Composition - Master Thesis
Royal Conservatory of The Hague
SEAMUS CATER
1 May 2020

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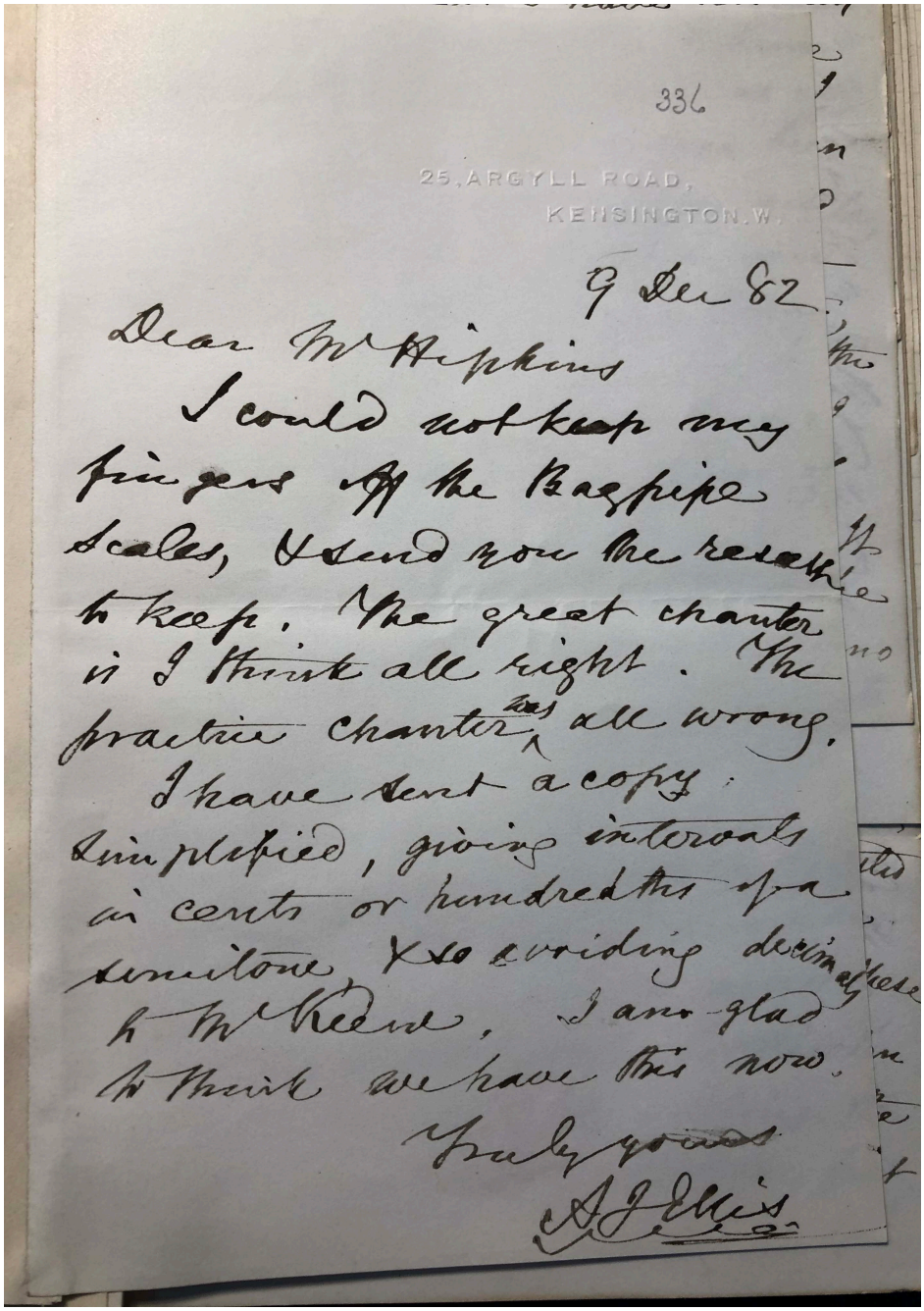
(RE)SOUNDING ALEXANDER J. ELLIS: A SPECULATIVE BIOGRAPHY THROUGH TUNING, SONG WRITING AND COMPOSITION.

CONTENTS.

CONTENTS, continued.


336
25, ARGYLL ROAD,
KENSINGTON, W.
9 Dec 82
Dear Mr Hipkins
I could not keep my fingers off the Bagpipe scales, & send you the results to keep. The great chanter is I think all right. The practice chanter was all wrong.
I have sent a copy simplified, giving intervals in cents or hundredths of a semitone, & so avoiding decimals to Mr McKeene. I am glad to think we have this now.
Truly yours
A J Ellis

25 Argyll Road,
Kensington. W.
9 Dec 1882

Dear Mr Hipkins,

I could not keep my fingers off the bagpipe scales, I send you the results to keep. The great chanter is I think all right. The practice chanter was all wrong.

I have sent a copy, simplified, giving intervals in cents or hundredths of a semitone, and so avoiding decimals to McKeene. I am glad to think we have this now.

Truly yours,
AJ Ellis[1]

[1] Item 336 – Add MS 41636 to 41639, British Library (Alfred Hipkins folios 1795 - 1927). Letter from Ellis to Alfred Hipkins, 9 December 1882, pertaining to the concertina which Ellis had tuned in a combination of Equal and microtonal bagpipe temperament.

Pesthuislaan 41
1054RH Amsterdam
29 March 2020

Dear Mr Ellis,

I address you across time with no real hope of reply, to inform you of my interest in your work. When this project began I had not imagined being overtaken by the desire to find music within your story, but it has happened and I hope it might comfort you to know.

Initially, a coincidence occurred where I discovered a footnoted Google reference to a Victorian gentleman tuning a concertina in Just Intonation. This had been my plan and it was temporarily dispiriting to find I would not be the first. Later, on reading your translation of Helmholtz, I understood the gentleman to be yourself. This gave a renewed impetus to continue the plans for my own retuned instrument, and to connect my project with yours. I was relieved that somehow, to the best of my knowledge, between June 4th 1875, when you signed off your translation at 25 Argyll Road, and now, that no further concertinas had been experimentally tuned.

Further to this I had the idea to put myself in your place, to try to imagine how you might have enjoyed music, playing in your private residence, or publicly at the Royal Society. I wanted to channel your delight in the investigation of musical pitch. I decided to speculate and make music with the means you had at hand.

After the successful tuning of this instrument, which combines your research with that of Helmholtz, I set about writing a series of songs, using carefully chosen words from your writing. The fragments chosen were first adapted into short poetic forms and afterwards set into song and arranged for the extended Pythagorean system you outlined within On The Sensations of Tone.

You talked of playing airs but your legacy is to be known as philologist, mathematician and musicologist. I wanted to hear the music which you may have heard or imagined in your time, and to achieve this I adapted an instrument unheard for more than a century, and let it sound with the knowledge I would be experiencing something only you have experienced previously. This shared experience is certainly the reason we are meeting now. It has been an act which I hope you will share my excitement in.

Truly yours,

S Cater

CHAPTER I

INTRODUCTION - FINDING AND (RE)SOUNDING ELLIS

This project is an attempt to explore a method of speculative biography through musical composition and tuning, taking Alexander J. Ellis as an object of research and creating opportunities for exploring elements of his output with the instruments available in that period.

I will present a kind of (re)sounding of some of Ellis' ideas, (re)sounding them in a manner I postulate he may have experienced or imagined himself, playing for pleasure in his Kensington home, measuring instruments with tonometers at the South Kensington Museum, or delivering the results of experiments at Burlington House, some hundred and fifty years previously during the peak of his undertakings. The (re)soundings bring together found information from archival research, transforming or projecting the traces into musical actions.

Since Victorian times, the most accepted approach to biography is that of gathering disparate facts to present as an authoritative narrative, somewhat akin to the form of the modern novel. In the contemporary literary discourse around biography, which falls under the umbrella of "life-writing", expectations on form are less prescriptive, with genre boundaries being continually challenged. My work renders various parts of the Ellis archive audible.

Paradoxically, then, it can be argued that our contemporary notion of biography (and, to a lesser extent, autobiography) as a historical or referential genre is also founded on the narrative strategies espoused by writers of fiction in an earlier era[2].

Without attempting an authoritative literary biography, much of my research is carried out in a similar fashion to that of biographer or historian. Information is gathered from public and private resources. Source texts, digital archives, libraries, biographies, anecdotes, translations, original letters and museum visits, have provided the background of a character who's surviving biographies, in the Grove Dictionary of Music and various Victorian journals, are mostly extremely lacking and often containing duplicate information. At this point in time, not enough has been written about Alexander J. Ellis, and while I explore this historical figure using composition as a method of representation, I consider my research a beginning, with many lines of enquiry remaining open for tracking down further correspondence and archive material.

So far, the private letters I have encountered are high in quantity but also highly technical in nature. These letters have offered an opportunity to build a subjective instinct towards a perceived personality of Ellis. Behind a Victorian formality of style a picture can be intuited. The letters were mostly written to Alfred Hipkins[3], a Victorian piano tuner who assisted Ellis. Taken in combination with texts in the public domain, the picture broadens. I do not intend to attempt a production of this picture as narrative, instead I hope the music will open a space for thinking about Ellis in a non-linear fashion.

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[2] Julia Novak - Lucia Boldrini and Julia Novak, Experiments in Life-Writing, Intersections of Auto/Biography and Fiction. Palgrave Macmillan, 2017. p.5

[3] British Library, Hipkins papers. Music Collections, Add MS 41636-41639. 4 bound folios of letters to Alfred James Hipkins, F.S.A (1826-1903), chief piano tuner for Broadwood Pianos. Hipkins assisted Ellis in much of his research concerned with tuning. Among the letters written to Hipkins, the folios contain 36 from Ellis, dated between 1876 up to Ellis' death in 1890. In a handwritten biography of Ellis within the folios, Edith J. Hipkins states that there were hundreds of letters from which these 36 were chosen to preserve. Hipkins was highly concerned with the standardisation of international tunings and part of his work was teaching piano tuners to tune equal temperament accurately.

1.1 Mixing our sensibilities

I can take the words of Ellis and imagine structural ideas based on the encountered traces of his personal trail. The data from his musicological experiments, can also be used to produce instruments and structures for music. But at best, the musical objects which I make, especially the songs, can only be a kind of mixing of mine and his sensibilities. What I perceive of Ellis is filtered through my own performance sensibility and inevitably this colours the work and creates a kind of blurred boundary between us. Despite embodying the words, above the instrument not dissimilar to his, I can only be myself in the moments of performance. The emotional markers I create should not be read explicitly as those of Ellis. While the execution is mine, the words are his, and I raise the issue that any muddling of personae engendered in this intermingling is projected by the observer or listener. I do not attempt to graft myself into the Ellis history but do hope to draw attention to unknown facts and minutiae.

Unintended misrepresentations are unavoidable. In relation to the narrative nature of traditional biography, Hilary Mantel talks about taking the past out of an archive and locating it in a body[4]. By doing this, she is creating a fictional self for delivery of the archive material, but in my case, especially in the songs, the self in which I locate the archive is mine, and not at all fictional.

1.2 Another lacking biography for background

As well as an enormous output of writing around acoustics, musicology, phonetics, dialect, language and mathematics, Alexander J. Ellis (1814 – 1890 b. Hoxton) added a substantial appendix (160 pages) to what I would call a diligent, bordering on lovingly crafted English translation of Hermann L. F. Helmholtz' *On the Sensations of Tone as a Physiological Basis for the Theory of Music.* Within the body of the translation he also added an enormous quantity of footnotes in a running dialogue with Helmholtz' work. The footnotes illustrate a testing of the theories of Helmholtz, where many experiments were double checked or explored with differing means, especially towards the musical. This being no mundane word exchange, Ellis was concerned to empirically understand, represent and expand the original text.

A Victorian scholar of independent financial means, enabling the possibility of devoting oneself to a life of self directed study after an Eton and Cambridge education in mathematics and classical languages[5], Ellis eventually became a Fellow of the Royal Society, delivering and publishing many papers within the specialities of music, physics, mathematics and philology. He was an early phonetician, creating one of the first phonetic alphabets, some letters of which are still to be found in the International Phonetic Alphabet[6]. He is also now considered a founder of comparative musicology for his statistical pitch analysis of musical scales, using the cent system, which he invented as an alternative to the then standard practice of denoting tunings in Hz. The cent allows equally tempered semitones to be given adjustments of plus or minus 50ct and thus expresses the octave in gradations of 1,200 cents[7]. Nearly all modern tuning in musical contexts uses the cent as reference.

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[4] Hilary Mantel, BBC Reith Lectures, BBC Radio 4, 2017

[5] Tucker, *Sketch Of The Life Of The Late A. J. Ellis.* General Report (Association for the Improvement of Geometrical Teaching), Vol. 17 (JANUARY, 1891), pp. 49-54. Published by: The Mathematical Association.

[6] Wikipedia, *International Phonetic Alphabet*: Some discussion of Ellis' role in the development of the IPA. https://en.wikipedia.org/wiki/International_Phonetic_Alphabet

[7] Jonathan P. J. Stock, *Alexander J. Ellis and His Place in the History of Ethnomusicology,* University of Sheffield, Society of Ethnomusicology, 2007

1.3 Approaches

In order to execute a (re)sounding of the ideas of Eliis, I have engaged with two major practical accomplishments: Firstly, his re-tuning of at least 4 English Concertinas in non-standard tunings or temperaments, these being the only extant documented instances of such instruments being tuned with any method, excluding Meantone or Equal Temperament, and secondly, his massive research project *On the History of Musical Pitch*, originally published in the Journal of the Society of Arts, London, March 5, 1880, later to be included in the translators appendix of the second English edition of *On the Sensations of Tone,* 1885[8], as *The History of Musical Pitch in Europe*.

The technical work leading up to this thesis includes the re-tuning of a 1924 concertina made by Wheatstone, the same manufacturer as the Ellis instruments, furthering his project to include extended possibilities of pitches. Additionally, I have tuned 74 tuning forks to different instances of the note A, based on *On the History of Musical Pitch*. The forks are a physical and sounding representation of the data, tuned in Just Intonation relationships, to be performed by 4 fork players, speaking voice, sine waves and flute. After this period of tuning research and execution, I created a suite of songs called *Traces of Alexander J. Ellis*, for concertina and voice which extract different textual elements from Ellis' archive.

[8] Hermann L. F. Helmholtz, *On the Sensations of Tone as a Physiological Basis for the Theory of Music.* Translated by Alexander J.Ellis. 2nd English Edition of the 4th (and last) German Edition. Longmans, Green, and Co. 1885. The first (1875) and second (1885) English translated editions differ somewhat. Ellis added more of his own research and the quantity of drawings in the translators appendix is expanded. A note on the edition information of the title page includes 'especially adapted to the use of musical students'.

Pesthuislaan 41
1054RH Amsterdam
30 March 2020

Dear Mr Ellis,

After Helmholtz, further surprises were in store; 'On The History of Musical Pitch', 'On The Musical Scales of Various Nations', 'Notes of Observations on Musical Beats', 'On the Influence of Temperature on the Musical Pitch of Harmonium Reeds', and so on. I made discoveries in these papers which are not to be found in existing biographies and all of them fed into songs in some way.

Your letters from the Hipkins Papers, now collected in folios at the British Library, gave me a more intimate picture of you. While mostly they retained a formality of style, over time a softening in your relationship with Hipkins was apparent, as glimpses of your humour, tireless enthusiasm and generous nature became visible.

While searching existing papers, I always looked for a written exclamation of your passion for the playing of music. So many times you talk of playing airs to demonstrate particular scales, and from this I think you must have enjoyed playing. But I also I imagine that the humility for which you were known may not have translated into exclamations to share your love of playing. I can't know this of course but I sense your desire to play to have existed alongside the scientific research you documented so extensively.

I have come to wonder many things, like whether you practiced singing in Just Intonation, either unaccompanied, or together with your experimental concertinas? I imagined you speaking parts of your speeches while practicing the concertina, to steady your nerves with the knowledge you were speaking above justly intoned intervals, adding gravity to your message. Please tell me if you did. I find this to be quite comforting, a sounding accompaniment to speech. I also wondered if we could have been friends. Perhaps we could have made experiments together, to test the possibilities of sustaining pitch memory with and without a sounding instrument. Perhaps we could have collaborated on a musical realisation of 'On The History of Musical Pitch'. I would have loved to have your input.

Thank you so much for taking the time to think along with my project.

Truly yours,

S Cater

CHAPTER II

TRACES OF ALEXANDER J. ELLIS

Traces of Alexander J. Ellis is an unfinished suite (c. 2020) of songs, which use selected written phrases of Ellis and abstract ideas related to his practice.

Using song, I wanted to combine the words of Ellis with the sound of the instrument to which he was so dedicated. Ellis played the English Concertina and used five instruments to experiment in the harmoniousness of different tuning systems[9]. Three of these are mentioned in *On the Sensations of Tone*; Just, Pythagorean and Equal Temperament.[10]. Two others, of less historical importance, are mentioned in another Ellis publication, *On the Musical Scales of Various Nations*[11]. At least two of these instruments are in the collection of the Horniman Museum in London. The instruments were all tuned professionally.

