

will turn out to be at the end is exactly what I hope to never do. It is in not knowing that I find the most stimulation, and what compels us forward in our experimentation to make something that we couldn't have imagined in advance.

ORIGIN AND DEVELOPMENT OF THE “EXCITED STRINGS”

ARNOLD DREYBLATT

“Proposition IX: To explain why an open string makes many sounds at once. Proposition XV: To determine if it is possible to touch the strings of an instrument or their keys so fast that the ear cannot discern whether the sound is composed of different sound, or if it is unique and continuous.”
—Marin Mersenne, *Harmonie Universelle*, 1637 (Marin Mersenne, *Harmonie Universelle; The Books on Instruments*, M. Nijhoff, 1957.)

I

The name Dreyblatt is a corruption of “Dreiblatt”. My grandfather Max Dreyblatt played clarinet in a pit orchestra for silent movies at Loew’s 175th Street Theater in Manhattan, whose last incarnation was as evangelist Reverend Ike’s “United Palace”. Max always used that old New York pronunciation, “Lowie’s”. When World War I came around, Max and his fellow Bronx Jewish bandmates managed to get drafted as an intact army band unit, surviving the war in the trenches in France by performing an endless loop of patriotic tunes, inspiring the young infantry to charge out of trenches to be immediately slaughtered. The entire band returned unscathed, except for the “i” being changed to “y” in my grandfather’s last name.

His father Nathan had come from Vienna to New York in the 1880s. The “Dreiblatt’s” had emigrated from Zbaraz in what was then Austria-Hungarian Galicia (and is now the western Ukraine) to Vienna in the mid-19th century. By the turn of the century, dressed in the appropriate costumes, they were performing Jewish, Gypsy, Russian and Turkish music and dance as Les Troupe Maximoff and under various other names fitting the occasion. Paula Dreiblatt, a yiddish cabaretist and actress, toured Europe and North and South America and appeared in silent films. They all lived in the Glöckengasse in Vienna’s second district and disappeared in the late 1930s without a trace.

II

After some years of piano lessons beginning at age six my teacher, having taught me with a number system of her own devising, tried to introduce me to the five line staff. I had been improvising a lot, and had apparently been memorizing the pieces in order to fool her into thinking that I was reading the notes.

With the introduction of the five-line staff, piano lessons came to an abrupt end. Being an only child, my parents didn't object. Forced into Recorder class at age eight in the local elementary school, I moved my fingers without blowing onto the instrument. After three months I was called upon to perform a solo and I was thereupon expelled. The arrival of the Beatles in 1963 prompted numerous attempts at learning the guitar, but lessons were repeatedly terminated as I was consistently rated tone deaf and unteachable.

III

In the early 1970s I developed an interest in electronic music and in video works which experimented with "electronic abstract images". From 1974–75, I studied experimental film and video at the Center for Media Study at the State University at Buffalo, N.Y. where I was exposed to the work of video artists Woody and Steina Vasulka who were experimenting with direct translations between sound and image: electronic audio signals controlled and triggered images and visa versa. In my early video from that period I created a number of stroboscopic video works dealing with periodic optical structures, culminating with a solo show at Anthology Film Archives in 1976. In what was probably the most successful of these early works, *Lapse*, two color "burst" frequencies (which tell the cathode ray guns which color to address), beat against each other, pushing the primary colors through superimposed moiré patterns at an incredibly high rate. This resulted in the perception of a generalized sense of color whereby any specific color became unidentifiable. In my last visual "statement" in 1976, I turned a video projector onto the audience, composing for a fast rotation of the blue, green and red guns in a somewhat aggressive perpetual attack. These tapes were created in the tradition of previous research by film artists Paul Sharits and Tony Conrad, both of whom I met in Buffalo during that period. Sharits was teaching in the same department, and Conrad visited a

number of times while I was studying in Buffalo, later to become a professor there. Our biographies later crossed paths a number of times.

While a student in Buffalo, I participated in two summer programs organized by the music Department, whose chairman was Morton Feldman. Feldman, who knew my family from his days working for his family business in the garment district¹, let me sit in on his classes and participate in workshops with Pauline Oliveros, Joel Chadabe (1974) and John Cage (1975). Here I was gradually introduced to the prevailing tendencies in contemporary music. I was heavily influenced by a performance by the Creative Associates of "Still and Moving Lines of Silence in Families of Hyperbolas" (1973–74)² by Alvin Lucier,

2. It may be that Lucier performed an early version of *Music for Snare Drum, Pure Oscillator* and *One or More Reflective Surfaces* from 1990, which I realized myself later in Dublin in 1995.

in which sine waves bouncing off the walls gradually "sounds" a waiting snare drum with the snare on. The standing waves would seem to vibrate through the bellies of the audience, and the drumbeats initiated without a "performer" seemed to reduce sound propagation to the simple movement of air in space, a lesson I have never forgotten. In my video works, I had been working with structures, which were analog to the acoustic event: periodic structures or waves of light and color. Yet, the perception of these structures, following their logical outcome in effects that can cause epileptic reactions, seemed to have run their course. I was excited by the visceral aspect of sound, that one can feel the vibration, that here was a structure that one can sense with one's body in space.

