creations emerged from these brunches, include Doty and Rosenthal's "American gamelan" used by the Other Music group—itself using a 14-tone-

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to-the-octave just scale dubbed OMJ14—and Garry Kvistad's first set of wind chimes tuned to a Greek pentatonic scale he calls the "Chime of Olympos" [sic].

Schmidt believes his Berkeley Tuning is the first just gamelan tuning to surface from these dialogues. Schmidt describes a long-standing disagreement between him and Harrison with regard to the best approach to creating rational tuning for gamelan instruments, and each builder ultimately chose their own solution. Schmidt formulated the idea of creating slendro and pelog scales by using consecutive harmonics of a given fundamental. Using a 60 Hz (cycles per second) gong as a reference, he built his pelog scale starting on the 10th harmonic, skipping only the 13th and 17th partials in order to create the 7-tone scale—harmonics 10, 11, 12, 14, 15, 16, 18 correlate to the scale degrees 1, 2, 3, 4, 5, 6, 7 of pelog. Schmidt then derived the slendro scale by referencing a 40 Hz fundamental—a perfect fifth down from the 60 Hz gong—and began the scale on the 14th harmonic—14, 16, 18, 21, 24 correlating to 1, 2, 3, 5, 6 of slendro. Though this latter scale seems to deviate greatly from the idea of consecutive harmonics posited by Schmidt, he invokes the notion of octave equivalency by noting that the first three tones can be

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49 Kvistad later created a large-scale business in Woodstock, New York constructing, tuning, and selling such chimes that are now common yard features in many American households. See Garry Kvistad, "Woodstock Chimes," accessed February 23, 2018 https://www.chimes.com/?gclid=EAIaIQobChMIgMr_maa92QIVjXt-Ch3GFQI6EAAAYASAAEgLQ2PD_BwE.

50 These harmonics are expressed as their absolute ratio relative to the fundamental. Their adjacent ratios showing their interval sizes relative to one another are: 11:10, 12:11, 7:6, 15:14, 16:15, 9:8.

viewed as octave transpositions of harmonics that are consecutive—14, 16, 18, transposed an octave down, becomes 7, 8, 9. Figure 3.3 shows a tuning chart created by Schmidt representing the Berkeley Tuning. This chart shows the intervals represented as ratios, as well as cents deviations from equal tempered pitches. Schmidt also provides absolute frequency measurements in Hz to the left of the scale degrees, and includes some non-stepwise interval ratios to the right. Both scales are arranged vertically, with the slendro scale occupying the left side of the chart and the pelog situated to the right side.
Figure 3.3 Berkeley Gamelan tuning chart. Used with permission of Daniel Schmidt
Schmidt's solution to finding slendro and pelog in the harmonic series created a gamelan tuning with three tumbuk tones, on pitch 6, pitch 3, as well as the coincidence between pelog 4 and slendro 5. The first gamelan to use this tuning was built collaboratively by Schmidt and Paul Dresher in 1976; just one year after Harrison began coordinating the brunch events. This first iteration of the Berkeley Gamelan was used for a performance at Harrison’s birthday concert in 1977, after which Schmidt developed his new designs discussed in the previous chapter. The 1976 version of the Berkeley gamelan made use of only one frame per instrument, as opposed to one frame for each scale, so keys had to be swapped out in order to change from one scale to another during performance. The extra tumbuk tones helped to mitigate the tedium of this process, but Schmidt eventually built additional cases anyway.

With the Berkeley Tuning already in his ear, Harrison worked to develop his own gamelan tuning for his own purposes, eventually completing his first set, Gamelan Si Betty, with William Colvig in 1979. Schmidt encouraged Harrison to simply follow his idea of consecutive harmonics, but Harrison chose not to use Schmidt's tuning for his own creative reasons. Well before he started building his Javanese-style gamelan instruments, Harrison had already theorized forty-six slendro-type scales in his Music Primer first published in 1971. At the time, Harrison used the word "slendro" as a generic term for 5-tone anhemitonic pentatonic scales, and

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52 A photograph of these instruments is included with the liner notes for, Daniel Schmidt "In My Arms, Many Flowers," perf. The Berkeley Gamelan, Recital Program, R17, 2016.