"The English Concertina had, for my purposes, two important advantages over any other instrument. First, I had been familiar with it since boyhood, having possessed some of the earliest concertinas made. Second, it has 14 notes to the octave, and was hence well adapted to introduce extra notes for various purposes."[12]

From this quote, and the footnote below listing the instruments tuned, we can be certain that as well as a scientist, Ellis was a musician capable of performing in public. I have not discovered compositions by Ellis, although there are several poems in the many letters written to Alfred Hipkins. I surmise him to have been more a man of letters, with great theoretical / scientific knowledge of music and practical levels of musical skill. He may have played for private pleasure, and certainly played publicly to demonstrate musicological facts but I have not found evidence of a desire to be a musical performer of any ambition. This is contrary to his obvious desire to be a highly regarded public scientist. Perhaps music was a exciting scientific territory for Ellis.

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[9]Alexander J. Ellis, *On the Musical Scales of Various Nations*. Journal of the Society of Arts. March 27 1885 vol xxxiii. p. 485 *"These five instruments were tuned as follows [tuned with great care by Mr. Saunders, of Messrs' Lachenal and Co."]:*

a. ***Meantone****, giving the old unequal temperament with extra A flat and D sharp.*

b. ***Equal and bagpipe****, giving the complete equal temperament, and also the bagpipe scale, and Meshagah's Arabic scales, allowing me to illustrate these by playing airs.*

c. ***Just****, giving the accurate harmonic scales of F, C, G major, and E major and minor, enabling me to illustrate the ancient Greek tetrachords.*

d. ***Pythagorean****, containing the 14 notes tuned as a succession of perfect fifths, allowing me to illustrate the Pythagorean or later Greek form of the several Greek modes, and also most of the medieval Arabic scales.*

e. ***Javese****, the white keys giving the Salendro, and the black the Pelog scales. This was from forks adjusted by myself to the pitches of the Javese instruments which were played at the Aquarium in London, in 1882, as ascertained by Mr. Hipkins and myself from careful examination. This enabled me to play several Javese airs."*

From the footnote discussing instruments used to illustrate the delivery of this paper. Ellis demonstrated examples of scales and airs during the presentation. It is not noted in the paper which airs or scales were demonstrated.

(Mr. Saunders [mentioned in footnote 9] had previously tuned for Wheatstone) – this information comes from Robert Gaskins: George Jones, *Recollections of the English Concertina*, 1844, published at Concertina.com by, 2004
http://www.concertina.com/jones/recollections/

[10] Helmholtz, p. 680-681. In Appendix XIX, Ellis discusses the ' Just English Concertina' and gives detailed explanations of the instructions to the tuner. He also states that The *"Pythagorean system,* [was for] *for constant comparison with just intonation".* Throughout the translation there are occasional footnote references to different concertinas, not always specifying which instrument.

[11] Alexander J. Ellis, *On the Musical Scales of Various Nations*. Journal of the Society of Arts. March 271885 vol xxxiii. p. 485

[12] Ibid.

My main practice of recent years has been built around song writing, but much of my playing has involved instrumental music, especially connected to minimal and reductionist styles which fit within Echtzeitmusik (Berlin) and Wandelweiser schools.

I had earlier retuned several harmonicas with just triads and 7th chords but wanted more flexibility than a mere four note system. I wanted to be able bring natural harmony, or Just Intonation, into my song practice. This way I would be in possession of an instrument where I could hear, sing, and experiment heuristically with Just intervals.

Previously, my song practice has also used biography. A series of songs from 2012[13], was a suite of biographies of artists, where the songs were delivered in first person, in the autobiographical voice. This was of course also speculative, based on multiple points of research, highlighting and embellishing particular anecdotal aspects of the subject's stories.

For *Traces of Alexander J. Ellis* I did not want to make a subjective re-telling of, or synopsis of the Ellis story. Instead I would keep it simple. Having immersed myself in his work, I chose small fragments of text, transposed them into poetic structures and set these to music with the newly tuned concertina. This provided me with a framework to artistically explore these new sonorities.

The tuning of the concertina is discussed in detail in the Appendix I of this paper[14]. Essentially I use a very basic just intonation system, where only the fifths are tuned justly. It is Pythagorean in nature, but Extended, as the chain of fifths uses 24 instead of seven, twelve, or fourteen (as Ellis) pitches. This gives many intervals, in small number ratio relationships, which are almost perfectly Just.

This system is outlined by Helmholtz and Ellis in *On The Sensations of Tone,* and it makes my instrument a modern descendent of the Ellis Pythagorean concertina. Because of developments in the design of concertinas, my instrument being 70 years younger, afforded 24 unique pitch classes within one of the octaves.

Ellis used his instrument for 'constant comparison with equal temperament' but didn't expand much further than this. I used this instrument for exploring, with a heuristic approach, the harmonic possibilities of extended Pythagorean harmony / natural harmonic series[15].

Most of the acoustic research of Ellis was in listening for and measuring scientific phenomena; listening for different kinds of beating, effects of temperature on pitch, classifying sonorities and organising data. I wanted to explore these phenomena within musical structures and give voice to the words, to express these things musically and poetically, without being necessarily didactic. His approach was scientific, mine artistic, but hopefully revealing some scientific phenomena through performance. Instead of measuring intervals, I try to activate them in music.

Getting to know the instrument was initially related to discovering its own capabilities, and then more thoroughly how these capabilities could be utilised to highlight words

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[13] Seamus Cater and Viljam Nybacka, The Anecdotes. Anecdotal Records 2012. https://seamusandviljam.bandcamp.com/album/the-anecdotes

[14] See Appendix I of this paper for a comprehensive description of how 'practically just' intervals work, when tuning a chain of 24 just Fifths.

[15] Helmholtz, chapter XIV. p. 431. This is discussed by Ellis in footnote to Helmholtz. Ellis states "a temperament with perfect Fifths [my extended Pythagorean] and major Thirds too flat by a skhisma, or nearly the eleventh of a comma, and which I therefore call Skhismic temperament".

from the Ellis story. The concertina in this project has therefore been investigated as an instrument of material potential for exploring the ideas of Ellis and framing them as musical works.

Pesthuislaan 41
1054RH Amsterdam
30 April 2020

Dear Mr Ellis,

Much of the following chapter gives a background to the choice of words in the songs, coupled with a technical description of the harmony.

I suppose therefore that it is a very analytic chapter. I know you will not have trouble in deciphering the nomenclature but I should really apologise to those that struggle with technical details.

I should also say that this is not why I made this music. It was never an intention to explain music theory or extol the virtues of one system over another.

This has always been a project of learning, about pitch, or tone, or sound, with the aim of finding new music along the way. Funny to say 'new', when this project is so Victorian in nature.

Most importantly, these songs represent my meeting with your work and its translation into music. I call it 'mixing our sensibilities'. I have always loved biography, but yours came to me through texts and letters which had not been written up in book form. Each item giving another sense of you, which slowly grew into an image. Not one I can see, like the two photographs of you in later life, but one which I perceive.

This image is there when I write, practice and perform the songs. But instead of trying to conjure the image, I can only actually embody or give voice to the words, and perform the physical gestures required for manipulating the instrument. All the elements are yours, the traces, the words, the tuning system and the gestures of playing you would have experienced yourself, but the body, voice and performance psychology in the middle of these elements is mine. Let's make a list out of this:

Yours	***Mine***
archive	*body*
history	*presence*
traces	*image of you*
letters	*voice*
writing	*re-writing*
theory	*practice*
demonstration	*play*
measuring	*sounding*

I think this kind of covers it? Each of my elements are responses to yours and somehow become this present but unseen image. I hope an image like this will be there for an audience also.

Can you see what I'm getting at by calling this mixing our sensibilities?

Truly yours,

S Cater

CHAPTER III

TRACES OF ALEXANDER J. ELLIS – THE SONGS

Pesthuislaan 41
1054RH Amsterdam
1 April 2020

Dear Mr Ellis,

You wrote of singing in Just Intonation, how voices sounding together harmonise and indeed settle into just relationships. This was true of the Tonic Sol-faists, in whom both you and Helmholtz were interested. Their musical training nurturing the singing of natural rather than tempered intervals.

I've given this some thought in relation to what I am doing. Singing alone with an instrument. If I sing the just pitches and intervals which are present on the extended Pythagorean concertina, I can produce them reasonably well with the instrument sounding. Sometimes, it really takes concentration to sing them accurately, and I might sing sharp or flat (this creates a beating between voice and instrument, which I'm sure you might appreciate). But to a great degree, I have found it hard to sing the intervals accurately unaccompanied. My pitch memory is lacking here. Sometimes I have to wait until I hear the pitch sounding before singing, some days are better for this than others. Recently though, because of the current period of isolation, I have more time on my hands and I can practice more thoroughly. Instead of treating the body of songs as a repertoire in preparation for a concert I am trying to listen more closely to the tuning of the intervals as I sing. This helps a lot. I've spent nearly a year playing the instrument now, and despite feeling I have quite some way to go towards real competence, my affinity with it is growing.

Singing the interval of a comma for example is a fun thing to practice and is now possible to an approximate degree unaccompanied. It is good to be able sing an interval smaller than a semitone! But to pitch a melody which involves a commatic shift when modulating is very hard, if not impossible, for me at this moment anyway.

I'll keep work working on it.

Having such an instrument, where I can demonstrate the sound of a comma, or a Pythagorean third against a just third, has been quite a luxury, and as time has gone on I have discovered more complex intervals. I never could have practiced these intervals in a 12 tone system and I'll try and outline some of this as I go on.

Truly yours,

S Cater

Pesthuislaan 41
1054RH Amsterdam
30 March 2020

Dear Mr Ellis,

Was this a gift for me, planted in time, discovering 'On the Influence of Temperature on the Musical Pitch of Harmonium Reeds'?

I was mid-process in tuning the Pythagorean concertina, during a month of fluctuating temperature and had already discovered inaccuracies between late afternoon measurements and early morning re-measurings. I felt a point of connection here.

You stated that the pitch of vibrating metal is affected by temperature. Cooler temperatures raising the pitch, warmer the inverse. In the experiment, you discovered that harmonium reeds are affected by temperature in the same way as tuning forks, by twice the amount (1 in 10,000 vibrations for each degree Fahrenheit)[16].

My idea for the series of songs is to embody and perform your words, with this act of embodiment being a kind of blending of our sensibilities, yours as scientist and mine as composer/performer. I am calling the series Traces of Alexander J. Ellis. Observations is the first song and I chose to use the opening sentence of the above mentioned paper, which I am pleased to say I obtained a original print of.

To set the words I needed a musical structure and was reminded of you performing airs to demonstrate the findings of the paper 'On the Musical Scales of Various Nations', which you delivered to The Royal Society in 1885.

I needed an air from the period.

Searching through popular music from the late 1800s, using Wikipedia, revealed an Alfred Tennyson poem, Sweet and Low[17], *which had been set to music by Joseph Barnby in 1863. At the risk of projecting, there is no reason why you would not have been familiar with this piece, Tennyson being Poet Laureate in this period (1850-1892), you being an amateur poet*[18]. *The harmony can easily be adapted to the extended Pythagorean concertina.*

My arrangement utilises the practically just major triads C-Fb-G and F-Bbb-C, with Fb and Bbb being the 'practically just' 5/4, one comma back from the 81/64 (E or A). The chords of G and Dm use standard Pythagorean intervals G-B-D and D-F-A, B being the 81/64, F being the 32/27. Additionally, two harmonic series intervals, the 7/8 and the 10/4 were included with Pythagorean and extended Pythagorean intervals (Cb and Bbb) as intro/outroduction material. Using C as a fundamental, the Extended Pythagorean interval Cb is a practically just 15/8, Bbb the practically just 5/3.[19]

After adapting the harmony, the words from Sweet and Low were substituted with your introductory sentence. One cycle of the song structure is filled with one sentence from the text, replacing one magnitude with another.

Truly yours,

S Cater

P.S An important point to note is that there will probably be a second part of this song, related to the high summer temperatures of 2019. At the tail end of the first 2019 heat wave, I

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16 Alexander J. Ellis, *On the Influence of Temperature on the Musical Pitch of Harmonium Reeds.* Journal of the Society of Arts. January 1881 vol 31. p. 413

17 https://en.wikipedia.org/wiki/Sweet_and_Low_(poem)

18 British Library, Hipkins papers. Music Collections, Add MS 41636-41639. Several letters to Hipkins are accompanied by handwritten poems.

19 Appendix I of this paper gives a clear outline of 'practically just' intervals.

was walking through Dusseldorf on my way to the Klangraum Festival. To get to the hotel I had to walk down Helmholtzstrasse and somehow this triggered an idea for a piece. Because I am making (re)soundings of your research, I should record the same piece of music in heat wave conditions and then again in sub zero conditions, to make the phenomena audible as a musical work. On returning to Amsterdam however, the heat wave had subsided, but later in August there was another heat wave where I promptly wrote the song. I would record the harmony at home in Amsterdam immediately, and then again in London in winter, preferably in the courtyard of the South Kensington Museum, where you made your experiments for this paper. Fyi, SKM is now called the Victoria and Albert Museum.

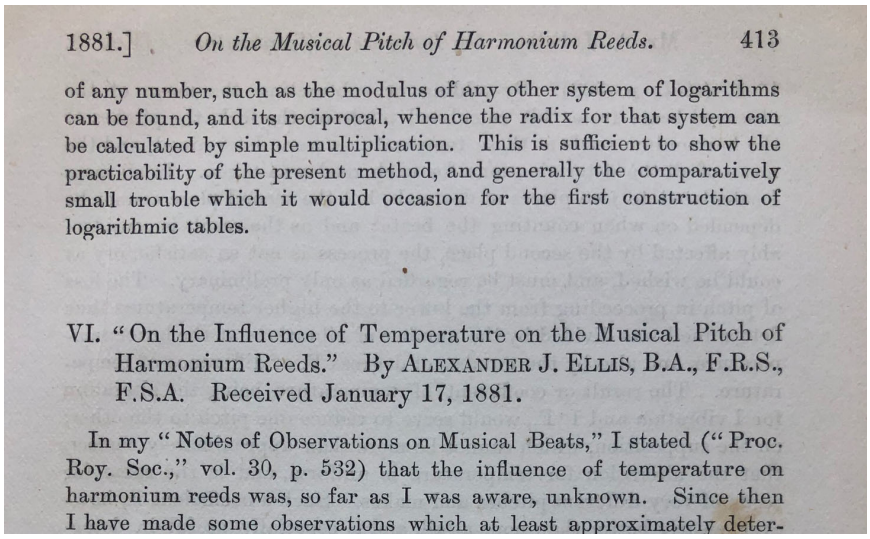
Although a recording of the original chord sequence was made during the second heat wave, it was an early realisation compared to the subsequently developed song for live performance. Winter of 2019/20 was damp and did not produce any extremely cold dry spells. I did not consider it safe to record a cold version in damp conditions in case the instrument was damaged by the extreme cooling and damp air. As you know, this could lead to the wood splitting or new rust on the reeds.

3.1

OBSERVATIONS (2019)

Observations

In my notes
of observations
on
musical beats
I stated that
the influence
of temperature
on
harmonium reeds
was so far
as I was aware
unknown



1881.] *On the Musical Pitch of Harmonium Reeds.* 413

of any number, such as the modulus of any other system of logarithms can be found, and its reciprocal, whence the radix for that system can be calculated by simple multiplication. This is sufficient to show the practicability of the present method, and generally the comparatively small trouble which it would occasion for the first construction of logarithmic tables.

VI. "On the Influence of Temperature on the Musical Pitch of Harmonium Reeds." By ALEXANDER J. ELLIS, B.A., F.R.S., F.S.A. Received January 17, 1881.