Shortly afterwards, I was at a party at filmmaker Hollis Frampton's house in Buffalo, and came upon a rare copy of *Selected Writings*³ by La Monte Young; which he subsequently gave me as a present. I was especially interested in the republished interview with Richard Kostelanetz⁴, in which La Monte explains the development of a music based on acoustic principles, establishing what was for me an essential connection between the empirical experience of the physics of sound, and the performance of acoustic music.

1. *Middle of the Night* (1959) with Kim Novak and Fredric March was filmed at Kaplan Brothers, a firm owned by a part of my family in the Garment District. Feldman was on the set, and his friend Paddy Chayefsky had written the Broadway play and screenplay.

3. *Selected Writings*, La Monte Young/Marian Zazeela. Heiner Friedrich, Munich, Germany, 1969.

4. The interview was originally published in *The Theatre of Mixed Means*, Richard Kostelanetz. New York: Dial Press, 1968.

IV

Upon graduation from Buffalo in 1975, I returned to New York and worked for Shigeko Kubota and Nam June Paik at Anthology Film Archives, where the last show of my stroboscopic video works was held in 1976. But immediately upon arriving in New York, I apprenticed myself to the composer La Monte Young and worked for him as archivist of his massive recordings collection until 1977. I was almost twenty-two when I first met La Monte Young after a concert of his on Wooster Street. I told him that I had read his book *Selected Writings* as a film and video student in Buffalo. He listened patiently as I explained a little about my background, and then he answered some of my technical questions, but finally he cut me short. “Talk is cheap”, he said. Then we made an appointment to visit him in his loft on Church Street.

La Monte, who had been a student of Leonard Stein, (who was himself a student of Schönberg), started me out with a number of books on musical training by Paul Hindemith, along with Schönberg’s *Harmonielehre*; then to *Genesis of Music* by Harry Partch, and most importantly, the rare work by the converted Hindu ethnomusicologist Alain Danielou (*Tableau Comparatif*)—in which the entire book passes through the thousands of historical and theoretical intervals which are found in one octave, giving one sense of the myriad possible locations along the continuum of one octave. Studying with La Monte in this period, the full “apprenticeship package” required studies in North Indian Classical Music with his teacher and guru Pandit Pran Nath. While these early studies with La Monte paved the way for the development of my own music. In my job as archivist of his extensive tape collection, I gradually became aware of his preferencing his later works under the influence of his Indian teacher, resulting in the repression of his seminal early period in the mid-’60s. In performances since the early ’70s of his “Theater of Eternal Music” in the “Dream House”, Indian-influenced melismatic singing over drones and romantic piano arpeggios (*The Well-Tuned Piano*) seemed to violate the severe minimalism of his original concept, (which was purely horizontal or vertical, depending on your point of view). I began to see the influence of Tony Conrad’s knowledge of mathematics, tuning and acoustics the more important mid-’60s ensemble music by Young⁵. In 1977, I left La Monte’s tutelage, in order to make my own way.

5. See *An open letter to La Monte Young and Tony Conrad, The Wire*, September 2000; and the uncut version along with Tony Conrad’s response on my website: www.dreyblatt.net/music/articles+interviews

V

The years 1977–79, largely represented a gestation and experimentation period in which I tried to define, the paths from which I had come and direction in which I was headed. I will quote from a number of manifestos of the period:

...my interest has slowly developed in the direction of a more traditional model of music performance. This model was initiated by a group of American minimal composers in the early 1960s and was largely based on the rock or jazz band-composer that performs with his own ensemble—a small amplified group formed expressly to perform his own composition.⁶

I am clearly referring here to La Monte’s “Theater of Eternal Music”, and to the later ensembles of Phil Glass and Steve Reich. In addition to his classical composition pedigree, La Monte had connections to the LA jazz scene in the late ’50s and early ’60s, performing with Don Cherry and Billy Higgins, who later made up the core of Ornette Coleman’s first ensemble. I was hindered by the lack of conservatory training, and would not be writing out complex scores for many years. My early ensembles were workshops in which the musicians would learn to hear and perform in the non-tempered intonation of my music, and parts would be worked out collectively.

6. Notes from the CD, *Propellers In Love*, Arnold Dreyblatt and the *Orchestra of Excited Strings*, Hat Hut, 1986, and later republished in *The Sound of One String*, Arnold Dreyblatt, in *ECHO, The Images of Sound*, Apollohuis, Eindhoven, 1987.