53 Because of this feature, this gamelan would be incapable of performing Ingram Marshall’s Woodstone despite having the same tuning.
many of the scales he includes in the primer do not exhibit other important characteristics of slendro.\textsuperscript{54} Interestingly, the slendro scale Harrison used for Si Betty is absent from this collection, but the Berkeley Gamelan slendro does appear. The difference between Harrison and Schmidt’s slendro scales is the placement of a single tone, slendro 2. Whereas Schmidt’s slendro begins with an 8:7 followed by a 9:8, Harrison’s tuning features the reverse. All the other intervals of the scales are identical, except for their absolute pitch.\textsuperscript{55} This difference is similar to the dichotomy in just intonation in which the interval between the fundamental and a 5:4 major third (scale degree 2) may be divided by either a 10:9 or 9:8 major second without disturbing the quality of the 5:4. The pelog scales differ more substantially from one another, and also mark a point of greater contention between the two composers. Schmidt recalls the moment he first learned of Harrison’s chosen pelog:

Lou called me up out of the blue one day and he says: ”I’ve got it! It’s a 14–17,” and I said ‘okay,’ trying to be polite, but I didn’t know what he was talking about at the time. So I took it back to my monochord and I played the scale, and he’s got his [pelog] 4 on G-sharp, and his 5 at A, his 6 at A-sharp, and his 1 at D, so therefore, he had [something that he liked].\textsuperscript{56}

Harrison’s choice of pelog features two segments of consecutive harmonics—12, 13, 14 and 17, 18, 19, 21—with a wide gap in the middle, marked by the 14–17 that Harrison noted as key in his phone call to Schmidt.


\textsuperscript{55} Schmidt’s latest instruments use Harrison’s tunings in accordance with the commission from Mills College, but he devised a way to lower the frequency of slendro 2 by affixing a screw to the end of the bar, effectively changing the instruments to his slendro.

\textsuperscript{56} Schmidt, interview with the author, February 7, 2018.
Harrison credits Pak Cokro with the final decision to use this tuning, claiming Cokro "chose the tuning out of several [because] it would be good to sing with." Figure 3.4 features a chart showing Harrison's gamelan tuning that Schmidt created in the same style as his own Berkeley Tuning chart in Figure 3.3. Schmidt credits Harrison and Larry Polansky for the data used to create this chart. Harrison and Colvig used the scales shown here for the Mills College Gamelan, which overlap somewhat with those used for Si Betty. The pelog scale of the Mills College Gamelan, known as Si Madeleine, is the same as that of Si Betty, but the slendro tuning of the Mills instruments, known as Si Darius, is different. According to Miller and Lieberman, Harrison sensed the Si Betty slendro to be "quite abnormal," and sought another solution for the Mills College Gamelan.  

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Figure 3.4 Mills College Gamelan tuning chart created by Daniel Schmidt. Used with permission of Daniel Schmidt.
Harrison’s pelog indicates an attempt to use Schmidt’s concept of consecutive harmonics—also known as *superparticular* ratios, which Harrison and Colvig were highly interested in—but with the additional aim of creating a tuning more compatible with the Western instruments that feature prominently in his work for gamelan.59 Schmidt, however, felt that by choosing the pelog tuning around this parameter, Harrison inadvertently sacrificed the quality of his tuning. Schmidt explains:

Now [Lou] wanted to get his tuning as close to Western tuning as possible, [in order] to combine it with Western instruments, and I was trying to diplomatically figure out how I could say to him that for that pelog I thought he should forsake the consecutive harmonics that I had used. By his standard of matching Western pitches, he was not going to get a good pelog.60

Schmidt’s personal tastes not withstanding, Harrison’s pelog features mostly *superparticular* ratios in a clear nod to Schmidt’s approach, as well as four coincidences with twelve-tone equal temperament. Schmidt’s primary critique of Harrison’s pelog lies with the markedly wide interval between pelog 3 and pelog 4 that skips over the 15th and 16th harmonics, the latter of which marks an octave of the tuning’s fundamental. The high number of coincidences between the chromatic scale and Harrison’s tuning serve as anchors for musicians playing on Western instruments, which Harrison often integrated into his gamelan compositions. In designing his own tuning, Schmidt didn’t prioritize such instrumental pairings and relatively few of his


60 Schmidt, interview with the author, February 7, 2018.
works use non-gamelan instruments.\textsuperscript{61} The only near coincidence between Schmidt’s tuning and the 12tet chromatic scale is his pelog 2 (E+1.9c). Though emerging around the same time, Schmidt and Harrison’s respective just gamelan tunings show how the concerns of the builders manifested in their different tunings. Like Lion Tuning, the Berkeley Tuning continued to transform beyond Schmidt’s initial creation of it.

