

JUST INTONATION: GATEWAY TO AN EXPANDED UNIVERSE OF HARMONY

PROPOSAL

It is proposed to produce and market a three record set entitled: "Just Intonation: Gateway to an Expanded Universe of Harmony". The first two records will contain a narrated demonstration of just intonation geared to musicians. The demonstration will have length from 1½ to 2 hours and will include the following: 1. Explanation of what just intonation is and of its basis in the natural laws of sound and of human hearing. 2. Demonstration of the more important intervals and chords based on ratios of the integers 1 through 16 with a view to their musical applications. 3. Explanation of the theoretical basis for and the usefulness of the twelve tone equal temperament system which has held a dominant position in western music over the past 250 years and against which just intonation is being compared and contrasted. 4. Juxtaposed examples of the more important intervals and chords in equal temperament and just tuning. 5. Demonstration of nuances of melody and harmony which are preserved in just intonation but which are obscured by equal temperament. 6. Exploration of harmonies and melodic figures based upon ratios of 7, 9, and especially 11 and 13 whose very existence is only revealed by going beyond the equal temperament framework.

The third record will be devoted to music in just intonation. The first side will be devoted to works of previous historical periods given a fresh sound by being performed in just tuning. The second side will contain contemporary works and focus upon harmonies and melodic turns lying beyond the pale of equal temperament.

BACKGROUND

At present, the average student of music learns that all music, all melody and harmony, is based upon a scale of 12 notes per octave equally spaced apart in pitch. In courses in acoustics, he or she learns that ideal musical intervals are based on small whole number frequency ratios and the foundations for just intonation are laid down. Normally, however, the conclusion is finally drawn that for all practical purposes twelve tone equal temperament is the best basis for music since it allows complete freedom of modulation between keys without, it is said, sacrificing anything essential in the way of harmony. This conclusion is normally accepted with very little questioning because it is virtually impossible for most students to actually hear melodies, intervals, chords, and chord progressions and resolutions in both tuning systems contrasted with each other.

In fact, there are marked differences in the way melodies, intervals, chords, and chord progressions and resolutions sound in the two tuning systems. There are a great many chords and melodic turns which can only be performed crudely and ambiguously in equal temperament tuning and which require just intonation for a performance which reveals their true character. Thus a performance ensemble or a single polyphonic instrument having full just intonation capability would be able to sound a music richer, more variegated, and more nuanced than

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BACKGROUND - CONTINUED

most music heard today. Composers would have a fuller, richer repertoire of harmonic and melodic material from which to construct their works.

Over the recent past, technological advances have been made which permit the manufacture of moderately priced "intelligent" keyboard instruments upon which music in just intonation may be performed. Such an instrument could act as a stimulus for other instrumental and vocal ensembles to perform just intonation music which they are already capable of performing but which they often lack the motivation to perform.

Thus the groundwork has been laid for a major evolutionary advance in musical art and practice as the once practical but at the same time limited and constraining equal temperament framework for musical composition and practice is modified and extended to form the more complex, but also much richer just framework.

It is said that one picture is worth a thousand words. At present there is a definite need for an audible demonstration which presents in some depth and detail the richness and variety of which just intonation harmony is capable and which faithfully contrasts just intonation with the presently ubiquitous equal temperament system.

In 1984 I distributed a very limited number of cassette copies of a three hour demonstration presenting just intonation in some depth and detail and contrasting it with equal temperament. The response was enthusiastic. Several people remarked that the demonstration enabled them for the first time to actually hear contrasts about which they had previously only read about.

It is my conviction based upon the evidence I have seen, that there is an appreciable market for the record set proposed. Among the nearly 40,000 music instructors at U.S. and Canadian colleges alone, it could be expected that an appreciable percentage would be interested in purchasing a record set which demonstrates many previously undemonstrated possibilities in music and which points the way to a true mainstream advance in musical art. It seems reasonable to anticipate sales for the record set in the thousands.

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STATEMENT OF PURPOSE

"What I want to do is open the eyes of musicians, composers, and teachers to the fact that many new possibilities for harmony exist of which they may have been unaware."

OBJECTIVES

- I Convince the musically intelligent listener by means of argument but more by means of striking examples that yes, there really is a whole new world of harmony which can be reached by breaking free from the 12 tone equal temperament framework.
- II Give the listener a clear feel for the numerical foundation for natural harmony and hence an appreciation for its orderliness and beauty.
- III Give the listener a clear feel for/picture of what 12 tone equal temperament is and how it works. Give him or her a clear feel for the contrast between harmonies in 12 tone equal temperament and just intonation.
- IV Sow in the listener's mind the idea that yes, at the time of its adoption, 12 tone equal temperament was useful but that now that means are available for going beyond 12 tone equal temperament, particularly in the case of synthesizers, much is to be gained by taking the step of going beyond 12 tone equal temperament.
- V Give the listener a delightful intellectual and musical experience and create in his or her mind a feeling of satisfaction that: "Aha! Now I really understand things about music and sound which I didn't understand before. I really know a bit more how it all works now!"