Having neither traditional music training or childhood indoctrination in this or that cultural scale or system I found it convenient to apply my background in experimenting with electronic sound and image to composition with acoustic instruments...

I looked to a physical description of sound—a definition in acoustic terms.... ...a description according to the laws of physics as opposed to a definition in cultural terms. An understanding of these acoustic laws has always been understood empirically by musical instrument builders.... ...Our language of sound description determines what we listen for.

... I began to sense that the standardization of notation, instrument construction and tuning which was finally accomplished during the 19th century represents a distorted conception of “progress”. Equal Temperament, and the gradual shift towards atonality, while allowing a greater vertical independence of melodic lines, has resulted in a kind of

acoustic “blurring”—a tuning system which is “out of focus” and a “blandness” of instrumental timbre. The instrument families and tuning systems which were discarded in the wake of this standardization are themselves a tribute (within our own tradition) to other realms of possibility...

I proceeded from a kind of “amateur” curiosity about sound and music, and developed a sense that composition begins with a consideration (often a re-consideration) of the dynamic materials of sound creation—e.g. strings and pipes, air and motion.⁷

7. Ibid.

I was self-consciously attempting to rationalize a path which began with electronically manipulated images and sound, and which resulted in the actual performance of music. I sensed early on that the language we use to describe a sound event influences how we hear, and what we hear for. In this excerpt from a conversation with composer and filmmaker Phill Niblock from the period, I compare the rational scientific measurement of pitch with empirical musical practice:

AD: I realized at a certain point that when musicians are tuning, they are hearing frequencies in their head...

PN: Listening to the harmonic overtones in order to tune the fundamentals...

AD: Right. It depends on what they are tuning. On a simple level, unconsciously, a musician tunes a 5th, and he learns to recognize the interval in his head. The speeds are somehow memorized...

PN: It's better than a tuner!

AD: I began to understand that this was music—that this process of signal comparison is a musical activity. This is what a musician does when he tunes—whether it's conscious or unconscious. It's conscious often in people who are interested in tuning systems and scales and so forth. It's unconscious in the majority of musicians who have to learn by hear anyway; and in instrument builders there has been a sort of underground tradition of knowledge about acoustic which is purely empirical...⁸

VI

I spent the late seventies and early '80s diving into the sonorities of world music. I took lessons in Balkan singing techniques, played in a Cantonese Opera ensemble in Chinatown, studied various Asian zithers, and took lessons in Turkish and Central Asian performance theory. Invited

8. Excerpt from recorded conversation between Arnold Dreyblatt and Phil Niblock in New York City in 1977; *The Sound of One String*, Arnold Dreyblatt, in *ECHO, The Images of Sound*, Apollonhous, Eindhoven, 1987.

for a graduate MA assistantship by composer Alvin Lucier in the World Music Program at Wesleyan University in 1980, I had the further opportunity to dabble in Javanese Gamelan, South Indian and Chinese Classical Music. The experience at Wesleyan cured me of any interest to become a professional performer in any of these non-Western musics once and for all, having met many “westerners” painfully trying to imitate the lifestyles of their Asian teachers, with a final cultural assimilation and musical success never even a remote possibility. However, I did arrive at a sense of the possibilities and tendencies in comparative tuning systems, instrumentation, performance techniques, and musical structures.

VII

I began to take apart instruments to see how they work. I still needed more empirical sonic feedback to interpret and balance my theoretical interests, especially in regard to tuning systems. Not having European temperament engraved into my perceptual system, I had no fixed reference point with which to compare alternative tuning systems. So it was the discovery of the historical literature on the monochord as a tuning reference system in early European and Chinese classical music culture that finally gave me the “theory and practice” I was looking for.

The phenomenon of simple and compound vibration might be represented by the structural “archetype” of a one-string instrument or a tube without finger holes (whether blown as a flute or a brass instrument). In a tube without finger holes the only pitches available are the fundamental tone and the tones of the overtone series. The frequencies of these tones are always related to a given length of pipe; but it was not until the appearance of a one-string instrument (probably the musical bow) that man had an experimental instrument capable of providing both an empirical and theoretical knowledge of sound. The musical bow represents one of the oldest members of the zither family of musical instruments.

Zithers are defined as chordophones in which the body of the instrument is also its neck—the strings are stretched across the entire body. Often the body of the instrument functions as a resonator for amplification (although the chest or mouth of the player or an earthen pit may also be used). The necked instrument is a later invention to facilitate faster strumming techniques. Zithers are usually played horizontally and since the strings are stretched over the entire body of the instrument, the relationships of pitch to length, tension and thickness of a string are

easily deduced through the faculty of hearing and can be correlated visually to simple mathematical proportions. The harmonic overtones can be heard in relation to the fundamental tone and located at the nodal point of the string.