In 1980, Schmidt returned to the United States after his Berlin residency, bringing with him the nearly completed second generation of the Berkeley Gamelan. Soon after arriving in the Bay Area, Schmidt traveled first to San Diego, California where his collaborator Paul Dresher was finishing his Master’s Thesis on gamelan building.\textsuperscript{62} The two composer-instrument builders then went to Seattle, Washington where Schmidt led an instrument-building workshop that produced the gamelan instruments that became the ensemble Gamelan Pacifica. Schmidt describes these instruments as "the fastest gamelan I ever built."\textsuperscript{63} The workshop resulted in an aluminum gamelan with adjustable resonators like those of the Berkeley Gamelan. For this gamelan Schmidt also used the Berkeley Tuning, both in terms of interval

\textsuperscript{61} One exception is a recent composition by Schmidt entitled \textit{Stevie’s Wonder}, for gamelan and electric bass. This work draws on Stephen Parris’ devised framework for a harmonic approach to gamelan composition. See Stephen Parris, "Towards a Harmonic Approach to Composing for Central Javanese Gamelan," MA Thesis, Mills College (Oakland, CA, 2015).


\textsuperscript{63} Schmidt, interview with the author, February 7, 2018.
size and absolute pitch (gong at 60 Hz). After Schmidt returned to the Bay Area, Drescher remained in Seattle as director of the newly formed, which performs both Central Javanese karawitan and contemporary music by international composers. Members of the group, including Mills alumni Jarrad Powell and Jeff Morris as well as UC Santa Cruz and Cornish College of the Arts alum Kent Devereaux—all of whom studied with Harrison—continued to add new instruments to the group and refine the ones built in Schmidt’s workshop.

By 1983 when directorship of the ensemble changed to Powell, Gamelan Pacifica had already acquired a reputation for its performances of new music for gamelan in the Pacific Northwest. In addition to hosting Harrison for a residency in which that composer’s *Scenes from Cavafy* (1980) was played, Gamelan Pacifica also joined Gamelan Son of Lion in a music-commissioning project under the auspices of an NEA grant. Especially in this formative period, Gamelan Pacifica utilized members’ skills in instrument building to expand the tonal palette of the instruments. To Schmidt’s pelog and slendro, which already included additional keys for the 13th and 17th harmonics for a total of eleven distinct tones (accounting for the tumbuk tones), Gamelan Pacifica gradually added additional pitches to

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64 Both Schmidt and current Gamelan Pacifica director Jarrad Powell remarked on the curiosity of the 60Hzr gong being “in tune” with electrical utility frequency, which in the United States and much of Asia is also 60 Hz. Powell specifically describes the illusion of the gong tone continuing indefinitely during some Gamelan Pacifica rehearsals. He attributes this phenomenon to the band saw operating in a carpentry shop next to the Gamelan Pacifica rehearsal space.

enable the performance of specific works arranged for gamelan. Powell explains:

In those days our thinking was that we could add pitches whenever we wanted to; we didn’t think anything of making a key for a piece. If we wanted some other pitch than those that were already available, we’d just make one, right? So I added a pitch to play Cage’s In a Landscape, and we later added another [two] pitches in order to play Debussy’s Pagodes, [which is commonly said to be influenced by gamelan].