In my "Notes of Observations on Musical Beats," I stated ("Proc. Roy. Soc.," vol. 30, p. 532) that the influence of temperature on harmonium reeds was, so far as I was aware, unknown. Since then I have made some observations which at least approximately deter-

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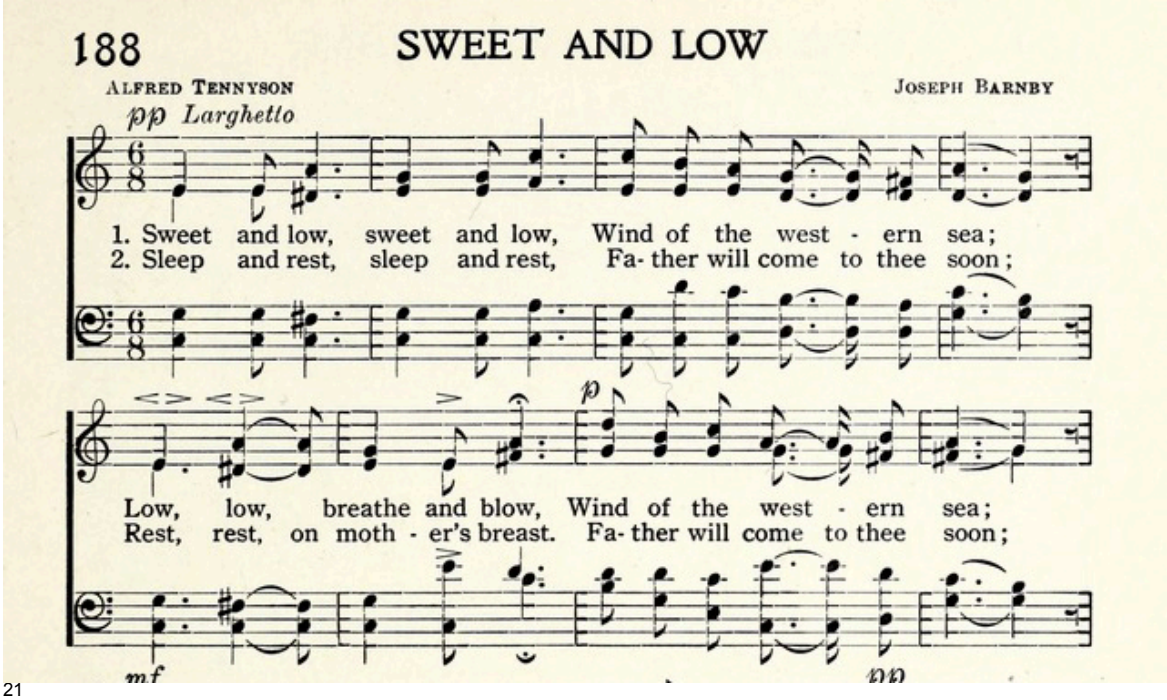

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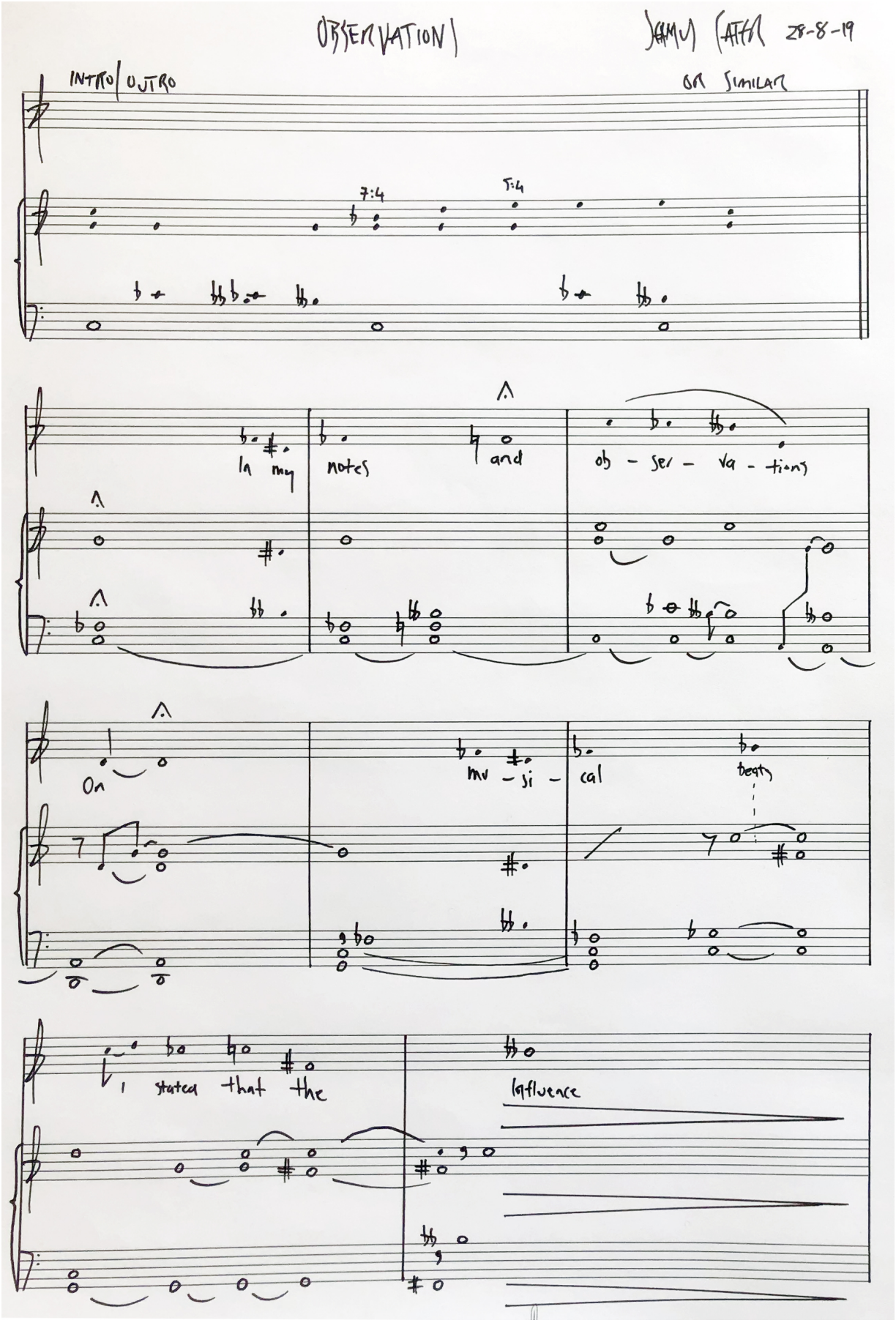
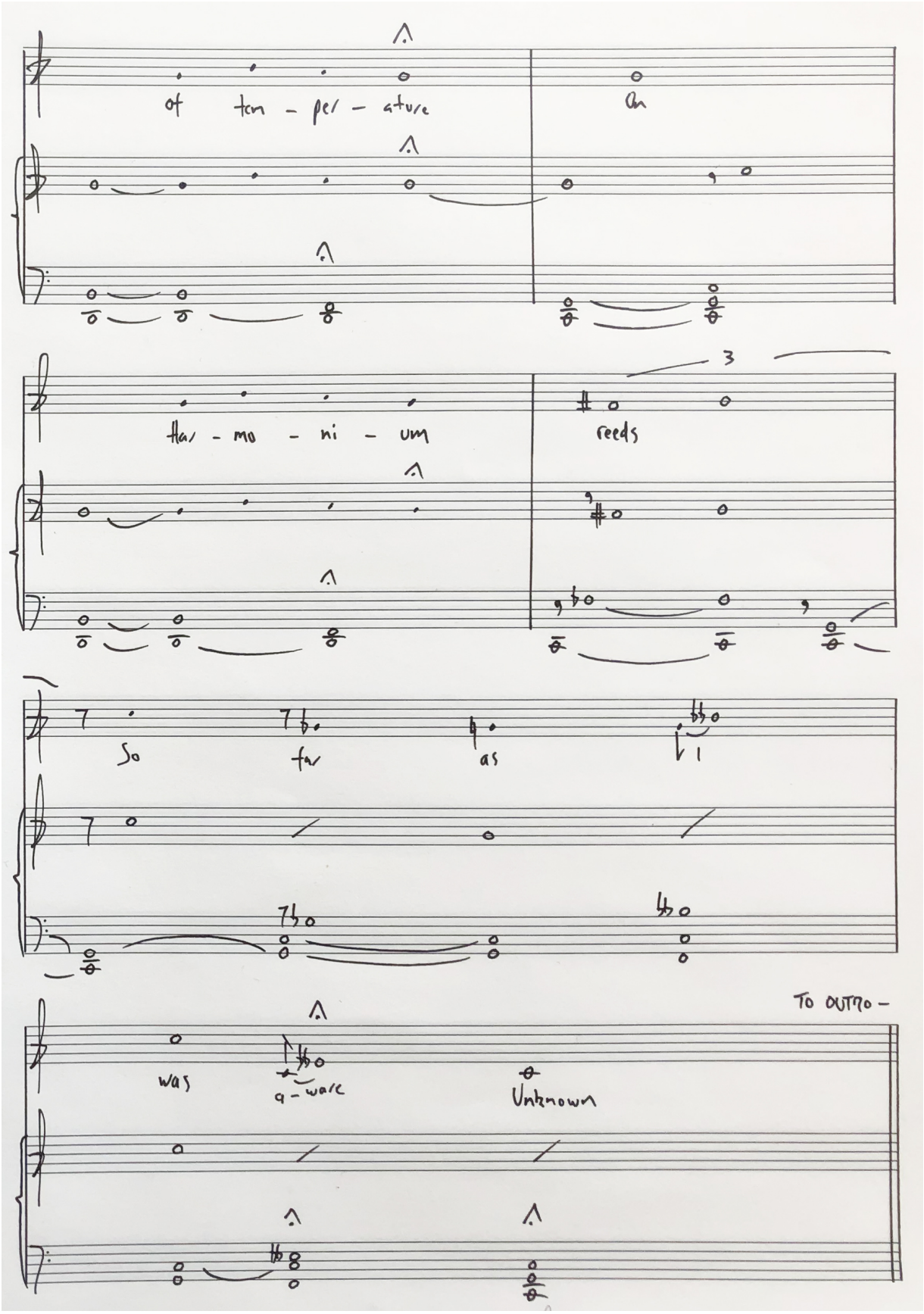
[20] Alexander J. Ellis, *On the Influence of Temperature on the Musical Pitch of Harmonium Reeds.* Journal of the Society of Arts. January 1881 vol 31. p. 413. Opening sentence of the paper. The photograph above is of an original manuscript.

[21] Alfred Tennyson & Joseph Barnby. Score fragment found at:
https://hymnary.org/tune/sweet_and_low_sweet_and_low_barnby


OBSERVATION
28-8-19
INTRO/OUTRO
OR SIMILAR
7:4
7:4
In my
notes
and
ob - ser - va - tions
On
mu - si - cal
beats
I stated that the
influence


of tem - per - ature
Oh
har - mo - ni - um
reeds
So far as I
was a - ware
Unknown
TO OSTIN0 -

Pesthuislaan 41
1054RH Amsterdam
1 April 2020

Dear Mr Ellis,

When I visited the British Library to see your letters there was not enough time to read them. In the two days I had I could only scan through quickly and take photographs to read later. Photography isn't generally permitted but one librarian didn't seem to think it would be a problem. I capitalised on this.

I noticed many things while leafing through, and the final sentence of the letter dated 9 September 1878 jumped out as an example of your enthusiasm for experiment. You had obviously been debating the frequency of tuning forks with Hipkins, and reading between the lines he probably stated that the pitch of a tuning fork is different when vibrating freely in air than when being resonated on a surface or resonator jar. I found it charming that you took the time to check this and report back to him. You proved that there was no difference.

On Beats in Air is a song where I set the said sentence in Pythagorean harmony.

Because I have the Extended Pythagorean, there is always a choice between Pythagorean thirds 81/64 and the more sonorous 'practically just' thirds which are a skhisma flat of the 5/4. In the first songs I mostly used the 5/4s, but decided to keep this song Pythagorean. All major triads retain the 81/64 sound, with major 7th being the 243/128, rather than the sweeter 15/8. Whilst there is some dissonance compared to the practically just intervals I find these ratios quite pleasant.

I kind of wondered if when you were checking the difference between your Pythagorean and Just instruments, whether you were also singing, and whether you could hit an 81/64. I would have liked to hear that, or measure it!

I found another way to put myself in your shoes by counting to 10 and 20 in the song, in the same way you would have when beat-counting to measure pitches with the tonometer. Further, I added a contrast in harmony to highlight the modulation of a Pythagorean comma. Over an E I sing 'too sharp' as a B (sounds fine) and 'too flat' as Cb (sounds flat).

Much pleasure!

Truly yours,

S Cater

3.2

ON BEATS IN AIR (2020)

On Beats in Air

your remark on beats
in air
or on a table
made me make
a series of experiments

one fork over jar
the other in air
both over one jar
each over separate jar
jar tuned wrong
too sharp
or too flat
and so on
in more than
a dozen ways

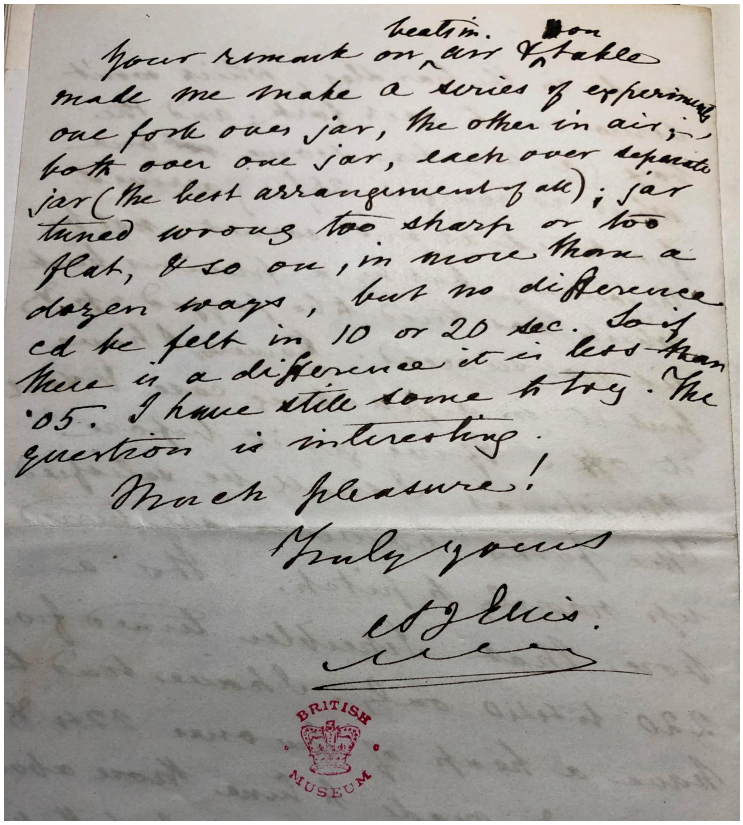
but no difference
could be felt in
10 or 20 sec.