It is therefore no accident that monochord and related members of the zither family have had an important mathematical-mystical role in the two great ancient cultural spheres, Greece and China. In both China and Greece the monochord was considered an instrument of acoustic measure—a kind of tuning reference. In China it gave birth to an entire family of instruments which then traveled to Korea, Japan and Vietnam. The heritage of Greek musical thinking was kept alive by Arabic musical theorists and was rediscovered by European monks in the middle ages. Medieval music speaks often of the monochord and the laws of acoustic and mathematical proportion.⁹

9. *The Sound of One String*, Arnold Dreyblatt, in *ECHO, The Images of Sound*, Apollonius, Einhoven, 1987.

I was fortunate while at Wesleyan to have lessons on the Chinese Ch'in with master Tong Kin-Woon, who also let me make copies from his vast collection of Ch'in recordings, including many from the pre-Communist era. The Ch'in seemed to be the apogee of the Asian zither family, having been traditionally played by most Chinese intellectuals, poets and philosophers. Tong sold me an instrument he had made and then he informed me that "it doesn't sound so good right now, but after a few hundred years it should be sounding really wonderful". On the Ch'in, all the strings are the same length, and the strands of silk woven into adjacent strings are in the same proportion as in their frequency relations. I painstakingly learned a tablature encoded into Chinese characters, where information would be encoded in abbreviated Haiku-like images such as "the bee taking dew from a flower" for the sounding of a harmonic partial on a string. The instrument seemed to be an embodiment of acoustic knowledge, expressed through music. The Ch'in or Kin is one of the branch of zithers developed from the monochord, which was used to sympathetically tune the royal bells which were used as tuning refer-

10. See *Science and Civilization in China*, Jacob Needham, Volume 4: *Physics and Physical Technology, Part I: Physics; (b) Sound (Acoustics)*; Cambridge, Cambridge University Press, 1962.

ences.¹⁰ We have the remnants of the dissemination of these instruments, in the Vietnamese "Dan Bau"; the Cambodian "Skhe-Diev" (with chest resonator) and the Japanese Ichi Gen Kin. A collection of ancient copies of the zithers, which came from China ("Kin"), can still be found in royal collections in Japan today.

I looked for a correlating lineage in the West, and found the tremendous respect accorded the monochord as a kind of "Ur" instrument in medieval Europe, often referred to in teaching and theoretical manuals by theorists such as Boethius, Guido von Arezzo, and many others. Images of the monochord often accompany charts on proportion and tuning, with theoretical links to mathematics and architecture. And indeed, these thinkers were harking back to what remained of a tradition from the Greek and Roman world, where music was one leg of the Quadrivium of classical learning, along with arithmetic, geometry and astronomy. Not only found in the mystical leanings of Pythagorean philosophy, this basic one-string instrument was a reference median for equating acoustic proportions with space and vibration in the ancient world.

That a hurdy-gurdy appeared in my first ensemble was no accident. It is descended from the classical Organistrum, a sort of two-person—and therefore longer—hurdy-gurdy (with a person to turn an rosined wheel and one who's job was to stop the strings with enormous levers), which was used in Organum in Medieval stone cathedrals. Trained by La Monte Young, I had no difficulty imagining this enormous drone instrument resonating in an overly reverberant environment. Largely ignored by modern musical historians, the respect which it was accorded is proved by its appearance on decorations in Gothic cathedrals. The effect would not be far from that of the Indian Tambura, especially when one places one's ear directly upon the hollow neck. Indeed, the functional use of the resonant drone, as I learned from La Monte, offers to provide an exact tuning reference for the voice or instrument.

An even more unusual and forgotten descendent of the monochord was the "Tromba Marina". A kind of triangular-shaped tapered wooden hollow tube, often up to 6' or 7' long. It rested on the shoulder of the player, and has a "stomping bridge", often found in contemporary French hurdy-gurdies, where one foot of the bridge is shorter than the other and buzzes against the sounding board. The player fingers simple harmonic partials near the upper bridge and sounds them with a small bow. Often used in medieval stone churches which couldn't afford to pay the expensive trumpet guilds, the Tromba Marina was used to fill roles valveless trumpets. Indeed, if you stand far away in a reverberant space, you might be fooled.

VIII

Most importantly for my investigations, I was beginning to see that in playing with this “Ur” instrument, one perceives a “geometry that one can hear” or perhaps an “acoustics that one can see”. I began to chart down these steps, as if one could go back to a beginning of musical creation and start again:

We can take a string and divide it softly with our fingers: we hear the harmonic overtone of that nodal point. As we increase the pressure we divide the string into two independent vibrating bodies. Each step alters the situation and defines new acoustic possibilities: what shape of a resonator, what kind of resonating material and thickness, the thickness and length of the wire, how and with what we excite the string, where we excite it.