The beneficiaries of inexpensive scrap aluminum salvaged from Boeing’s manufacturing plant in Everett, Washington, the composer-instrument builders of Gamelan Pacifica had considerable freedom to deviate from strict usage of slendro and pelog in their music. The tuning chart in Figure 3.5 shows the most used tones of these Gamelan Pacifica instruments. The Ss and Ps next to the familiar Javanese ciphers identify slendro and pelog tones in this chart. The tone "T4" represents a 10:7 tritone that was created for In a Landscape, while "S4" and "S7" fill out the necessary tones for Pagodes. The layout of this chart created by Devereaux integrates both gamelan scales with these additional tones as a way of representing the entire gamut of possibilities for composers.

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66 Powell, interview with the author, February 6, 2018.
### Gamelan Pacifica Tuning Chart

The tuning system is based upon pitch 6, now, tuned to 60 hertz.

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<th>Partial</th>
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<th>P1</th>
<th>S2</th>
<th>P2</th>
<th>3</th>
<th>S4</th>
<th>T4</th>
<th>S5</th>
<th>P4</th>
<th>P5</th>
<th>P6</th>
<th>S7</th>
<th>P7</th>
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<td>7/4</td>
<td>56/13</td>
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<td>6/5</td>
<td>7/6</td>
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</tbody>
</table>

Costs: 111.7 111.7 53.2 150.6 63.1 111.7 84.5 111.7 111.7 70.7 133.2 63.1

The tuning system is based upon pitch 6, now, tuned to 60 hertz.

Figure 3.5 Gamelan Pacifica tuning chart. Created by Kent Devereaux. Used with permission of Jarrad Powell
In 1987, shortly after formally incorporating as a 501(c)3 non-profit, Gamelan Pacifica commissioned new gamelan instruments to be jointly constructed by Indonesian builders Eligius Suhirdjan (1956–2012) in Yogyakarta and Tentrem Sarwanto (d. 2015) in Surakarta. Powell ordered an unusual set of instruments mixing bronze and iron instruments, with Suhirdjan constructing the iron gong and pencon instruments, notably using a new style of iron gong making he developed, and Tentrem making the bronze keys.\(^{67}\) Powell describes the origins of this bifurcated commission:

It was a funny genesis: initially, I thought, the least satisfying aspect of [our aluminum] gamelan were the slab [key] gongs... So I said, "I'm going to get some [new] gongs, and maybe some pot gongs, to go with our gamelan," and it just kind of mushroomed from there. When we started looking at what it would cost, we [realized we] could [affordably add the other instruments]. So I just had the keys made for the demung, and saron peking, and eventually through this process of adding things, it turned into a full gamelan.\(^{68}\)

The commissioning of the instruments coincided with Gamelan Pacifica member Kent Devereuax’s Fulbright-sponsored research in Indonesia, and he facilitated communication and coordination between Powell, Suhirdjan and Tentrem.

The occasion of commissioning a new gamelan created an opportunity to rethink the gamelan's tuning, sparking a series of events that changed Pacifica’s intonation over the following two decades. Powell decided to stay with a just tuning, but came up with a new one distinct from Schmidt’s Berkeley Tuning. Powell explains his motivations:

\(^{67}\) Powell and other members of Gamelan Pacifica constructed the cases for all the instruments, with the exception of the gong stands, which were purchased from Tentrem.

\(^{68}\) Powell, interview with the author, February 6, 2018.
Basically I was trying to come up with a tuning that I thought would be acceptable for playing traditional music, but also would allow us to continue to play some of the repertoire we were interested in, [such as] the Cage piece, and some of the pieces that composers were writing, particularly Jeff Morris, who was writing stuff for the gamelan at the time, and he liked to use dyads in his pieces. At that point I had gotten a hold of the Gadjah Mada tunings, and I had been studying that to try and figure out what good tunings were, and what ranges were possible, to come up with a tuning that I wanted to use.69

Powell created a set of aluminum bars with his newly devised tuning, including the anomalous T4 and other idiosyncratic pitches, which he sent to Indonesia with Devereaux for Tentrem to eventually use in tuning the rest of the iron and bronze instruments. Interestingly this tuning never made it onto the instruments as Powell had envisioned.