so if there is
a difference
it is less
than 0.05

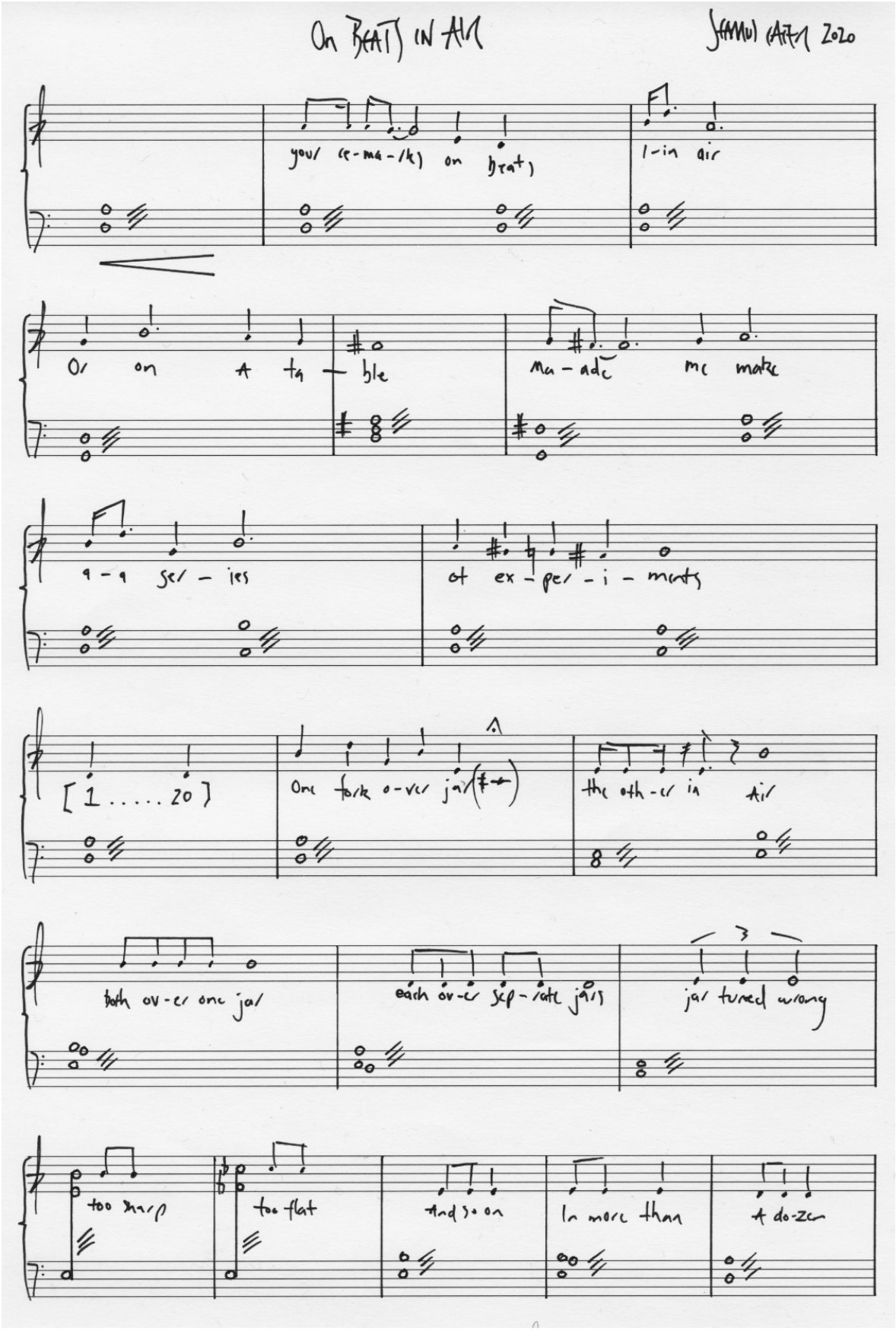
I have still
some to try

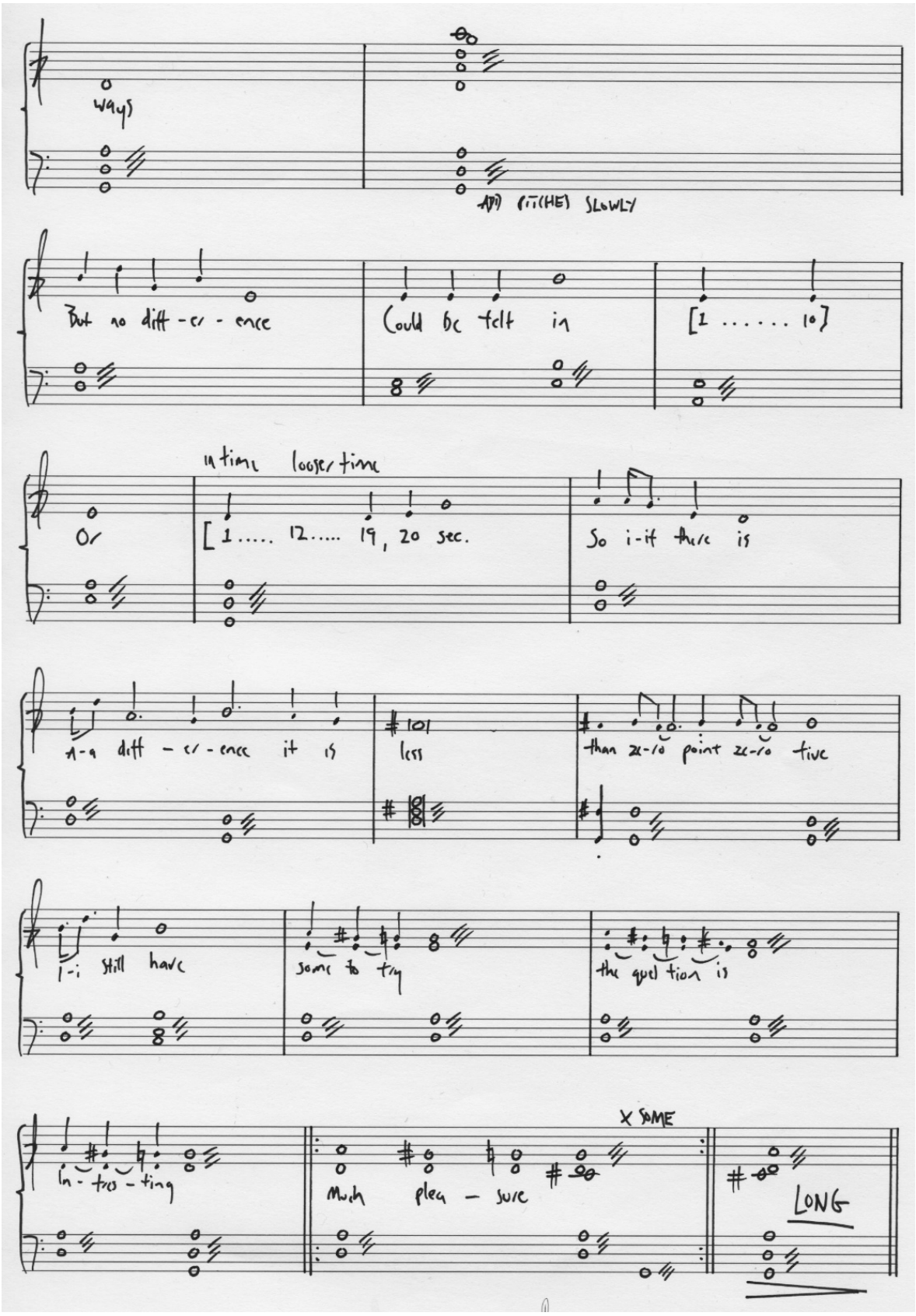
the question
is interesting

much pleasure!



Item 151 – Add MS 41636 to 41639, British Library (Alfred Hipkins folios 1795 - 1927). Final page of letter to Hipkins dated 9 September 1878.


ON BEATS IN AIR
SAMUEL CAZEN 2020
your (e-ma-ik) on beats
1-in air
Or on A ta - ble
ma - ade me make
9 - 9 ser - ies
of ex - per - i - ments
[1 ..... 20]
One fork o-ver jar
the oth-er in air
both ov-er one jar
each ov-er sep-a-rate jars
jar tuned wrong
too sharp
too flat
and so on
In more than
A do-zen



On Beats in Air – score / harmony – note lengths are indications.

Pesthuislaan 41
1054RH Amsterdam
8 April 2020

Dear Mr Ellis,

I have dealt with On The History of Musical Pitch as a project in itself, a description of which finds place in Chapter VI of this paper. This letter outlines a song based on its introduction.

You had collected the 223 historical instances of tunings of European instruments. This had taken at least three years and in your introduction to the paper, you acknowledged and thanked more than a hundred institutions, academics, instrument makers, individuals, friends and assistants by name.

Within this song I repeat your original thanks. I know my project has also been a work of time, labour and expense, and somehow this makes the delivery of this song rather uncomplicated.

The harmony is a short melodic ostinato which builds several chords along the way. Beginning with an F# minor triad, where the A is replaced by Bbb, giving the practically just 7/6. This then adds an Fb, the practically just 7/4. Next Fb becomes the 7/6 of C#. Then Fb becomes tonic with a minor triad using G in the place of Abb, the G being the practically just 6/5. G is replaced by Bbb, which draws on the Quintal Harmony discussed in section D of Appendix XIX in OTSOT, building scales and harmonies from consecutive fifths. Then a C major triad using Fb, the practically just 5/4, diminishing with an F# at 729/512. Bbb over C is the practically just 5/3. Finally the ostinato rests at the opening F# 7/6 triad before resuming. Apologies for the style of this paragraph, I know that text like this can be tedious and hard to follow. To make it easier to follow, or indeed to avoid it all together, a sketch is attached on the following page.

At two points in the song I colour the C major triad by ascending the harmonic series, the first time as 9:10:11, the second as 9:10:11:12:13. Further to this, two practically just dominants (4:5:6:7) are sustained and repeated at two points of the piece, with F# and B as roots.

In OTSOT, the practically just intervals are discussed but not in great detail. As a rule of thumb when playing minor chords on the concertina, it can be said that each Extended Pythagorean pitch has the choice between a Pythagorean minor third (A-C), or either a 7/6 or a 6/5. In my system, there are 9 practically just 7/6 thirds, one Pythagorean comma lower than their Pythagorean third, always a sharp going to a flat, or natural to double flat: B#-Eb, E#-Ab, through E-Abb.

Likewise 15 practically just 6/5s, one Pythagorean comma higher than their Pythagorean third, always natural to sharp, or flat to natural: A-B#, D-E# through Abb-Bb.

Truly yours,

S Cater

3.3

THANKS (2020)

Thanks

[22]

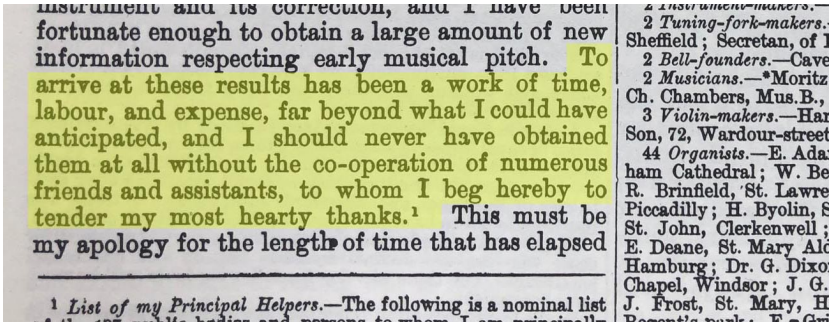
to arrive at these results
has been a work of time
labour and expense
far beyond what
I could have anticipated

I could never
have obtained
them at all

without the
co-operation of
numerous
friends
and
assistants

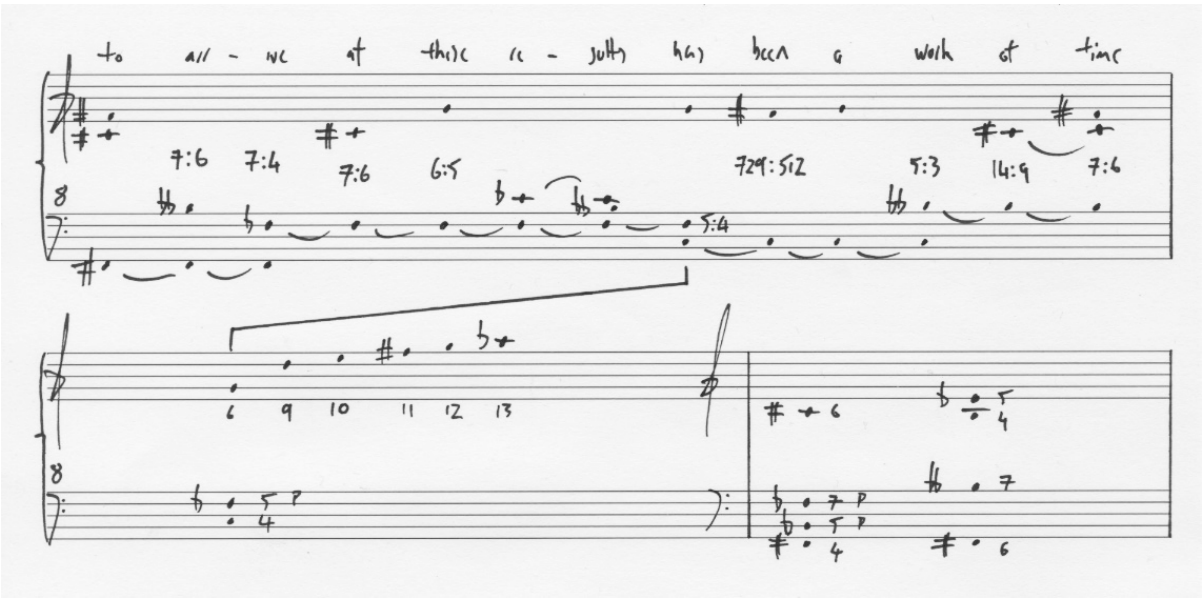
to whom I beg
hereby to
tender
my most
hearty

thanks


instrument and its correction, and I have been
fortunate enough to obtain a large amount of new
information respecting early musical pitch. To
arrive at these results has been a work of time,
labour, and expense, far beyond what I could have
anticipated, and I should never have obtained
them at all without the co-operation of numerous
friends and assistants, to whom I beg hereby to
tender my most hearty thanks.[1] This must be
my apology for the length of time that has elapsed

[1] *List of my Principal Helpers.*—The following is a nominal list

1968 facsimile of the original On The History of Musical Pitch [23]



Elements of score – Upper line: ostinato with its relational ratios. Lower line: Harmonic series of C, and 4:5:6:7 dominant chords. A 'p' indicates a practically just interval.

[22] Alexander J. Ellis, *On the History of Musical Pitch*. Journal of the Society of Arts. March 1880 vol 28. p. 293.
[23] Alexander J. Ellis & Arthur Mendel (Monographs by), Studies in the History of Musical Pitch. Frits Knuf - Amsterdam, 1968. The facsimile appears alongside commentaries by Mendel and several chapters of Mendel's own research. Mendel explains that when the paper was published, for the second time, within On The Sensations Of Tone (1885, second English edition), it omitted some of the important explanations which were in the original paper. Because of this, many historians and musicologists have quoted Ellis data out of context. Mendel republishes the original Royal Society paper in the hope of drawing attention to this.

Pesthuislaan 41
1054RH Amsterdam
9 April 2020

Dear Mr Ellis,

The letters I photographed date between 31 October 1876 and 23 May 1890. Quite some time. You sign off the opening letter of the correspondence with your first name, as Alex J Ellis, and invite Hipkins to meet you at the south end of Room Q of the South Kensington Museum. You mention your portly figure. This meeting would have been the first of very many, where the two of you collaborated in measuring the frequencies of countless instruments while researching the history of tuning.

All following letters are signed more formally as AJ Ellis, with three exceptions. Two thanking Hipkins for birthday gifts, and another, which would be one of your last. In this letter you ask Hipkins if you might visit him and together make decisions about how to divide your collection of tuning forks. I found this a particularly poignant moment, the passing on of precious artefacts toward the end of ones life. This will be the only song where I sing your name and introduce you formally within the song cycle.

The harmony repeats three times as a sequence, beginning with four chords over an A pedal. The first with B#, the practically just 6/5, a skhisma, or 1.95ct flat of Just. Next, adding E#, the 8/5, a fourth above the B#. Abb and E then replace the sharps, Abb being the practically just 7/4, two skhismas, or 3.9ct flat of Just, before the 8/5 takes its place again. The next line uses G with its 8/5 and 9/5, both one skhisma flat.

"Soon after 3, before people call" uses E# and Bbb over G, E# being the 9/5 and Bbb the 10/9, 9/5 a skhisma flat 10/9 a skhisma sharp. The interval between E# and Bbb creates a practically just 13 limit interval, the 16/13 which is 1.4ct flat, this is a quite beautiful sounding major third which is 40ct flat of equal temperament. I try to sing this interval accurately. It's hard. This sequence moves to C with 6/5, then C with Just 7/4, before a high Pythagorean A minor with Bbb in the bass, which creates some beating with the poorly tuned octave, A over Bbb, out by a comma, all resolving to C.

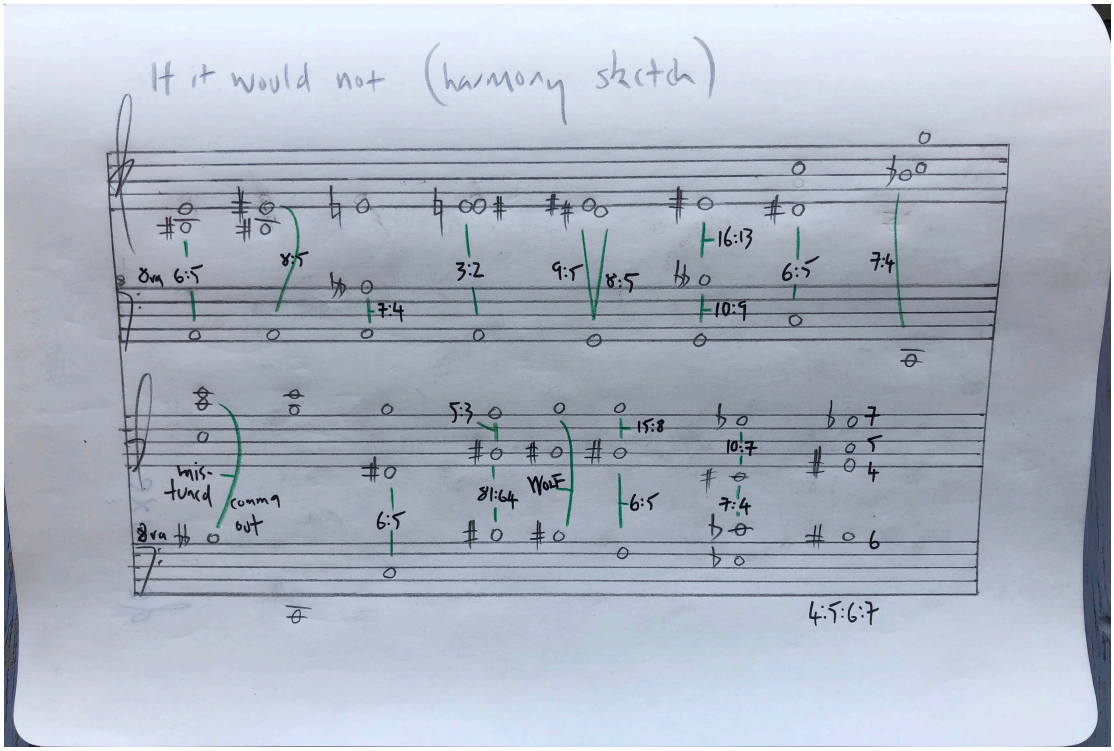
"To bring down to your house" uses the C with D#, its 6/5. Then G# with its Pythagorean major third B#, the 81/64 and a practically just F, the 5/3 above, a skhisma sharp. F is then replaced by G, the 15/8 above, a skhisma sharp. Within this second G# chord, the interval between the B# and the G is what one might call a wolf fifth. It is a practically just 40/27, three fifths down and a major third up, illustrating the non commensurability of temperaments discussed in section C. of your appendix of OTSOT. Still, it blends well in this sequence, resolving as F with G# as it's 6/5. The final two chords are C# with Eb, its 10/7 and Cb the 7/4, moving to an E# practically just dominant 7th chord, 4:5:6:7 (E#, A, B#, Eb).