...with a one-string Zither: You know where you are: the only sounds you can make are harmonic partials or in dividing the one string: there is nowhere else to go.¹¹

11. Unpublished manuscript, 1978.

I then began building a number of experimental string instruments to test this hypothesis. It was in the spring of 1977 in my studio on Fulton St. in Manhattan, that I first built a one-string instrument according to instructions in an antiquated British acoustics book¹². The book calls for a meter stick with two identical strings of extremely thin wire (.008"). The vibrations of this wire are made audible by a medical stethoscope, which is attached to the wood with tape. He ingeniously proposed to build “hanging nodal locators”, a small piece of thread with small metal nuts at each end. The sides of the meter stick were notched at the nodal points. With the locator placed over the strings into the notches one would pluck the open string and the weighted locators would sound the nodal pitch without losing its place. By following the set of exercises presented for use of this instrument, I passed through a sort of “initiation”, which provided me with an understanding not only of the construction of all string instruments but also the relations between such basic concepts as frequency, pitch, tension, length, division and multiplication.

12. *Intervals, Scales and Temperaments*, L.L. S. and Hugh Boyle, St. Martin's Press, New York, 1963.

In the spring of 1978, I began to realize the plans for a number of larger instruments based on this same principle. I designed and built an instrument (the “The Zither with Hanging Harmonic Locators”) with twenty strings of thin steel wire. It was composed of twenty monochords, each with its own calibrated meter stick, along its length were grooves at the nodal points to keep hanging “nodal locators” in position. The strings were

all tuned to the same pitch, and the nodal locators isolated a different overtone on each stick. Choruses of overtones were sounded as the strings were plucked. A second instrument, the “The Long Zither With Magnetic String Drivers”, had E-bow modules¹³ mounted permanently on the strings, so that all the strings were permanently in vibration. When one isolated a harmonic overtone, it remained permanently sounding, resulting in an infinitely sustaining chord.

13. The E-bow invented by Greg Heet in 1969 is a hand-held, battery-powered device for performing on the electric guitar.

IX

It was the development of my technique for performing on the double bass that has since contributed to the signature character of my ensemble sound, and it is this unusual sonority, now thirty years later, that I am still requested to perform. I became attracted to the instrument for its large resonating box and the long speaking length of its strings, which make possible the production of the higher overtones. I purchased a plywood “Kay” bass in 1978 for \$100 from the artist Robert Longo¹⁴, who had moved from Buffalo around the same time as I did and lived in my building on Fulton Street with former co-student Cindy Sherman.

14. I have generally found no difference in using a plywood or carved spruce bass for the excited strings technique.

The following “origin story” has been told repeatedly. It happened that I broke one of the thick, wound steel strings on the double bass and I didn’t have the cash for a replacement, so I attached some of the piano wire which I had ordered for restringing the miniature piano that later became part of my first ensemble. The unwound wire raised the fundamental tone a number of octaves and made possible the production of extremely high upper overtones. The thinner diameter of this relatively long string (42") enabled the wire to vibrate in the shorter lengths representing the higher vibrational modes. I began working with the bow, striking and bowing in isolated attacks upon this one string, moving closer and farther away from the bridge. I marked the nodal points on the fingerboard and occasionally isolated overtones with the fingers of my left hand.

At the time of my first “concert” in May 1979¹⁵, I had already developed a repertoire of isolated percussive and bowed attacks, and these

15. First performance of *Nodal Excitation*, Warren Street Performance Festival, organized by Joseph Nechtival and Carol Parkinson.

evolved into a continuous rhythmic technique in which I could excite chords of overtones above the fundamental. This technique is a combination of bowing and striking, in which a short portion of the bow is brought into contact with the string in a forward and backward motion. If the striking aspect is emphasized, the inharmonic nature of the attack overwhelms the sound and little resonance is excited. If a long section of bow hair is brought into contact with the string, the resulting sound is lacking in resonance. In daily practice over a two-month period, I gradually learned to make fine adjustments, bringing specific harmonics in and out of the foreground, as times touching a nodal point with my left hand. I taped each of the experiments and was inspired by the clarity and metallic richness made audible through amplification. I structured a didactic performance in which I began with a new one-string instrument that I built with nodal markings in the manner of a Chinese Ch'in. I performed the simplest operations: plucking at the nodal points of the string. I then switched to the double bass, performing the isolated attacks upon the unwound wire and gradually working my way to the rhythmic technique that I had developed. I prepared the following notes for the performance:

Nodal Excitation

The vibrational characteristics of music wire with consideration of the location and influence to the nodal regions. The integrity of a fundamental vibration is maintained for each string; all movement of pitch occurs in the overtone structure. A shorter speaking length is never created through "stopping" or "fretting" technique. Harmonic (partial) vibrations are coaxed and occasionally isolated.¹⁶