When Suhirdjan finished constructing the gongs, he began waiting for Tentrem to arrive in Yogyakarta from nearby Surakarta with his bronze keys, at which point Tentrem, the senior of the two builders, would tune the entire gamelan.70 Eventually Devereaux's fellowship period ended before Tentrem arrived to complete this task. Devereaux had to returned to the United States, leaving behind the yet to be completed or tuned gamelan. Powell resumed written correspondence directly with Suhirdjan, anxiously waiting for the instruments' completion. Eventually Suhirdjan notified Powell that Tentrem had finally arrived in Yogyakarta with the bronze portion of the gamelan ready to tune. The only caveat Suirdjan mentioned in his letter is that Tentrem had forgotten to bring the aluminum bars that contained Powell's

69 Powell, interview with the author, February 6, 2018.

70 Suhirdjan began to make instruments professionally in 1987, the same year as the Gamelan Pacifica commission. Program notes to the performance "Suhirdjan Reverberations" perf. Gamelan Pacifica, May 5, 2013.
desired tuning.⁷¹ Tentrem then proceeded to tune the instruments without the reference keys, producing something dramatically different from what Powell had wanted. Powell thinks that the tuning that eventually arrived in Seattle was different from what Tentrem would have created had they commissioned a typical pelog and slendro gamelan. Since Powell had sent a requested tuning, it is safe to assume Tentrem would have taken that into consideration rather than ignore the request entirely. Moreover, the instruments commissioned included the addition of pitches not found in either of those scales. Thinking about these elements, Powell speculates:

That must have been tricky for Tentrem, because the slenthem I had built had that T4 in it, so he had to figure out what to do with it. I think he was trying to figure out "how am I going to make this work" and what not. In the end the tuning that he sent us was [so different that] we were never able to play [pieces from our repertoire like my piece] *Gending Erhu*, or [Cage’s] *In a Landscape*, or those other pieces, because the gamelan wasn’t tuned the way I asked for. But we accepted that and just worked with the tuning from there.⁷²

These new instruments were given the proper name Si Thomas, in honor of Thomas Nast who helped provide financial support for the instruments' commissioning.⁷³ In the ensuing years Powell and other members of Gamelan Pacifica embarked on a number of retuning efforts, gradually bringing Tentrem’s tuning closer to the just intervals Powell had

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⁷¹ Both Powell and Joan Suyenaga, Suhirdjan’s spouse, think they still have records of these written correspondences, though they do not presently know their precise location. Powell, interview with the author, February 6, 2018; Joan Suyenaga, personal communication, August 18, 2017.

⁷² Powell, interview with the author, February 6, 2018.

previously envisioned. Among these later retunings, two instances stand out for the ways they shaped the intonation. The first important occasion benefited from the knowledge and experience of Sutrisno Hartana, a Javanese musician and *dhalang* (puppeteer) now based in Victoria, British Columbia, and has collaborated with Gamelan Pacifica in various wayang performances.\(^{74}\) Hartana had previously worked with a gamelan builder in Java and had developed his own tastes in gamelan tunings. Working with Powell over several days to retune the whole ensemble, Hartana’s approach helped Powell clarify his own knowledge and understanding of gamelan tunings, and even came to trust his own instincts. Powell recalls:

> It was a very intense thing, but it helped me better understand what I thought I knew about the tuning process. Sutrisno had certain proclivities: he liked stretched octaves, for example; and quite stretched, more so than I do. After that I had a lot more confidence in regards to tuning, and went back later and made more adjustments myself.\(^{75}\)

One of Powell’s adjustments in part narrowed the octave stretch from what Hartana implemented to one more to Powell’s liking. That the octaves are stretched at all is remarkable considering the incongruity between stretched octaves and the premise of just intonation.\(^{76}\) Schmidt is frank in his preference for "pure" 2:1 octaves in his gamelan, noting his desire for the

\(^{74}\) Notably, the subject of Hartana’s Ph.D. dissertation is Wayang performances in North America, in which Gamelan Pacifica figures prominently. See Sutisno Setya Hartana, "Origins, Journeys, Encounters: A Cultural Analysis of Wayang Performances in North America" (Ph.D. Diss., University of Victoria, 2017).

\(^{75}\) Powell, interview with the author, February 6, 2018.