I have been unable to ascertain whether the V&A have your forks in their collection. This is something I plan to check in the future. Along with the original Pythagorean concertina I would very much like to locate them and hope they have not been scattered to the wind unattributed.

Truly yours,

S Cater

P.S. I attach this sketch so you might see the harmony more clearly. Also, you can see from the following page that many of your letters to Hipkins are well preserved. Of the hundreds you wrote to Hipkins, 36 were preserved by the British Museum and are now found in the British Library.



As it stands, I have not located an archive of your personal papers and communication. The concertinas were possibly given to the Royal Institution. Neil Wayne somehow acquired two instruments which are in the Horniman Museum, the others are missing.

What interests me greatly and can be a future project is the communication with Helmholtz, which is hopefully in the archive of Helmholtz. In a paper written by Julia Kursell discussing your translation, I read of a bundle of rejection letters[24] from publishers which you shared with Helmholtz. Along wth this I suspect there will be much more correspondence, but so far I have not been able to locate this.

[24] Julia Kursell, *Alexander Ellis's Translation of Helmholtz's Sensations of Tone.* Isis – A Journal of the History of Science Society, Volume 109, June 2018.

3.4

IF IT WOULD NOT (2020)

If it would not

if it would not
inconvenience you
I should like
next Sunday

soon after 3.O
before
people call

to bring
down to
your house
all my forks
other than the
measuring forks

to go over them
with you
and to
select
what you think
would be fit
to give with the
measuring forks

to (say) the
South Kensington Museum

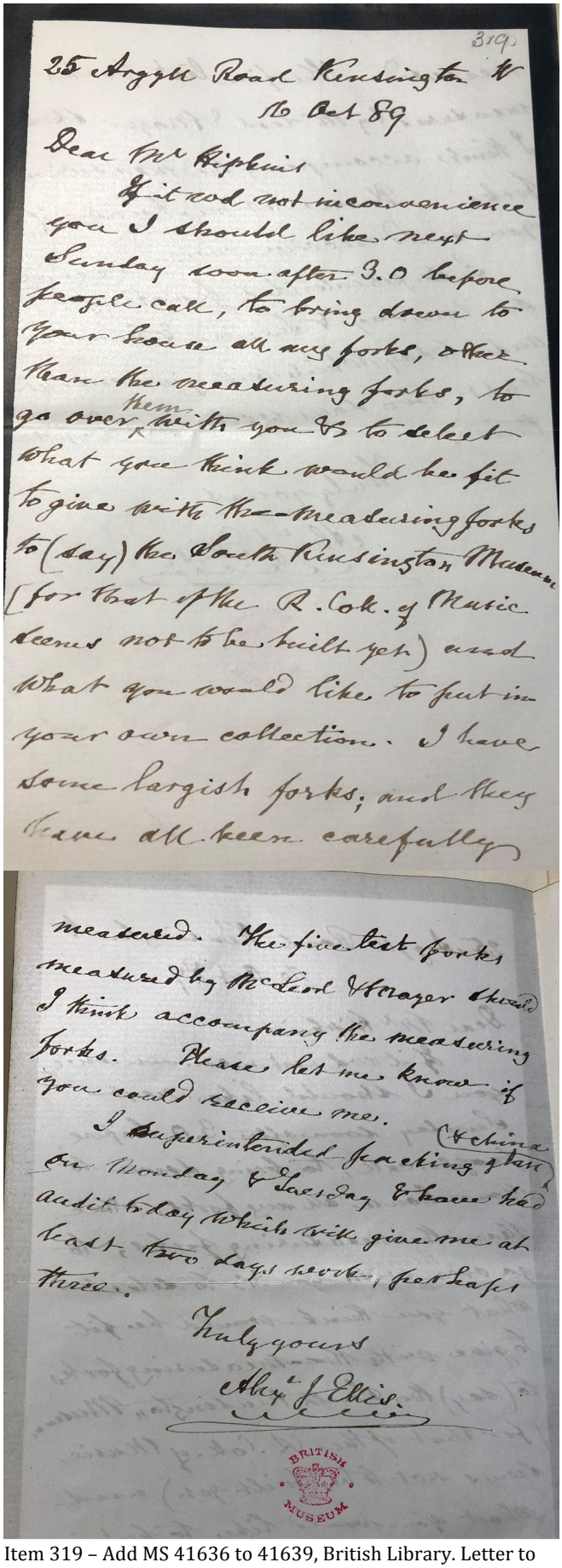
and what you would
like to
put in
your own collection

I have some
largish forks
and they have all been
carefully measured

the 5 test forks
measured by
McLeod and Mayer
should I think
accompany
the measuring forks

please
let me know
if you could receive me

truly yours
Alex J Ellis


319

25 Argyll Road Kensington W
16 Oct 89

Dear Mr Hipkins

If it would not inconvenience you I should like next Sunday soon after 3.O before people call, to bring down to your house all my forks, other than the measuring forks, to go over them with you & to select what you think would be fit to give with the measuring forks to (say) the South Kensington Museum [for that of the R. Col. of Music seems not to be built yet) and what you would like to put in your own collection. I have some largish forks; and they have all been carefully measured. The finest forks measured by McLeod & Mayer should I think accompany the measuring forks. Please let me know if you could receive me. I superintended packing (at home) on Monday & Tuesday & have had audit today which will give me at least two days work, perhaps three.

Truly yours
Alex J Ellis

BRITISH MUSEUM

Item 319 – Add MS 41636 to 41639, British Library. Letter to Hipkins dated 16 October 1889.

Pesthuislaan 41
1054RH Amsterdam
3 April 2020

Dear Mr Ellis,

I enjoyed your description of tonometers in Notes of Observations on Musical Beats. I had imagined beat counting (to ascertain the frequency of a sounding pitch) would be extremely difficult but your explanation very much demystified the art.

When I decided to make a (re)sounding of the pitch data from 'On The History of Musical Pitch', I realised that tuning 74 tuning forks in a range of a fifth plus a quarter tone, would essentially be making a tool not unlike Scheibler's tonometer.

My reason for creating this instrument was to hear the music of your pitch history unfolding within the timescale of a concert performance. To give your paper a musical life, extending its musicological usefulness.

Early rehearsals of the piece were promising, but due to the Covid-19 pandemic, all institutions are closed and people are advised to keep distance from one another. Therefore all performances and gatherings have been cancelled until further notice.

In the meantime I hope to achieve a digital recording of the piece before a projected future performance. Currently this is also impossible as I only have one set of forks, the other 3 being locked in the conservatory.

It has been quite disappointing to postpone this performance. But in this time I begin to fantasise about bringing the piece to London, for performance in one of the museums to which you were connected. A kind of homecoming for a set of tuning forks, whose frequencies were previously only found together within your paper.

Truly yours,

S Cater

P.S. I found a price list for Ragg's tuning forks in the Hipkins folios. So I know we used the same forks. The modern packaging of my forks states that the forks are tuned at 20 degrees centigrade. This is presumably a nod towards your research.

CHAPTER IV

A HISTORY OF MUSICAL PITCH (2020)

This piece acts as a (re)sounding of *On the History of Musical Pitch* (1880). In the work which led up to it, Ellis undertook the project of gathering different tunings from historic European organs and organ builders, piano makers, choir conductors, instrument makers, bell-founders, tuning fork makers, etc. This project resulted in taxonomic organisations of pitch ranges, specific frequencies, and dates, from nine countries, with 223 instances of the note A being collected. These range between the years 1361 and 1880 and the pitches F# 370Hz to C# 567.3 Hz, by modern A440 standards. However, all pitches are technically A's. The most simplistic of musical instruments, tuning forks, were often shared and duplicated in order to make a record of a pitch, or carry one pitch from one maker to another.

Player 1 of 4: Tuning fork set for *A History of Musical Pitch*, showing ratios and Hz frequencies.

Data was amassed over several years. Three years had elapsed since Ellis' earlier paper *The Measurement and Settlement of Musical Pitch* (1877). This added time to gather further pitch data, and to resolve the error of *Appunn's Tonometer*, which led to a higher degree of accuracy than the previous paper[25].

Tonometers of this period were scientific acoustic instruments used for measuring the frequencies of musical instruments by means of beat counting. Two kinds were in use, a tuning fork variety (Scheibler), and a reed organ / bellows variety (Appunn). Scheibler invented a system where 52 or 56 tuning forks were used, tuned between 220Hz and 440Hz[26], subsequent forks being tuned 4 Hz sharper than the previous. In brief, because it is relatively easy to identify between 0 and 4 beats per second using the tuning fork (unison) tuned closest to the frequency of the pitch in question, resulting beats between fork and instrument can be counted with a chronometer over a period of 10 or 20 seconds, giving an accurate measurement of the sought frequency[27].

I settled on the idea of making a piece of music based on this early musicological research. Working with the original Royal Society publication of *On the History of Musical Pitch,* I studied the data and considered tuning all 223 forks mentioned. But this seemed an unwieldy quantity to attempt. Removing the decimal point yielded 74 distinct Hz frequencies which seemed more manageable. This would mean a crude musical instrument with a tessitura of approximately a fifth plus 40 cents. In the frequency range of 440Hz, 1Hz is approximately 4 cents, giving extremely fine gradations of pitch.

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[25] Alexander J. Ellis, *On the History of Musical Pitch*. Journal of the Society of Arts. March 1880 vol 28. p. 293. Introductory paragraph giving a background to inaccuracies of the previous paper.
[26] Alexander J. Ellis, *Notes of Observations on Musical Beats*. Journal of the Society of Arts. June 1880. Description of a missing Scheibler tonometer and another which Ellis borrowed for a year. P 525
[27] Ibid. p. 520. Generally, this paper describes beat counting in much greater detail, methodologies, etc. Ellis talks of Scheibler's forks being of the highest quality in many papers and letters. Also descriptions of Appunn's reed and bellows tonometer.

74 John Walker tuning forks were purchased from Ragg Tuning Forks Limited, a Sheffield based company supplying musical tuning forks since Victorian times. Forks purchased were tuned in either 392 Hz (G), 415Hz (A), 440Hz (A) or 523Hz (C). The rather laborious task of tuning involves either filing by hand with a round file at the U of the tuning fork. This lengthens the prongs of the fork and therefore lowers the pitch. Grinding the prongs of the fork shorter, using a water stone, raises the pitch. The metal, being extremely hard spring steel, must be filed with a sharp and fine file.

Much of Helmholtz seminal and authoritative publication discusses ratios of vibrational numbers discussed earlier by Pythagoras and other ancient Greek and Renaissance scholars. Giving the basic sonorities 1:2 (octave), 2:3 (fifth), 3:4 (fourth), 8:9 (second), 4:5 (major third), 5:6 (minor third), etc. These relationships form Just intonations from the harmonic series, as opposed to temperaments. The 74 distinct Hz frequencies I had extrapolated from Ellis's work, were not organised in any harmonic relationships and I wondered if it would be possible to express them as Just Intonation relationships. In this case I needed to choose a fundamental and find the ratios which aligned with the Hz frequencies Ellis had given.

The concertina was tuned with a fundamental of 60Hz, thus it was logical to tune the forks with a fundamental of 480Hz, that being three octaves above, creating a possibility of bringing the instruments together in future.

Most of the ratios in Helmholtz, are of small numbers. With the exception of ratios that employ larger harmonic distances, or Pythagorean ratios which become rather large as a chain of fifths lengthens. For example, B# in relation to C, is a Pythagorean comma, or 531441:524288 (B# being sharper than C). For the forks, I wanted to find the smallest number ratios I could and this was achieved using an internet resource created by Thomas Nicholson in collaboration with Marc Sabat:

The *Helmholtz-Ellis 31-Limit Harmonic Space Calculator*[28] enables searching for harmonic relationships to a fundamental, and to refine results by setting a harmonic limit. For example, I could search within the 7 limit, and when no further intervals were available to fit the Hz frequencies of Ellis paper, I could search using 11 limit. Eventually, all ratios expressed within this set of 74 forks, fall within the 19 limit. At this point the decimal point was therefore reintroduced. For example, a frequency of 373Hz did not reflect a perfectly tuned ratio, but a frequency of 373.3Hz is the 7/9 of 480Hz. Sometimes, when a ratio did not coincide exactly with a Hz frequency, but there was a very close adjacent Hz, I shifted the Hz frequency. This is outlined in Section 4.1 of this paper.

Ellis certainly never intended this data to become music, but by gathering these pitches together as sounding objects, a kind of speculative, collected sonic archaeology ensues. The pitches of organs from different countries or towns could never be sounded together in one place. Until now, their records have only existed at distance or in paper form. But by bringing this somewhat forgotten paper to life acoustically, a memory of the work of Ellis is invoked using the tools available to Ellis at the time.

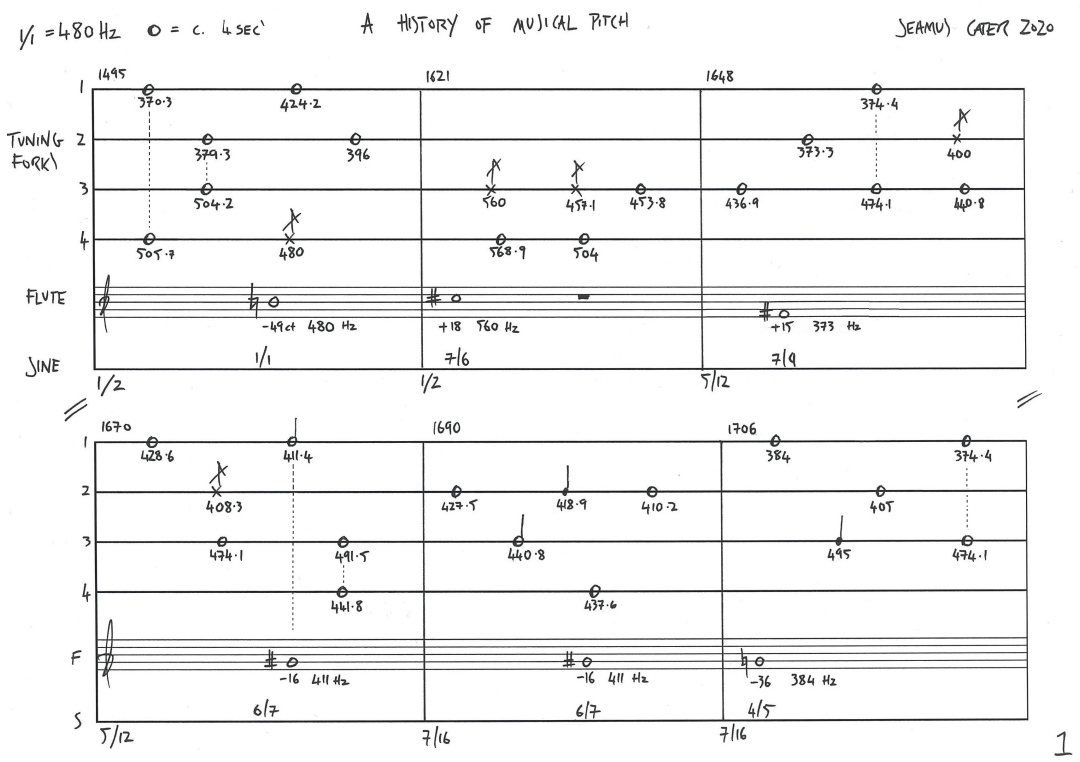
Ellis spent his later life surrounded by tuning forks, carrying some of them at all times in his overcoat which he named Dreadnought[29], a garment containing 24 pockets for

[28] https://www.plainsound.de/HEJI/
[29] Jonathan P. J. Stock, *Alexander J. Ellis and His Place in the History of Ethnomusicology,* University of Sheffield, Society of Ethnomusicology, 2007

different tools, tuning forks and various documents. In one of the final letters among the Hipkins Papers at the British Library, Ellis requests a visit to Hipkins to help decide which of his tuning forks should be donated to important London institutions or museums, Ellis also offers Hipkins a pick of the forks he might desire. As the only portable means of communicating, storing, and checking pitch facts, for early musicologists, these were prized possessions.