16. Program Notes, *Nodal Excitation*, 1979.

X

Long before my first solo performance in 1979 I had been interested in developing ensemble music, and had been tinkering with a number of instruments with that goal in mind. In the fall of 1977 I bought a miniature piano for \$200 from a piano supply house¹⁷ and brought it home in a checker cab. It had an abbreviated upright action, forty-one keys, one string per key, with a range of 3½ octaves. For some time I had been interested in realizing the pitch relationships of the harmonic series on a keyboard instrument. I attempted a variety of tunings, but it soon became

17. The piano was a miniature copy of an upright piano, with a full iron frame, spruce sounding board, with one string per note, and with the designation "Princess Piano" written on it. I have never seen another one. I called it the "Miniature Princess Pianoforte".

apparent that re-stringing would be necessary. In March of 1978 I began drawing up plans for tuning a selection from the harmonic series into the span of an octave on the piano. I selected a fixed fundamental tone (F), and then calculated the first twenty-three odd harmonics (even numbers are octaves of the fundamental or another tone) through multiplication. I then divided by powers of 2 until the higher harmonic partials fall within the desired octave. Engineer Bobby Bielecki, created a computer program to load a series of formulas and equations dealing with the important variables of a string vibration. One encounters inharmonicity in a string as it becomes too thick, short and tight to vibrate in perfect harmonic relationships. The three variables of frequency, length and tension are interrelated. A wire becomes more perfectly harmonic as it approaches its breaking point. In order to equalize tension across the piano, one determines the suitable diameters and frequencies. The extent of inharmonicity may be judged by reading the deviation (in cents) of each harmonic from its true harmonic position. I hoped to utilize these pitches to emphasize specific overtones within the texture of the fundamental tone which was supplied by the "excited" double bases. Since the wide felt hammers dampen many of the higher harmonics, I removed the hammer felt from the hammers and snipped the dampers off so that all the wires would resonate sympathetically. I found that the thick steel wires, when hit by the pointed hard wood hammers, supplied an unusually rich and piercing timbre. I eventually arrived at the following compromise. The tones appear in an order different from their order in the harmonic series.

As the tuning was accomplished, tonal relationships became apparent. The prime numbers, which include 3, 5, 7, 11, 13, 17, 19 and 23, represent new and unique pitches identities. In other words, proceeding from 1 (the fundamental), each prime number has neither a mathematical nor a tonal relationship to a preceding number in the series. It is factorable only by itself and one. Odd-numbered harmonics which are not primes are tonally and mathematically related to a lower prime root.

I found that when groups, or "families", of these pitches which are simple multiples of one another were sounded simultaneously with the fundamental tone, a distinct series of tonalities resulted. I rethought the scale in order to utilize these relationships more effectively. I eliminated prime-numbered identities above 11 in order to include more multiples of the lower primes¹⁸. A compromise was arrived at, which

18. While the 9th Harmonic is not a prime number, I decided to include it in the system because of its strong harmonic relation to the tonal family based on the 5th. Important relationships are based on it.

included the following tones, appearing here within their order in one octave. In the table below, the first row contains the partial numbers of each pitch in the order in which they fall within an octave; the second row the names in equal temperament; and the third row the deviation from equal temperament in cents:

1	33	35	9	77	5	81	21	11	45	3	49	99	25	27	55	7	15	121	63
F	F \sharp	F \sharp	G \sharp	G \sharp	A	A	A \sharp	B	B	C	C	C \sharp	C \sharp	D	D	D \sharp	E	E	F
0	-47	-45	+4	+20	-14	+8	-29	-49	-10	+2	+38	-45	-28	+6	+37	-31	-12	+2	-27

The resulting “Magic Square”, has often appeared on recordings of my music. It illustrates how the pitches are related:

1	3	5	7	9	11
3	9	15	21	27	33
5	15	25	35	45	55
7	21	35	49	63	77
9	27	45	63	81	99
11	33	55	77	99	121

These mathematically related overtones are heard as tonal relationships when they are transposed and sounded above a fundamental tone. It is as if one changes key, but retains the root fundamental at the same time. I’ve always called these relationships “tonal families” which are only perceivable when they are sounded along with the fundamental tone.

At the time I wrote the following text to explaining the system.