\(^{76}\) Though a detailed discussion of acoustic is beyond the scope of the current discussion, the harmonic structure of resonant aluminum lends itself to just tunings better than bronze. Schmidt’s use of aluminum has as much to do with that material’s acoustic properties as its efficiency and availability.
melodies he writes to be transposable by octave.\textsuperscript{77} Larry Polansky has previously highlighted the incompatibility between the Javanese concept of \textit{gembyangan} and Western notion of the octave; whereas the 2:1 octave assumes equivalency, gembyang are variable and may be stretched or even constricted compared to a 2:1 octave. Unlike Schmidt's desire for octave transpositions, Polansky notes that in the context of Javanese karawitan, "Javanese patet and melodic configuration are in no way registrally transposable in the way that octave equivalence implies."\textsuperscript{78} Gamelan musician and tuning theorist Raharja goes a step further in his 2015 dissertation on gamelan tunings, arguing that pure 2:1 octaves are incompatible with gamelan tunings.\textsuperscript{79} According to Raharja the stretched octaves of gamelan tunings not only facilitate the ranges of different vocalists, they also endow the gamelan with its distinctive affective character. His research demonstrates that each gembyang (octave) of a gamelan will be stretched, and sometimes constricted, differently from the others, resulting in what he describes as "curves" in the octave stretches. In other words, the stretch between pelog 1 may be more or less extreme than that of pelog 2, and so on. These characteristic curvatures are markedly different from Benary's approach to stretching the octaves of Gamelan Son of Lion, which features a uniform stretch of 5¢ across all octaves and scale.

\textsuperscript{77} Schmidt, interview with the author, February 7, 2018.


\textsuperscript{79} At the time of this writing I am waiting for Raharja to share an electronic copy of his dissertation, which is currently only available in the library of ISI Yogyakarta. This summary is based on a conference paper version I witnessed in 2017 at that university combined with personal communications with Raharja in August, 2017.
degrees. Raharja even connects the particular shapes of these gembyang curves with the specific affective qualities attributed to particular gamelan sets.\(^80\) Powell’s new tuning for Si Thomas can then be understood as a compromise between the just intonation ideal of pure intervals and the Central Javanese conception of gembyang. Though it takes as its premise the rational expressions of just intonation, Powell allows for significant variance in the actual sounding of those intervals bringing them closer to a Javanese model of tuning.

The most recent retuning of Si Thomas "solidified the tuning" in its current form, according to Powell. The occasion of Gamelan Pacifica’s performance and subsequent recording of works by Lou Harrison sparked a new critical consideration of the ensemble’s tuning, particularly with regards to Harrison’s Concerto for Piano With Javanese Gamelan (1986/1987).\(^81\) Powell and composer Stephan Fandrich had to consider how to best approach pairing the piano, an instrument closely associated with 12tet, with Si Thomas’s Javanese-inclined just intonation. As they explored possible solutions to the problem, Powell and Fandrich prioritized maintaining the piano’s melodic character. Powell explains: "Looking at Lou’s score and realizing how he was hearing things, we realized that we couldn’t just arbitrarily tune the piano to the gamelan, because then the piano might not

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\(^{81}\) This piece and the new tuning can be heard on the recording Gamelan Pacifica, *Lou Harrison: Scenes from Cavafy—Music for Gamelan*, New World Records, 80710, 2010.
sound the way it should.” Notably, Harrison's score for the Piano Concerto makes no mention of tuning at all. A common feature of compositions in just intonation is an indication of the tuning, either in preliminary explanations or by inserting interval ratios in the score itself. The only indication that the gamelan and the piano should even match takes the form of gamelan ciphers written over corresponding piano measures. By closely examining the piano music and considering potential interval sizes Harrison likely desired, Powell and Fandrich began to formulate possible just tunings that could both suit the piano part and be feasible given Si Thomas's existing tuning at the time.

Through this process of deliberation Powell and Fandrich eventually decided on what Powell describes as an "8 series" for the pelog scale, meaning pitch 6 is tuned to the eighth harmonic and the scale follows mostly consecutive harmonics from there: 8, 9, 10, 11, 12, 14, 15, 16, correlating to pelog tones 6, 7, 1, 2, 3, 4, 5, 6 respectively. Interestingly, by transposing the lowest 6 and 7 up an octave, this tuning reveals itself to be the same as the Berkeley Tuning of the original aluminum Gamelan Pacifica instruments that

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82 Powell, interview with the author, February 6, 2018.