A History of Musical Pitch (2020) **- structure**

In *On the History of Musical Pitch* (1880), Eliis sets out the list the 223 pitches from low to high, accompanied by the date of the instruments making, information on the instrument, anecdotes, and the individual responsible for collecting or recording the pitch. Modern instruments were included but Ellis did not include organs or instruments where the original tuning had been changed in modern times. In order to explore the history of pitch through time, I created a timeline of the pitches gathered which became the structure for the composition. The structure is organised into 54 time periods, generally containing 5 forks, sometimes more if a pitch was repeated.



First page of *A History of Musical Pitch* score, showing the first six of 54 time periods. Dates are spoken to begin each time period.

From the 74 tuning forks which were tuned in Just Intonation relationships to the fundamental 480Hz, 19 were small number ratios which could be expressed with numbers lower than 16. I called these 'special' and they included 7/6, 1/1, 15/16, 14/15, 13/14, 12/13, 11/12, 9/10, 8/9, 7/8, 13/15, 6/7, 5/6, 9/11, 4/5, 11/14 and 7/9. The flute only plays 'special' intervals, and these ratios were also used for the sine wave accompaniment.

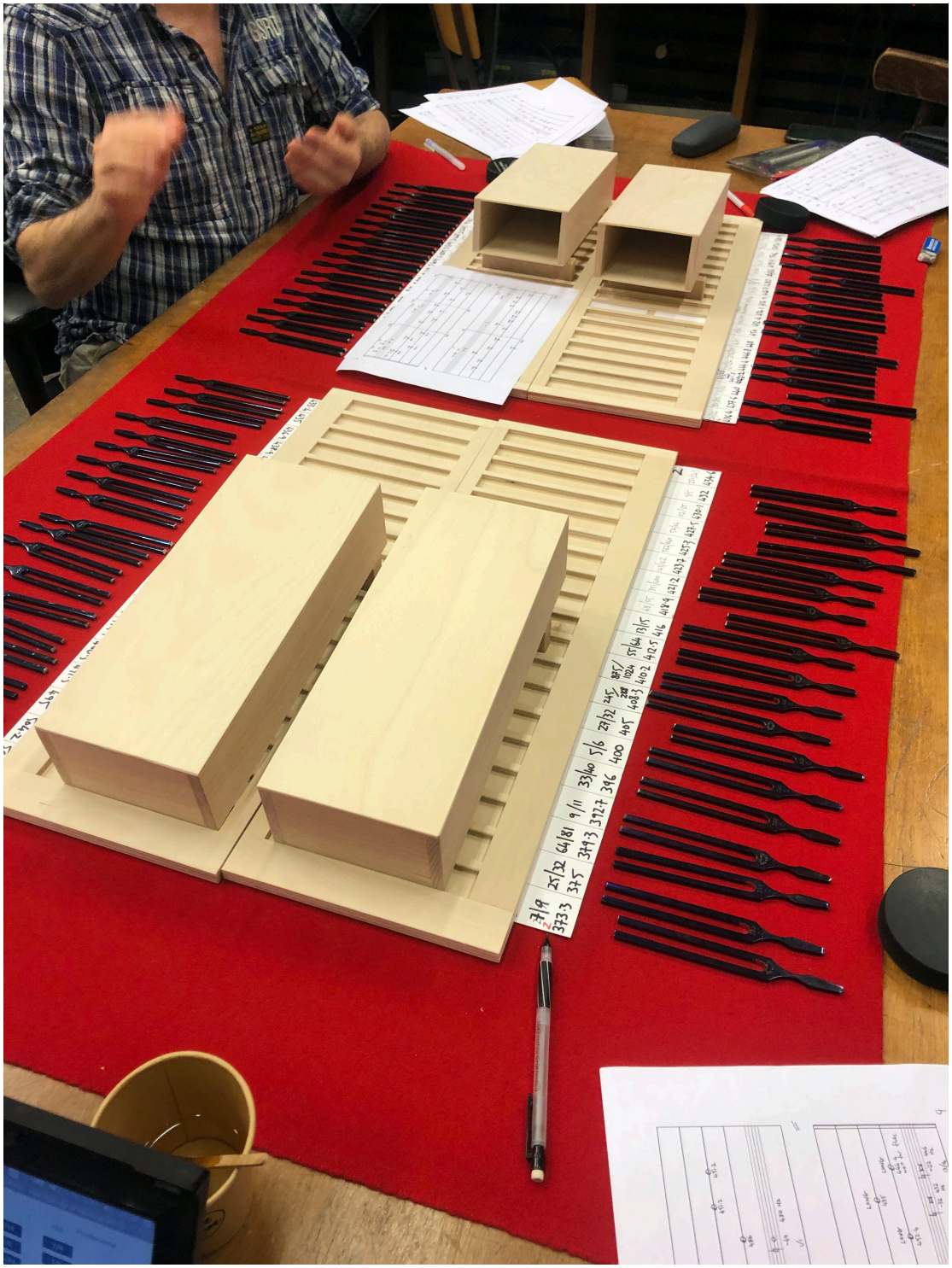
Also present were Pythagorean intervals, which were of particular interest to me as they were in tune with the concertina. The Pythagorean intervals included 32/27 Eb, 256/243 Db, 1/1 C, 2056/2187 B, 2048/2187 Cb, 8/9 Bb, 27/32 A, 16384/19683 Bbb, 64/81 G#. These are illustrated in table 4.1 with all other ratios. 'Special' intervals are shown in bold.

The forks are divided among 4 players, who sit around a large table. Each fork player has either 18 or 19 forks and a wooden resonator box tuned to 240Hz, on which the fork is held after being struck on a rubber puck. Forks sound for their whole duration of 5 seconds or more, with subsequent forks in the time period joining them. A fork may be released if it is imperceptible from other forks sounding. This enables picking up and playing of a second fork within one time period.

Time periods are introduced by the spoken voice, giving a guide to the historic timeline of the piece. The flute and sine wave players sit at the head and foot of the table. The table is covered with a felt baize not unlike that of a gaming table, the baize limits the sound of forks being put down by the players.

Without exception, each time period of 5 forks, beginning in 1495 and ending in 1880 contains a fork which is a ‘special’ ratio (s), or a ‘close special’ (cs). A ‘close special’ is always within 7 Hz of a ‘special’. These specials dictate the harmony of sine tones and flute, and the forks sound in unison, close beating unison or more distant relationships. Simple rhythmic relationships are scored for the players, where the ensemble plays in a rubato ensemble time.

At the time of submitting this thesis, a recording is unavailable.



An early rehearsal of *A History of Musical Pitch.*

4.1

A HISTORY OF MUSICAL PITCH – tuning data

Original Ellis Frequencies in Hz	Hz Adjusted to Just Frequencies	Final Tuning Fork Set Ratios Of 480Hz	Cent Deviation From 1/1	Ratio terms 480Hz = C
370	370.3	27/35	-449.3	
373	373.3	**7/9**	-435.1	
374	374.4	39/50	-430.1	
375	375	25/32	-427.4	25th harmonic
376	377.1	**11/14**	-417.5	
377	379.3	64/81	-407.8	G# Pythagorean
384	384	**4/5**	-386.3	
392	392.7	**9/11**	-347.4	
395	395.5	3375/4096	-335.2	
396	396	33/40	-333	
398	399.5	16384/19683	-317.6	Bbb Pythagorean
402	400	**5/6**	-315.6	5 limit major sixth
403	403.2	21/25	-301.8	
406	405	27/32	-294.1	A Pythagorean
407	407.3	28/33	-284.4	
408	408	245/288	-279.9	
409	409.6	64/75	-274.4	75th utonality
410	410.2	875/1024	-272.2	
411	411.4	**6/7**	-266.9	septimal major sixth
413	412.5	55/64	-262.4	
414	414.8	70/81	-252.7	
415	416	**13/15**	-247.7	
418	418	128/147	-239.6	
419	418.9	48/55	-235.7	
420	420	**7/4**	-231.2	septimal minor 7th
421	421.2	351/400	-226.2	
422	422.4	22/25	-221.3	
423	423.7	143/162	-216	
424	424.2	243/275	-214.2	
425	425.3	567/640	-209.7	
426	426.7	**8/9**	-203.9	Bb Pythagorean
427	427.5	57/64	-200.5	57th harmonic
428	428.6	25/28	-196.2	
430	430.1	112/125	-190.2	
431	431.3	115/128	-185.4	115th harmonic
432	432	**9/5**	-182.4	5 lim' large minor 7th
433	433.4	512/567	-176.6	
434	434.6	220/243	-172.1	
435	435	29/32	-170.4	29th harmonic
436	436.4	20/22	-165	
437	436.9	1024/1125	-162.9	
438	437.6	320/351	-160.1	
439	438.9	32/35	-155.1	
440	440	**11/12**	-149.4	
441	440.8	45/49	-147.4	
442	441.8	81/88	-143.5	
443	443.1	**12/13**	-138.6	
444	444.4	25/27	-133.2	
445	445.7	**13/7**	-128.3	
446	446.8	256/275	-123.9	
447	447	176/189	-123.4	
448	448	**14/15**	-119.4	
449	449.5	2048/2187	-113.7	Cb Pythagorean
450	450	**15/16**	-111.7	5 limit major 7
451	451.2	2056/2187	-106.9	B Pythagorean
452	452.4	1296/1375	-102.4	
453	453.8	121/128	-97.4	
454	454.1	(approx. 18/19)	-95.9	Philharmonic Pitch
455	455.1	128/135	-92.2	
456	456.9	99/104	-85.3	
457	457	20/21	-84.5	
466	466	35/36	-48.8	
474	474.1	80/81	-21.5	u syntonic comma

Original Ellis Frequencies in Hz	Hz Adjusted to Just Frequencies	Final Tuning Fork Set Ratios Of 480Hz	Cent Deviation From 1/1	Ratio terms 480Hz = C
480	480	**1/1**	0	**Fundamental / C**
483	480.5	32805/32768	0.2	Skhisma
484	486	81/80	21.5	Syntonic comma
489	491.5	128/125	41.1	Diminished second
494	493.7	36/35	48.8	Superior quarter tone
495	495	33/32	53.3	33rd Harmonic
503	504	21/20	84.5	
504	504.2	104/99	85.3	
505	505.7	256/243	90.2	Db Pythagorean
563	560	**7/6**	266.9	Septimal minor 3rd
567	568.9	32/27	294.1	Eb Pythagorean

Table 4.1 lists frequency and ratio data related to *A History of Musical Pitch* (2020). Ratios marked in bold are the special relationships or small number ratios used in the electronic part of the composition. Ratio terms are borrowed from Kyle Gann's, The Arithmetic of Listening.[30]

[30] Kyle Gann, The Arithmetic of Listening. University of Illinois Press, 2019. The appendix entitled 'Anatomy of an Octave' lists hundreds of Just ratios within 1200 cents, which further credits his sources: Harry Partch, Alain Daniélou, La Monte Young, Terry Riley and Henry Cowell. p. 248.

Pesthuislaan 41
1054RH Amsterdam
26 April 2020

Dear Mr Ellis,

I couldn't help but take the opportunity to pay tribute to your pleasure in annotations. Footnotes and appendices are too often full of surprises.

My starting point had been the tuning of a concertina, but as yet this data has not been presented. The music of the project, and getting to know some elements of your life and work became my real subjects of interest.

The tuning had been a practical accomplishment, but once completed it felt like a footnote of what was to come.

Tuning data can be tiresome and I didn't want it to weight the paper, or my work, too much. I was lucky enough to have experienced your tuning observations in letter form to Hipkins, where the data was mixed with everyday pleasantries. This was a privileged way to see your working process, beyond the definitive publications.

I said before that I was looking for music heuristically within the chosen system, and I undertook this process in a one way dialogue with yourself. Up until now, I hope I have presented a satisfactory account of this.

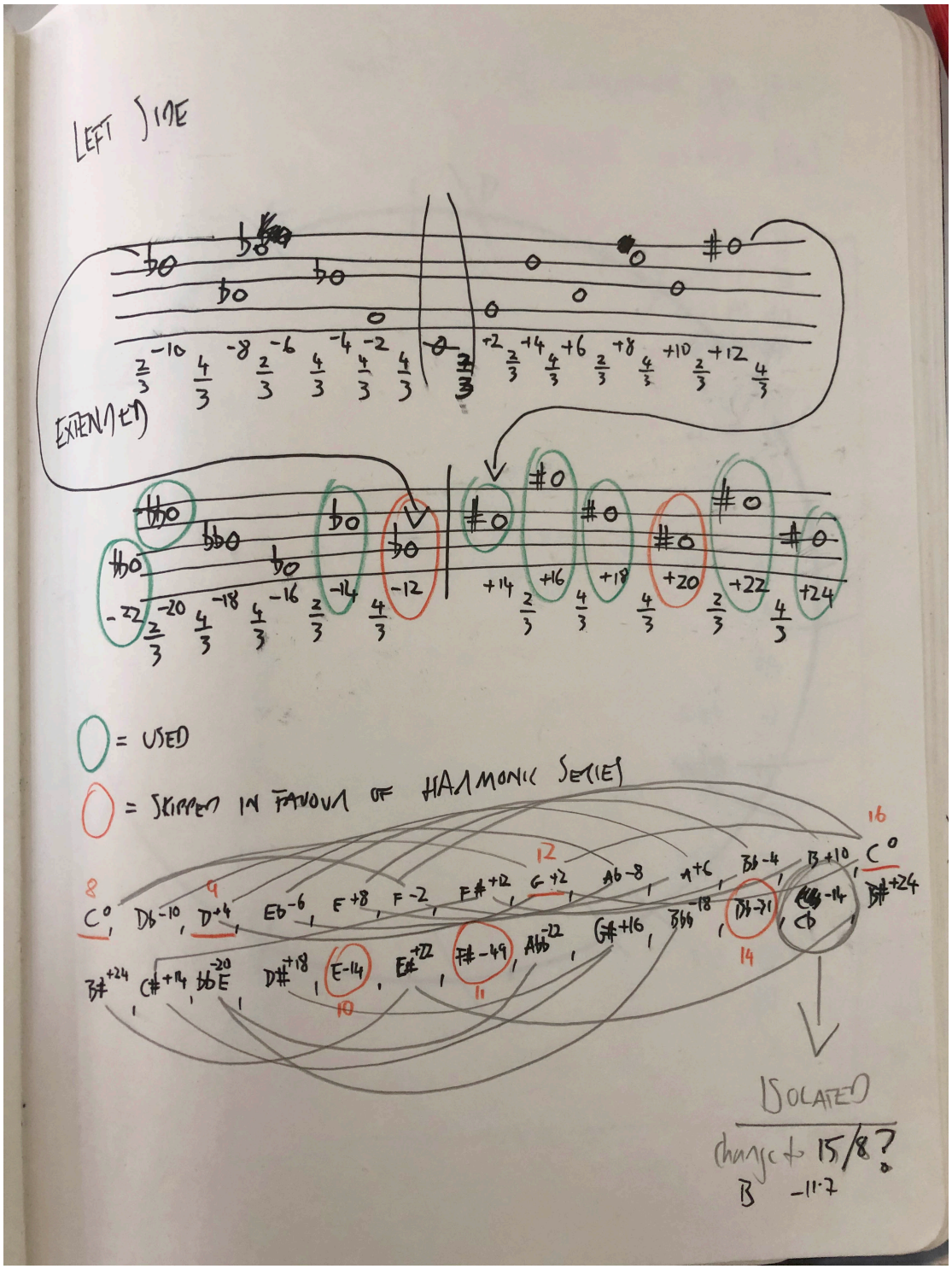
Hence, for several reasons I have moved the position of the description of the tuning. On the one hand, the information didn't need to drown my project from the beginning, but on the other, it is so important that it needs a special place within the paper. Also, because your Appendix to Helmholtz was where I first found your instructions to the tuner of your Just English Concertina, the Appendix seemed the appropriate place.

Truly yours,

Seamus Cater

APPENDICES
APPENDIX I

THE EXTENDED PYTHAGOREAN



Early sketch of extended Pythagorean pitches.

Pesthuislaan 41
1054RH Amsterdam
27 April 2020

Dear Mr Ellis,

on first discovering your concertina tuning experiments from the 1800's, the image that came to mind was that of a craftsman tinkering in a workshop. This was inaccurate.

But now I wonder what came first? Your commissioning of the tuning of the first just intonation concertina or the assignment to translate Helmholtz. I imagine the latter but have no documentary evidence of this. Where is the communication from this period?

I was given permission to visit the depot of the Horniman Museum at Dreadnought House in London. A coincidence, as your overcoat was also named Dreadnought. The Horniman has the largest collection of concertinas of any museum, totaling more than 600. I could examine three of your Wheatstone concertinas in their collection and check them against your tuning data. With the curator Margaret Birley present, I was allowed to check all the sounding reeds of these extremely fragile and now unplayable instruments. To the sound of creaking bellows, of paper and leather, where the ancient animal glues had dried until they are no longer flexible, I ascertained that the 'Just' tuned instrument detailed in your Appendix of Helmholtz was still approximately in its original tuning. I also identified the second of the instruments as the 'Equal Temperament and Bagpipe', also in its original tuning. The third instrument which gave irregular readings and therefore didn't fit into any of your descriptions was subsequently identified by Birley as mistakenly attributed as yours, thus a historical correction was made in the museum records.