The relations between pitches are understood through an examination of the factor that result in that particular pitch. For instance, the pitch (35), being divisible by five and seven, is a member of both the Five and the Seven families. In the tonal context of the Five Family, the pitch (35) carried a tonal weight of a seven (there is an interval of a minor 7th from (5) to (35), or, in other terms, $35:5=7:1$). When, on other hand, (35) is sounded in the context of the seven family, we hear it as a five in relation to (7). Each family contains two pitches that can only be related within that family. These are the “root pitch” and its square. In the Seven family these are (7) and (49), which are both divisible only by seven.¹⁹

It has been almost thirty years since I began composing in this tonal system, which

19. M.A. Graduate Thesis, Wesleyan University, 1982.

only includes harmonic overtones in their relation to the fundamental tone rather than intervals between harmonic overtones²⁰. A possible expansion would include the pitches based on the 13th and 17th harmonic or further up the series, as this system is in theory infinitely expandable. Yet the addition of the 13th partial would add six new tones (that of the 17th would add seven more tones, and so on...) and I have found the tonal palette of consonance and dissonance sufficient up this point in time.

20. Therefore, the “4th” (ratio $4/3$) does not appear as an interval step. It is implied whenever a perfect 5th is sounded along with the next highest octave.

XI

The notations used in the ensemble in the early years were fairly rudimentary, elaborating the tonal chord changes but leaving most rhythmic aspects up to idiosyncratic notations by the musicians themselves. The rhythmic patterns were derived from the simple “beating and brushing” techniques used in the solo performance on the Excited Strings Double Bass. Most of the early pieces were assembled according to my basic sketches within a workshop period together with the musicians. I often thought of structure in terms of linear edits, most likely reflecting my background in film and video structures.²¹ I would conceive the structure in terms of “blocks” or “loops” which are comprised of a rhythmic pattern, a tonal chord, and a specific instrumentation which included specific performance techniques.

21. Many years later, I titled a work: *Next Slide* (appearing on *Animal Magnetism*, Tzadik, 1995).

The first ensemble music naturally developed out of my solo performance of *Nodal Excitation*; reflected particularly in the steady rhythmic pulse of striking the wires which was translated for the ensemble.

Below is an example of an early piano chord progression from *Slow Changes* on my first recording:

7	1	35	21	49
55	1	5	55	
27	1	9	81	3
15	1	5	45	25

I first began to write out scores for the ensembles with notated rhythmic patterns in the early 1990s. Since the musicians in my ensembles

were already familiar with the tuning system, it was sufficient to only to give the pitches as harmonic numbers corresponding to each rhythmic pattern.

Until the end of the '90s, each rhythmic and pitch loop was repeated until a cue to change was given by one of the performers, usually the drummer or myself. The result was that these blocks were generally longer in live performance (responding to the atmosphere of the live situation) than on the resulting studio recordings. The first fully written out scores finally fixed the time duration of all loops, though occasionally adjustments were made in performance.

After receiving a commission to compose a string octet and string quartet²² in 2002 and 2003, I understood that it was necessary to develop a notation for classically trained musicians who had neither the time nor inclination to learn and understand my tuning system. For these two pieces, I had the musicians retune the open strings of their violin family instruments. Only open strings and flageolets (fingered natural harmonic partials) were allowed in the score, resulting in an unusual sonority.

In 2005, I was commissioned by the Irish Arts Council to compose a piece for the Crash Ensemble, based in Dublin. During a number of workshop periods where I introduced the tuning system, the Crash Ensemble became the first group outside of my former orchestra to learn to perform in my tuning system. I expanded upon the tuning information included in the previous scores, notating the pitch to the nearest equal-tempered note. The additionally provided tuning information provide the musician with information for locating the correct pitches after a short introductory training period:

The image shows a musical score for Flute (Fl.) and Violin (Vin.). The Flute part is on a treble clef staff and contains three notes with specific tuning instructions: C+38 (49), G#+20 (77), and A#-29 (21). The Violin part is on a treble clef staff and contains a triplet of notes with the instruction D#-31 (7). The Flute part is marked with measure numbers 806 and 265.

In the case on the upper left: “C” is the equal tempered note, one is the C is to be played 38 cents higher, and the note is called “49” in my system.

XII

Acoustic knowledge is now passed on by instrument builders and physics departments of universities. Whereas a music maker might at one time have taken upon himself the responsibility of instrument construction or the supervision thereof, as well as the adaptation and selection of a tuning system, the music maker today farms out these responsibilities...²³

...in the development of my music, it has been the instruments themselves that have been my greatest teachers.²⁴

In the early years, I spent a great deal of time researching the development of western and non-Western instrumentation. I apprenticed myself to a number of instrument builders, but learned quickly that a life in a woodworking shop was not for me. I took apart countless instruments in my studio, and I’ve probably been more adept at “communicating” with the idiosyncrasies of the instruments themselves than with the instrumentalists!