83 Though it's safe to assume that Harrison wanted the piano and the gamelan to match their tuning, other American composers have written pieces that seek to highlight such intonational incongruities as a mode of critiquing cross-cultural music making while participating in it. Upon hearing the Solonese tradition "lawung," in which gamelan and trumpets play together, Philip Corner became interested in these kinds of juxtapositions and incorporated the idea into many of his works for Gamelan Son of Lion. Some other notable examples include Barbara Benary's *Aural Schoehorning* (1998) for piano and Central Javanese gamelan, Michael Tenzer's *Puser Belah* (2003) for two Balinese Semaradana, and Daniel Goode's *Western Sieve* (2014), also for piano and Central Javanese gamelan.

84 Central Javanese gamelan are typically tuned in accordance with musical contexts. Tuners will play several gending and adjust pitches to best suit multiple kinds of compositions in different pathet. For one documentation of this process, see Vetter, “A Retrospect on a Century of Gamelan Tone Measurements,” 223.
Schmidt built in 1980. In fact, the one constant maintained between Powell’s requested tuning and the one Tentrem and Suhirdjan produced was pitch 6 being tuned to a 60 Hz fundamental. The pelog tuning, shown in Figure 3.6, had come full circle.
Figure 3.6 Gamelan Si Thomas pelog scale created by Stephen Fandrich. Used with Permission of Jarrad Powell
The same cannot be said about Si Thomas' slendro, however. Compared to the Berkeley Gamelan slendro, Si Thomas' intervallic structure is more uniform. Beginning on pitch 1, the Berkeley Gamelan slendro consists of the adjacent just intervals 8:7, 9:8, 7:6, 8:7, and 7:6, whereas the equivalent Si Thomas intervals are 8:7, 8:7, 7:6, 8:7, and 147:128 (See Figure 3.7).\textsuperscript{85} Harrison proposed a similar slendro as that of Si Thomas, though with the intervals in a different order: 8:7, 8:7, 147:128, 8:7, and 7:6. Miller and Lieberman identify the 147:128 as a "remainder" interval resulting from the use of three "supermajor seconds" (8:7) and one "subminor third" (7:6).\textsuperscript{86} Though the interval sizes of Si Thomas' slendro changed overall, the slendro pelog pairing in Si Thomas can still function like that of the Berkeley Gamelan in terms of the tumbuk tones. Though Si Thomas' slendro 3 and 5 are about 3 Hz flat from their pelog equivalents (pelog 3 and 4), that small variance is unlikely to be perceptible, especially given the stretched octaves already present in Si Thomas.

\textsuperscript{85} These kinds of tunings were a favorite of Harrisons and are known as "septimal" tunings, meaning the largest prime factor in all ratios is 7.

\textsuperscript{86} Miller and Lieberman, \textit{Lou Harrison: Composing a World}, 123.
Figure 3.7 Gamelan Si Thomas slendro scale created by Stephen Fandrich. Used with Permission of Jarrad Powell
Conclusion

The tunings described in this chapter, like the instruments that sound them, may be understood as neither wholly Javanese nor completely distinct from their slendro and pelog models. They are the result of different ideas in circulation combined with evolving perspectives and tastes that become inscribed into the physical instruments at different moments. Some of these changes are dramatic, others subtle, and sometimes indeterminate regarding the natural aging of the materials or affects of technological mediation when tunings are measured. In cases when particular individuals set out to retune the instruments with particular goals in mind, those values can then be read in tunings and reinterpreted later by others. The ambiguity of perception and understanding among American gamelan tuners, musicians, and composers frames the reality of their early interactions with gamelan music, instruments, and concepts. They necessarily relied on other ways of understanding music and tuning and sometimes chose or were compelled to prioritize their own creative needs and cultural outlook. As these individuals developed their understandings, they accordingly adjusted their practices in some cases, and not in others, shaping their creations along the way.