While checking the tuning of the instruments, I felt I was measuring the measurer.

Nowadays, we don't need tonometers. The mathematical formulas you proposed for measuring cents have been implemented into digital tuning applications which can be operated easily on modern telephones. No beat counting required. The 20 or sometimes 10 seconds required to realise a correct pitch reading, when measuring by beat counting with the Appunn Tonometer, would hardly have been possible with your concertinas, their small bellows giving a clear tone for much less than this period.

The instrument I tuned was more modern, being from 1924. It is heavier, with bigger bellows, and has 24 pitches in one of the octaves. This was perfect for implementing the Extended Pythagorean, or the Skhismatic as you called it in Helmholtz. I think you would have liked playing this system, it gives the practically just sound and therefore combines the capabilities of your Just and Pythagorean instruments, in one, with many extended intervals available.

Truly yours,

Seamus Cater

Skhismic / Extended Pythagorean / Practically Just / Spectral
Two tuning approaches were combined in this instrument. Firstly, the Skhismic, as named by Ellis, which is an extended chain of 24 justly tuned fifths, hence Extended Pythagorean. It builds on Greek and Arabic music theory and is described in detail in Helmholtz[31]. Ellis also calls this 'practically just'[32]. Additionally, this tuning is augmented with a natural harmonic series from the central fifth, C (240Hz).

Other tuning approaches could have included the monophonic system of Harry Partch, which is fixed to one fundamental, with small number ratios and remainders thereof. Partch's monophonic approach involves tuning ratios and sub harmonic equivalents and building these into a system which incorporates Otonalities and Utonalities within a number limit or Numerary Nexus[33]. Through Partch, I had become interested in the tuning relationships which could express the intervallic discoveries of the ancient Greeks; Pythagoras, Ptolemy, Didymus, etc. Most of the intervals, tetrachords and scales named by these early theorists informed Partch's 43 note monophonic fabric. The scales are explained in detail in the Twenty-eight Tonalities chapter of Partch's *Genesis of a Music* (1974).[34]

The combination of otonality and utonality was Partch's way of expressing a much older idea, that of the 'remainder'. Aristoxenus, the Greek 4th century BC thinker's treatise *Elements of Harmony* proposed that an octave was divided into two fourths, or tetrachords, separated by a tone[35]. Pythagoras had identified the fifth (3/2) and the fourth (4/3) as consonances. While the 3/2 is present in the harmonic series as the 3rd harmonic, the 4/3 is not present as a harmonic. It exists as a remainder when the 3/2 is subtracted from the 2/1 (the octave). Expressed mathematically this is: 2:1–3:2 = (2x2):(1x3) = 4:3 [36]. When two fourths are added, actually a form of multiplication, the sum is 16:9: 4:3+4:3 = (4x4):(3x3) = 16:9. 16:9 is a utonality, a Pythagorean 7th which is 3.9ct flat of equal temperament. It's remainder is an otonality, the 9th harmonic, or the 9:8.

Later, Ptolemy rejected the dissonant Pythagorean major 3rd, because the 5:4, or 5th partial of the harmonic series is beat free when sounded with the fundamental, therefore a truer consonance. Its remainder within a fifth is the 6:5. Although the 6:5 cannot be heard in the harmonic series, it exists as a step between the 5th and 6th harmonic and is therefore a utonality in 'remainder' thinking.

In *On Temperaments,* section C. of Ellis' appendix of *On the Sensations of Tone*, Ellis touches on the idea of non-commensurability of small number ratios*:*

It is impossible to form Octaves by just Fifths or just Thirds, or both combined, or to form just Thirds by just Fifths, because it is impossible by multiplying any one of the numbers 3/2 or 5/4 or 2, each by itself, or one by the other, any number of times, to produce the same result as by multiplying any other one of these numbers by itself any number of times.[37]

The chapter outlines various historic temperaments and discusses the fact that any temperament results in a reduction of harmoniousness. Part 4 discusses Skhismic or Arabic tuning according to Helmholtz' indication, and Ellis states *"Skhismic, and the*

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31 Helmholtz, chapter XIV. p. 431.
32 Ibid. Translator's Appendix XIX. p. 679.
33 Harry Partch, *Genesis of a Music*, New York, Da Capo Press 1974, p. 72. Partch's definitions pertaining to intonation.
34 Ibid, p. 173.
35 Daniel Heller-Roazen, *The Fifth Hammer: Pythagoras and the Disharmony of the World*, New York, Zone Books, 2011, p.31.
36 David B. Doty, The Just Intonation Primer, third edition, self published, 2002, p.25.
37 Helmholtz (Ellis), p. 647. A beautiful example of Ellis' fluidity of style within his Appendix XIX.

harmonic effect is shewn to be much superior to that of any commatic temperament"[38]*.* Partch picks up on this:

One of the most important British figures was Ellis… inventor of the ratio-navigation instrument of cents, and translator and copious annotator of Helmholtz… and proposed his "Unequally Just Intonation" as a basis for the attainment of purer intervals. This involved 53 tones to the 2/1, derived wholly by Pythagorean processes [tuning only pure fifths: S.C] *Ellis was strong advocate of 7 in harmony, calling the numbers 4:5:6:7 the "justification" of the "dominant seventh"*[39]

Helmholtz links Pythagorean and Arabic traditions[40] and with Ellis expanding by footnote, goes on to discuss the workings of extended Pythagorean tuning. By tuning four Fifths upwards from C we reach the interval of E, or 81/64. This E is a Pythagorean major third, and while it is technically the 81st partial, it is a dissonant sounding third which is 81/80, or a syntonic comma, sharper than a just major Third (the 5th (80th) harmonic in the overtone series). Alternatively, if we tune 8 Fifths downwards from C, we reach an interval called Fb, with Fb being one Skhisma, or an 11th of a comma, lower than a just major Third.[41] A Skhisma is 1.9537 cents. Helmholtz finds this interval scarcely imperceptible, or at most only perceptible by the extremely slow beats produced by the chord C – Fb – G, a therefore Practically Just C major triad. Marc Sabat expands on this stating that:

the Practically Just major thirds exist one Pythagorean cycle back. By tuning twelve 5ths down from E (the Pythagorean 3rd), you reach Fb (the Practically Just 3rd), which is a Pythagorean comma lower than the Pythagorean E. On tuning fourteen fifths downwards from F# you reach Fb, which is 28ct flat in relation to the F#, therefore within 3ct of a just 7/4, hence another important practically just interval.[42]

An obvious drawback to a monophonic approach was being bounded by a system which cannot modulate outside itself, and because my practice revolves around song writing, modulation while maintaining a 'practically just' sound, seemed advantageous. Many practically just intervals would be available; major and minor thirds, sixths and sevenths, all within or close to 2 or 3 cents of Just tuning, with the chain of 24 Pythagorean fifths offering precise 3 limit intervals. The attraction of this emancipated system has the disadvantage of slight beating in the thirds, sixths and sevenths compared to pure harmonic series intervals[43]. To give important context to this, the beating is comparable to the beating of a fifth on an equally tempered instrument, which is the most in tune interval of equal temperament.

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38 Helmholtz. p. 651

39 Partch. P 395

40 Helmholtz. p. 430 - *"there is no perceptible reason in the series of Fifths why they should not be carried further, after the gaps in the diatonic scale have been supplied. Why do we not go on till we reach the chromatic scale of Semitones? To what purpose do we conclude our diatonic scale with the following singularly unequal arrangement of intervals - 1, 1, ½, 1, 1, ½ ? The new tones introduced by continuing the series of Fifths would lead to no closer intervals than those which already exist. The old scale of five tones appears to have avoided Semitones as being too close. But when such two intervals already appear in the scale, why not introduce more. The Arabic and Persian musical system, so far as its nature is shewn in the writings of the elder theorists, also knew no method of tuning fifths. But this system, which seems to have developed its peculiarities in the Persian dynasty of the Sassanides (A.D. 226-651) before the Arabian conquest, shews an essential advance on the Pythagorean system of Fifths".* All Helmholtz footnotes in this paper relate to the 1st English Edition. In the 2nd English Edition, which I did not use during the majority of this research period, Ellis lists The Skhismic Temperament in Art.17. of his Appendix. P.435. Extending the Pythagorean chain from Abb to G##, thus 27 Fifths. He calls the Pythagorean Major triads "horrible chords" and the Skhismic triads "quite smooth and pleasant". Page numbers between 1st and 2nd Editions are very different.

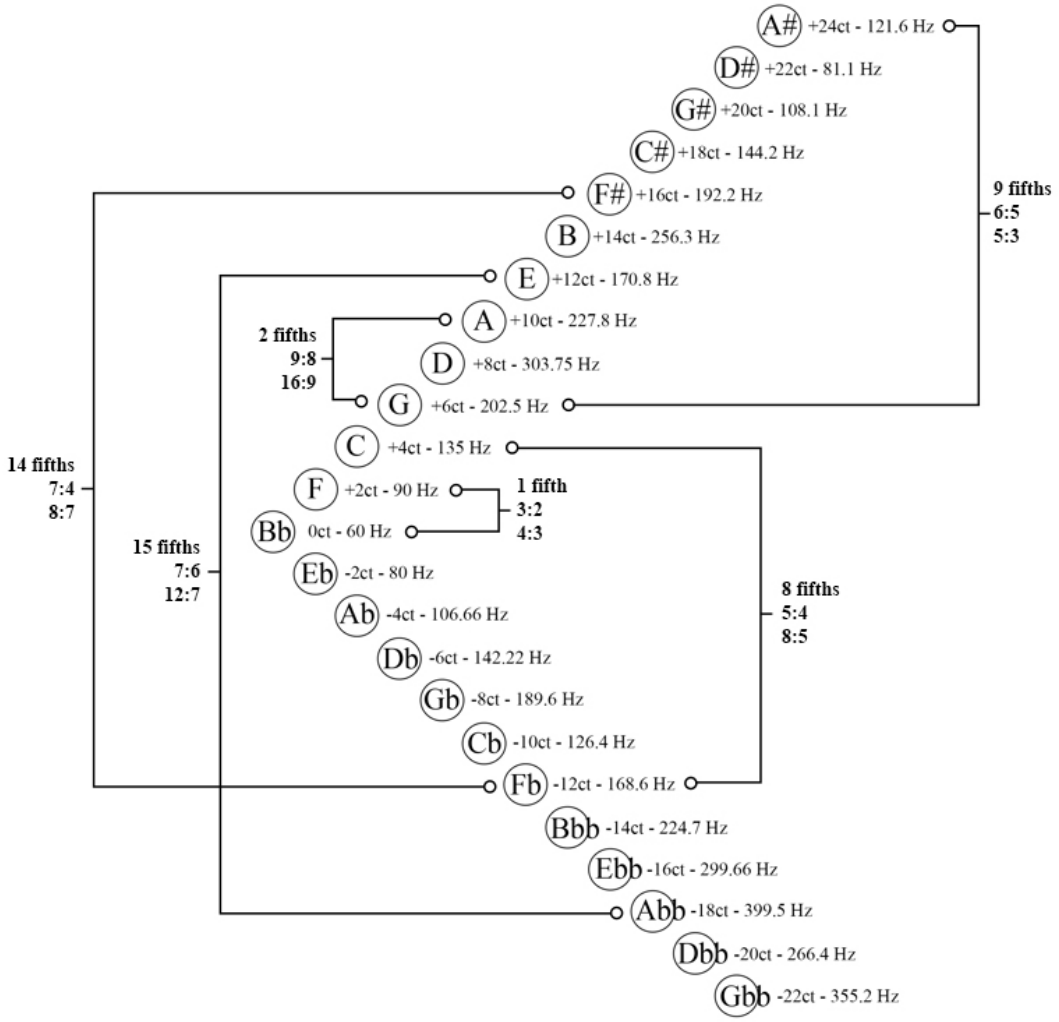
41 Ibid. p. 431

42 email communication with Marc Sabat, winter 2019.

43 Alexander J. Ellis, *On the Musical Scales of Various Nations*. Journal of the Society of Arts. March 27 1885 vol xxxiii. p. 485. Ellis posits that *"No ear has yet succeeded in hearing the interval of 1 cent between two notes played in succession. Even the interval of 2 cents requires very favourable circumstances to perceive, although 5 may be heard by good ears, and 10 to 20 ought to be at once recognised by all singers and tuners."*

I arranged the Pythagorean pitches in the lower reeds of the left hand of the concertina, the spectral in the higher reeds of the right. In the overlapping octave, I tuned the double flats and flats in the left, the sharps in the right, among the harmonic series.

My system used Bb as the central fifth of the Pythagorean chain, tuning 12 fifths upwards and 11 fifths down. The diagram below illustrates the most important practically just intervals available. Each of the forks pictured representing a 'special relationship'[44]



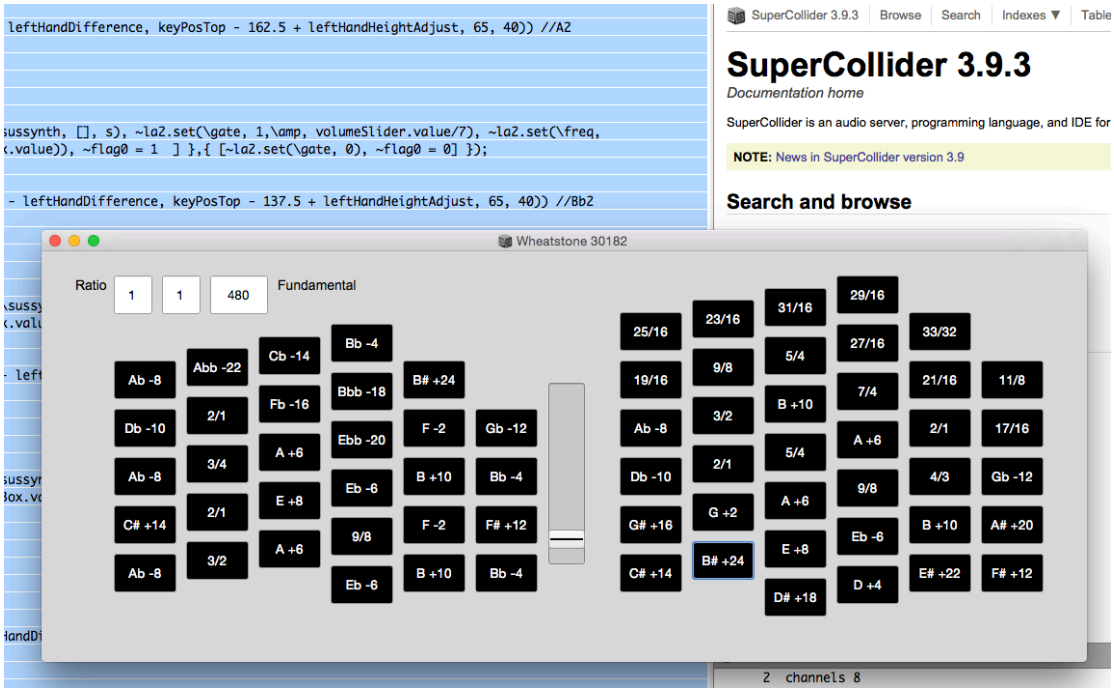
Each fork in the above diagram may be moved up and down to show the quantity of practically just intervals available. This layout is untransposed.

After finishing the tuning, with all 24 fifths in the octave above middle C, I found I missed a sequential rendering of the harmonic series through the instrument. I had the 2nd to 6th harmonics within the Pythagorean tuning, with the 5th overtone being the Fb and therefore practically correct. But, the position of the 7th partial could only be inserted sequentially if taking the place of A# among the chain of Pythagorean fifths,

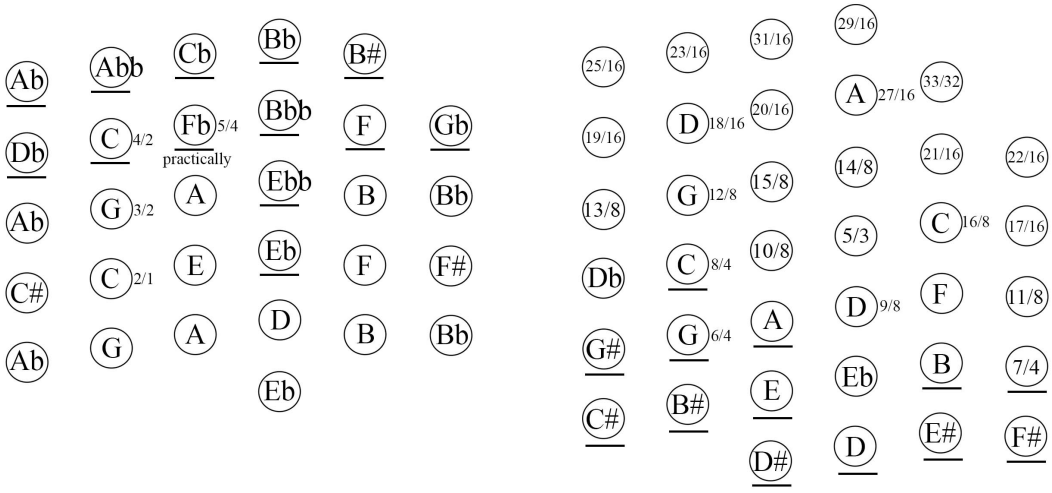
[44] David B. Doty, The Just Intonation Primer, third edition, self published, 2002, p.23. Doty discusses Arthur H. Benade's 'special relationships', an experiment where subjects tune two oscillators until they obtain beat free relationships between restricted regions. The 10 ratios represent the most important consonances of just intonation, raked in the following order of consonance: 2:1, 3:2, 4:3, 5:3, 5:4, 6:5, 7:4, 7:5, 8:5, 7:6.

therefore breaking the chain. After having developed 2 songs which did not utilise this A#, I decided to sacrifice it in favour of a well tuned 7/4. This allowed a complete harmonic series sequence from the 2nd to the 23rd overtone, with the 23rd, 25th, 27th, 31st and 33rd available above.