The instrumentation of my ensembles was first based upon the rich textures in the combination of the Excited String Bass sounding together with the miniature piano (both described above). Additions to the basic sound module included, in various combinations, the string sounds of a second Excited Bass (with an extended neck), a hurdy gurdy, a cello, and a violin. Also constructed were two acoustic “string drums”: a Transylvanian “Gardon” and a Basque “Ttun-ttun”. Over the years, I have experimented with additional brass instruments, including French horn, trumpet, trombone and tuba. Brass players, trained to adjust from the natural overtone series, can easily understand the tuning system, and with some “un-training” can learn not to “adjust” for equal temperament. Some dedicated musicians have also found alternative fingerings for flute; soprano, soprano, alto and tenor saxophones²⁵ and the clarinet. This is needless to say, not an easy task!

In working with the violin family and with the acoustic guitar, I developed an analogue technique to the rhythmic production of overtones on the “Excited Strings” bass. This rhythmic bowing technique for violin, and an analogous rapid plucking technique for acoustic guitar, (moving toward and away from the bridge) has appeared again and again in numerous pieces.

In 1990, as I re-formed the second ensemble in Berlin, the “Midget

23. Unpublished manuscript, 1978.

24. *The Sound of One String*, Arnold Dreyblatt, in *ECHO, The Images of Sound*, Apollohuis, Einhoven, 1987.

25. Most notably: Werner Durand, Erik Balke: saxophone; Evan Zipoyrn: clarinet; Susan Doyle: flute.

22. *Music for 32 Strings* (Octet), 2002; *Music for 16 Strings* (Quartet), 2003 were both written for the Pellegrini Quartet (additional musicians were added for the Octet).

26. A hammered-dulcimer with the case iron frame of a piano, first invented in Hungary.

Princess Pianoforte” found a new life as kind of cimbalom²⁶. The original action had been disintegrating, and it was restrung with two strings per note and hand-held cimbalom hammers were built for it. Needless to say, the action was taken out and the instrument has been played on its back ever since. It was brought to New York for a number of concerts with the American ensemble which was formed to record and perform *The Adding Machine*, and it remained there until it accidentally disappeared from a storage room in 2005, only to be miraculously relocated by years later by guitarist Marc Stewart.²⁷

Also in 1990, I had an electric guitar built to my specifications for the original solo version of *Animal Magnetism* with a built-in E-bow-like magnetic driver system and a fingerboard which had frets fitted for the intonation of my music. Additional copies of this instrument were made by the Bang On the Can All-Stars and by the Austin New Music Co-op in order to perform my compositions without my presence.

Two great improvisational musicians have worked with my ensemble. Vocalist Shelley Hirsch, was invited in the '90s to perform an essential musical role in my multimedia opera project, *Who's Who in Central & East Europe 1933*, for which she first improvised and then fixed her parts for tours of western and eastern Europe from 1991–97. Klezmer clarinetist Andy Statman recorded two tracks with the ensemble in New York in 1991²⁸, and later was invited to Berlin to perform these and other pieces in 1995.

XIII

It's interesting to recall just how limited the “downtown new music” scene really was back in the 1970s when I first became active. It was often the case that one knew everyone in the audience, and there were very few possibilities outside of New York and a handful of other cities to make this music heard. Without doubt, this situation contributed to my initial “escape from New York”, as I first toured a culturally decentralized and heavily funded Europe in the early 1980s. In 1995 I received a fax from the then relatively unknown Jim O'Rourke in Chicago inviting me for a concert at “Lounge Ax” and for a CD reproduction of my first record. Thus began a sustained interest in my music from a younger generation, whose ears had been trained by “Ambient”, “Techno” and the flexibility of digital “ready-made”

music to appreciate the most stringent minimalism and who have a fluid rejection of the traditionally rigid categories of “composer”, “performer” and “originator”, which I have found to be very healthy. As a result of these resonances, in recent years, performances on the “Excited Strings” bass have been revived in recent years, gradually developing into a largescale solo work that now stands on its own. I've also been experimenting with a kind of “instant-band” concept of late, in which I meet a group of diverse musicians for a short workshop of up to one week, creating, rehearsing and “fixing” a number of pieces for a resulting performance.

Since ending the last “Orchestra of Excited Strings” in 1997, I've attempted to challenge myself with new musical situations, commissions and collaborations within both the “composer” music world and in contexts which reflect the interests of the “electronica” and “club” scene. I've never been easy to categorize, and as my parallel activates in theater and the visual arts have deepened in the last fifteen years, the external confusion has mounted. While my music has certainly grown from its initial interests in the 1970s, the following words, which I originally wrote in 1985, would still hold today:

One could say that the entire history of my work in music has been derived from a single, subjective experience of sound. It is this experience which has which generated the musical ideas—and not the other way around. One might speak about a “mode of listening”—to the timbral and textural qualities that constitute what for me is a “great sound”. Without the dominating presence of these subjective acoustic qualities I feel that something is missing...²⁹

29. Ibid.

28. *Concert Notes*, 1979.

27. Found on *A Haymish Groove*, Extraplatte, 1992.