By focusing on specific tunings in this chapter as more than the precise intervallic structures that are measured at any one moment, they can be understood as kind of living entities that interact with their environments. These tunings emerged for particular purposes at specific moments. Over time, they encountered new ideas and new purposes, acquiring new
meanings and associations that became embedded in the tunings themselves. The distant origins Lion Tuning can be traced to the refined or halus karawitan music as performed in the courts of Surakarta, Central Java that traveled to UCLA where it became part of a methodology shift in ethnomusicology. These sounds then traveled into New York's experimental music scene, where it left the gamelan instruments and entered a new life in JMSL. Despite all this, it is still possible to trace this tuning's remarkable journey, revealing a small, but fascinating part of the story about the internationalization of Central Javanese gamelan.

The Berkeley Tuning tells another version of that story. Whereas Lion Tuning can be traced to Central Java, this tuning developed locally in the United States. In listening to Indonesian recordings, Schmidt, Harrison, and others designed just gamelan tunings as a way of making sense of tuning ideas that were strange to them. Their interpretations of pelog and slendro reflect their understandings of those models combined with their own particular tastes and compositional needs. The complicated journey of the Berkeley Tuning tells another story that involves more intentional changes to the tuning by both American and Indonesian tuners. That the tuning ended up being so close to original structure is striking considering the trajectory it took to get there. Reflecting on this complex network, and the values and concerns that go into gamelan tuning, Powell said:

It's an interesting dilemma: who determines what sounds good? At some point you have to assume the responsibility for that. We may have our own taste on tuning, so there's been times when Javanese musicians have come through and they say, "oh, your 3 needs to be a
little flatter," or something. And Stephen [Fandrich] and I will look at each other and say, "nah, it's good where it is. We like it." And other Javanese musicians will come in and give us a different opinion about it. So it's sort of like, if it's good for us, and we like it, and Midiyanto [S. Putro] says he and Heni [Savitri] like the tunings, then I think we're in a pretty good place.\textsuperscript{87}

The tuning biographies presented here are necessarily incomplete. It would be burdensome to account for every detail and every modification to each tuning. Furthermore these tunings are used by active performing ensembles, and they will surely be met with additional changes as they age and meet with new purposes. Following our most recent conversation on this subject, Schmidt emailed me with additional thoughts reflecting upon our conversation and considering his next steps with regard to gamelan tunings and instrument building:

I'm coming to a fresh way of conceiving of American gamelan tunings. I am referring more to the present than in the past, but, yes, my thoughts apply to the past also. But as I write this, I recall that Pak Cokro told me of similar considerations in Java way back when. My thoughts are about tuning serving the nature of the piece. As a composer, I feel that the feeling of a piece deserves an appropriate tuning. For example, the pieces on my first album [such as \textit{Ghosts} and \textit{In My Arms, Many Flowers}] came into existence soon after I designed the [Berkeley Tuning], and I unconsciously wrote in that tuning [emphasis Schmidt's]. Those pieces would not work in the same way in another tuning. Ideally I'd love to create each composition and tuning together.

This is born out in my work at present. I am composing in my Berkeley Tuning here at home, but I then go to rehearsal [at Mills College] on Lou’s tuning and my intentions do not come out as intended.

I touched on this when [you and I] were together, but it is growing on me. It isn't far in the future that I may be operating with tunable keys toward this end. I see the evolution of our American gamelan venture

\textsuperscript{87} Powell, interview with the author, February 6, 2018.
as something we must conceive of openly, allowing flexibility in our approach.88

Schmidt’s move toward adjustable gamelan tunings is another kind of compromise instigated by the dialogues between tuners, musics, and cultures. Achievable by adding weights to the ends of keys, effectively lowering their pitch, these tunable keys would allow Schmidt to write pieces in different tunings playable on the same gamelan.

The ongoing dialogue of gamelan tuning and instrument building in the United States is constantly transforming as a reaction to an unpredictable network of voices, ideas, and purposes. As Lion Tuning and the Berkeley Tuning approach their fifth decade of existence, younger American composers and instrument builders like Brian Baumbusch (b. 1987) of the Lightbulb Ensemble, Stephen Parris (b. 1975) of Gamelan Encinal, and Tyler Yamin (b. 1988) of Pandan Arum are currently designing new instruments and tuning them in ways that reflect their own subjectivities and their various relationships with Indonesian arts. This story will continue with new, exciting, and unforeseeable results.