Using the SuperCollider software, I mapped out the keys of the instrument in a GUI where I could listen to the intervals before committing to the tuning.



Development screenshot from SuperCollider, showing the concertina key layout used for testing before tuning. + and – numbers indicate cents in relation to fundamental.



Final Pythagorean / Spectral note layout. Underlined pitches are the 24 note octave between left and right hand. Pythagorean pitches are shown as note names, sometimes together with their correct or 'practical' ratio in relation to the C harmonic series intervals, which are shown as their ratio only. The higher a circle appears in the drawing, generally indicates a higher pitch.

Pesthuislaan 41
1054RH Amsterdam
4 April 2020

Dear Mr Ellis,

My instrument was bought from Chris Algar, a concertina dealer based in Stoke. I flew in from Amsterdam to meet him at Manchester Airport. He had four instruments in my desired system. After choosing, we sat in his van in the short stay car park while I checked its tuning, again, using my telephone. It was in beautiful cosmetic condition but had been stored so badly that the steel reeds had a slight coating of rust, meaning they either did not sound, or gave off quite ugly high metallic overtones. Someone had retuned several of the notes which indicated irregularities. Some reeds in A440, but most indicating Old Philharmonic Pitch. This instrument had been half bastardised by this retuning, leaving all rusty reeds in the old high tuning. It was therefore difficult to take an accurate measurement, not only because of the two tuning systems therein, but also Chris, who likes to natter, talking cheerfully throughout. Only when I was back in Amsterdam three hours later did I realise the instrument's keys were laid out in the key of Bb. Thus a whole tone lower than expected.

By your classifications in On the History of Musical Pitch, Old Philharmonic Pitch is A 452.5 Hz. This was recorded on a tuning fork in 1859 by Mr. J. Black of Broadwood's Pianos and kept in the records of Mr. Hipkins. The tuning was still in use by concertina manufacturers in the 1920s, it is around 49ct sharp of A440.

This being a transposing instrument, with Bb in the position of C, created the dilemma of choosing of a fundamental. I planned to use C 261.6ct but this instrument threw up difficulties in taking that approach. Firstly, the C as I know it, would be in the position of a D, which didn't feel sensible or logical. Secondly, if I was to tune the Bb (49ct sharp) up to C, I would be removing quite a lot of irreplaceable steel. I pondered this before deciding to keep the high tuning, because in this case, I would leave the instrument as far from equal temperament as is possible. This felt like burning a bridge, or certainly inviting future problems for playing with other instrumentalists. But so be it.

My instrument's Bb being 49ct sharp gave almost exactly 120Hz, which is Bb 50.6ct sharp. Keeping this fundamental was the kindest way to treat the concertina. Although technically it is a B 49.4ct flat, for the sake of simplification I call it Bb, as this makes a more pleasing array of names for the chain of 24 Pythagorean fifths. To further complicate things I would call Bb, C, so I can sight read more easily, thus keeping it a transposing instrument.

Later, comparing your data from On the History of Music Pitch with a Wheatstone concertina pricelist produced for the British Empire Exhibition of 1924/25, Wheatstone list their instruments as Philharmonic (C 540 vibrations), this was a joyful serendipitous discovery that I was not altering the C of the Wheatstone instrument at all, because your 201st entry lists A as 454.1 Hz, displayed with equivalent meantone and just pitches, with C noted as 540Hz. A Just fifth being 1.5 times its fundament means the Pythagorean chain follows Bb 240Hz, F 360Hz, C 540Hz. The 201st entry also states that this was wrongly attributed as Philharmonic pitch on the date of the first delivery of your paper.

Truly yours,

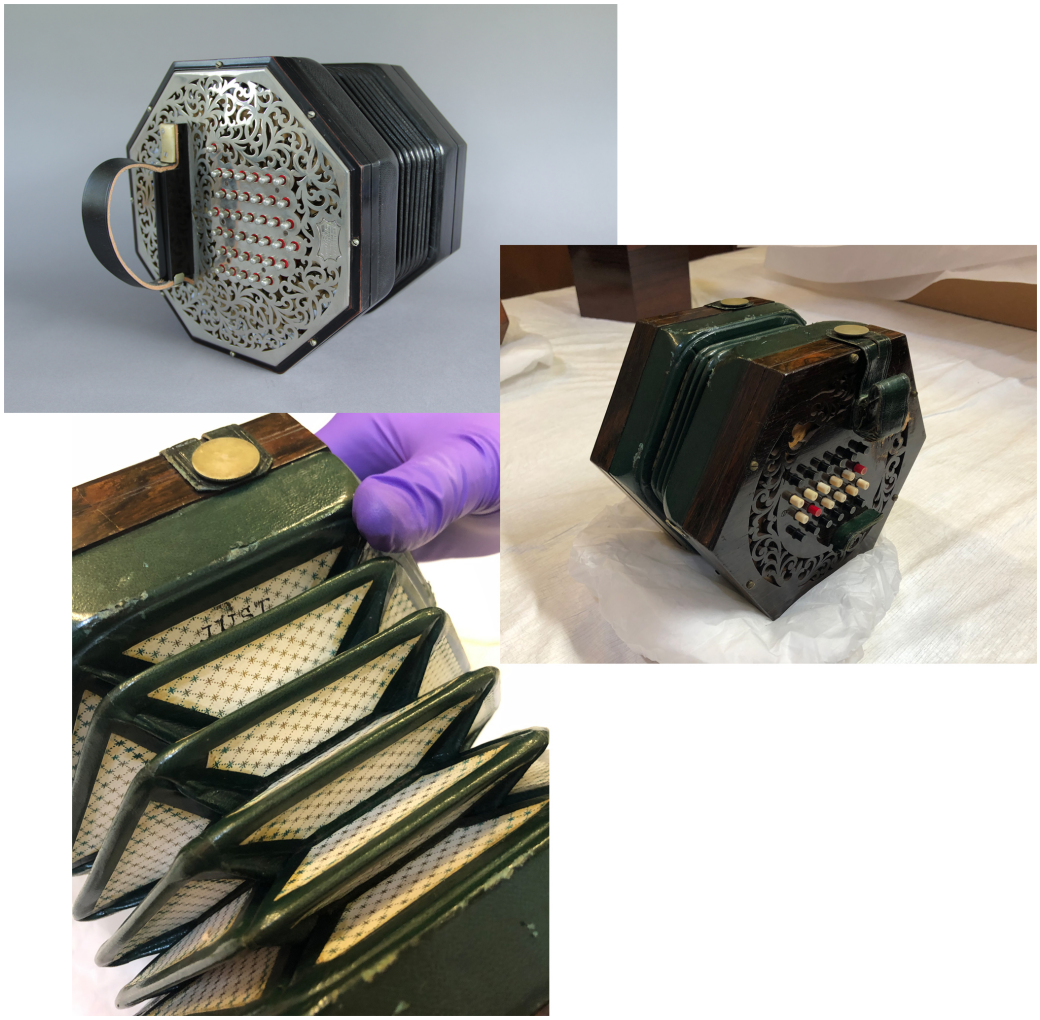
S Cater

APPENDIX II

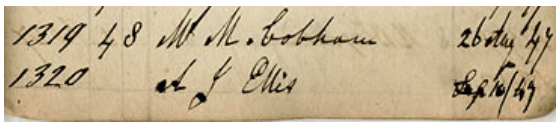
TUNING THE EXTENDED PYTHAGOREAN

Tuning Process

Ellis could send his instruments to professionals for re-tuning. This would be extremely expensive nowadays, but fortunately I was in possession of the skills for completing the task. The instrument chosen, a Wheatstone Maccann Duet from 1924, had 67 pitches available, with 134 reeds.[45] The concertina is two instruments joined by a bellows. The sound produced by the lower reeds, projects left, the higher sounding reeds project rightwards.



Top left: Extended Pythagorean Concertina, tuned 2019, Amsterdam. Right and lower: Examining Ellis' Just Intonation instruments, Horniman Museum, London. January 2020. Lower left image shows the word 'JUST', handwritten. The Extended Pythagorean instrument is probably more than twice the size and weight.



Sale entry in Wheatstone Ledger, for the Eliis' Just instrument, serial number 1320. September 10 1847. Horniman Museum, Wayne Archive. Ledger C104a, Page 067.[46]

[45] Concertinas were produced in large numbers between the 1850s and the 1920s, manufactured in London by companies like Wheatstone, Jeffries, Lachenal, Jones, and Crabb. The concertina covers three distinct systems: Duet, the system I am using, is unisonoric, playing the same pitch in both directions of bellows movement, with two reeds needed for each pitch.

[46] Image found at: http://www.horniman.info/WNCMARC/C104A/PAGES/C1P0670S.HTM

Re-tuning was achieved by filing reeds. Filing at the tip of the reed sharpens, filing at its base flattens. The choices can be altered after tuning, with further loss to the mass of the reed's steel.

An analogue stroboscopic tuner was used. This uses a spinning disc which stands still when it hears the same pitch from an instrument or sound source. The desired pitches are programmed into the tuner as a series of temperaments, after which, strict steps should be followed:

1/ All individual reeds are measured in relation to their desired pitch using the temperaments of the tuner.

2/ The difference of each individual pitch is noted and the instrument is taken apart so the reeds can be reached.

3/ Because the reeds sound at a different pitch when outside the instrument, they are re-measured and this difference is also noted.

4/ Then the tuner must then be tuned to the untuned reed, and adjusted to the difference from point 3/.

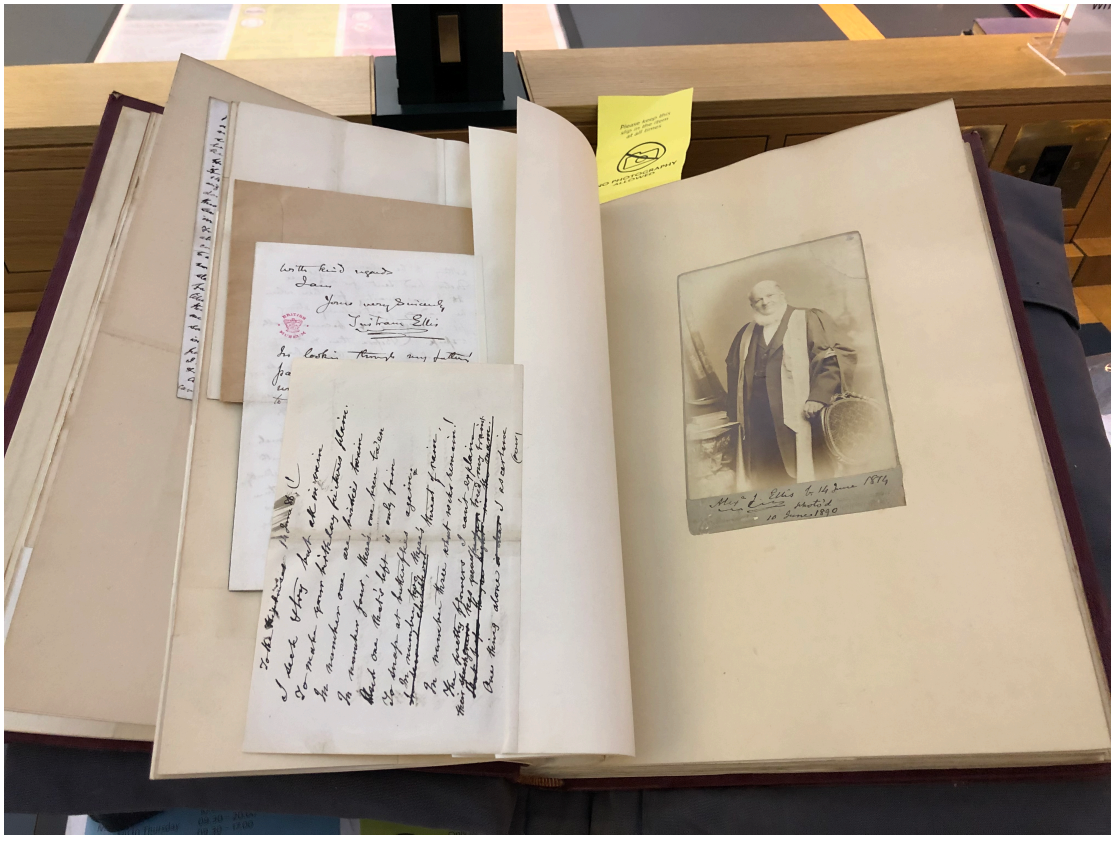
5/ The reed is tuned to this fictional pitch.

6/ The instrument is re-assembled for re-measuring.

At this point it is unlikely that any reeds will be perfectly in tune, but the majority of steel removal is done. The process is repeated several times until the reeds are within 0.3ct of being in tune. This is a long process, where it is only possible to concentrate for so many hours, but within about one month, the instrument was tuned. The concertina holds its pitch very well but minor fine tunings were carried out after nine months.

A video of part of the tuning process can be seen on the Research Catalogue.[47]

[47] video of fine-tuning the instrument in researchcatalogue.net



Pesthuislaan 41
1054RH Amsterdam
25 April 2020

Dear Alexander,

In this last letter I hope you don't mind me using your first name. I'm surprised this is only the first time, as I have been tempted many times previously. If I think about it, I've made so many trips to learn more details about you, and feel by now that we must have arrived at first name terms.

When I visited Kensal Green Cemetery to see your grave, I looked around Lot 140 without luck. I tried to imagine how the grave might be, and considering your generous and sober character made me think I should be looking for something simple. Sure enough, when I finally found it, it was a large flat granite slab, marking the resting place of you and Ann. To some extent I felt this as a moment of acquaintance, where the traces of you were enough to make predictions about your taste, and with the knowledge that I write from modern times, I begin a period of less formality.

I borrow from your humour in saying that you'll be pleased to know this is probably the last letter I will write. It has been a journey, the turns of which I could not have predicted, which may not be an at end.

Having this instrument to play, a descendent of yours, which extends your research, has given me countless hours of learning, playing and discovering tones with which to deliver words from your archive. I called this a (re)sounding, and while I have not attempted a true rendering of you, I have felt a responsibility towards your memory.

Everything has been a source of great pleasure but it has not been easy to find the sound of this music. Much slow repetition has been lived through in preparing the songs for performance, and still, the music is not quite ready. More practice is needed and I must find the right room in which to record, a room with a sound which compliments the harshness of the steel reeds of the concertina. In some ways though, I think the music has found itself, with me as a kind of medium, bringing the various elements together.

All concertinas have a different character. Other instruments are more agile but this specimen tends towards a slow and heavy sound. I think this is reflected in my delivery. I experimented with different modes of playing, but could not create great contrasts because of restrictions of manoeuvrability from the weight, which is nearly 4 kilos, and slow flow of air. Any sombreness in the music is not intentional. I hope it comes across more as commitment to subject matter, much like your life's work. I am trying to find a lightness in the playing and singing.

I tried to find subtle differences between each song. Each piece highlighting different combinations of harmonies and atmospheres. There are more in process as well. I didn't want this music to be about scale analysis, that didn't feel like the right way, considering my practice. Instead of first analysing what was there it felt more natural to discover things slowly. This heuristic approach suited my way of discovering. I practiced rudiments to begin with but soon tired of this approach to learning. My method has been to write each song and practice it until it felt natural, with an understanding of the intervals in use. As subsequent songs came, new intervals emerged. Hopefully there will be further surprises.

Finally, in the first letter, I talked of putting myself in your place but not wanting to write myself into your history. I am now unsure if this can be avoided, with search functions so efficient and your biography so scant. I am also concerned that this project may be deemed presumptuous in regard to your memory. I really hope not. I have done my best to illustrate some moments in your history and hope you would see some value in this labour.

With thanks and truly yours,

Seamus