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CONTENTS OUTLINE

- I INTRODUCTION Present situation - just intonation vs equal temperament today; Plan of this demonstration
- II PHYSICS OF JUST INTONATION Small integer frequency ratios - demonstrate just fifths and fifths out of tune by 1%
- III BASIS FOR JUST INTONATION ROOTED IN HUMAN AUDITORY SYSTEM
Sine waves; The harmonic overtone series - demonstrate; Fusion - demonstrate; Beauty, art united with physics, mathematics, numbers in music, a wonder
- IV THE OCTAVE We shall proceed successively from ratios based on 1 to those based on 3, 5, 7, and so on to higher and higher odd integers; The octave - similarity between notes an octave apart; Interval and chord inversion
- V FIFTHS AND FOURTHS Demonstrate these intervals; Circle of fifths; Medieval music based on these intervals - demonstrate; Canons at fifth and fourth; Dominant - tonic and subdominant - tonic harmonic transitions - preview
- VI MAJOR AND MINOR THIRDS $5/4$, $6/5$, $8/5$, $5/3$ - demonstrate; Major triads in different inversions; Reversal of order of intervals in a chord to give minor triads; Historical advance made by British musicians in 12th, 13th, and 14th centuries spreading throughout Europe in the early 15th century - briefly demonstrate contrast between medieval fifth based music and the "new art" which appeared in the early 1400s
- VII THE JUST MAJOR SCALE Fixed pitch instruments (keyboards and fretted instruments) require a limited set of notes (pitches) from which a variety of pieces of music must be constructable; The just major scale based on tonic, subdominant, and dominant triads in relation to the first or tonic note of the scale; Problem between D and A - demonstrate convincingly; Human voice can accommodate for this but in the case of fixed pitch instruments a tempering system became necessary
- VIII THE EQUAL TEMPERAMENT SYSTEM Theoretical mathematical foundation; Its successes - perfect octaves, excellent fifths and fourths, fairly good thirds and sixths - demonstrate contrasts - just major scale vs eqt major scale, just vs eqt

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CONTENTS OUTLINE - CONTINUED

VIII THE EQUAL TEMPERAMENT SYSTEM - CONTINUED

intervals and chords - fifths and fourths, major and minor thirds, major and minor triads in various inversions, music passage (Lo how a rose e'er blooming or old 100th)

IX MELODIC DISTINCTIONS OBSCURED BY EQT Diatonic vs small chromatic semitones - how derived harmonically - demonstrate; Major vs minor whole tones - harmonic derivation - demonstrate; Contrast just melodies accentuating these distinctions (eg. White Christmas) with their eqt counterparts

X INTERVALS AND CHORDS BASED ON RATIOS OF 7 $7/6$ vs $6/5$ - demonstrate melodically, as contrasting two part intervals, and in 4 and 6 part just minor triads and dominant 7th chords - marked distinction in just vs none in eqt; The $36/35$ diesis - demonstrate; Blues melody demonstration; $7/5$ vs $10/7$ - $4:5:7$ vs $6:7:10$ chords; Diminished minor 7th chord; Contrast just and eqt versions of dominant 7th chords and diminished minor 7th chords; Diminished minor triads - $5:6:7$ and the chord with the order of these intervals reversed contrasted; $8/7$ vs $9/8$ and $10/9$

XI INTERVALS AND CHORDS BASED ON RATIOS OF 9 The harmonic dominant 9th chord; $9/7$ vs $5/4$ and just minor triad vs $6:7:9$ chord; $4:5:6$ triad vs supermajor triad; $5:6:7:9$ harmonic dominant 9th chord vs just diminished minor 7th chord; Contrast brief passage of septimal harmony music in just and eqt tuning

XII INTERVALS AND CHORDS BASED ON RATIOS OF 11 Harmonic dominant 11th chord; The $11/9$ blues third; The $7:9:11$ triad and its counterpart with interval order reversed demonstrated to best advantage in several ways; $8-9-10-11$ melody and $10:11$ and $11:12$ melodic intervals; The French 6th chord - contrast just and eqt musical passages which display this chord as a diamond is displayed to best advantage through cutting and setting; The $5:7:9:11$ chord; $7:9:11$ as an intermediate between $4:5:6$ and $3:4:5$ on same middle note; Further explorations - this is a high point of the entire demonstration

XIII INTERVALS AND CHORDS BASED ON RATIOS OF 13 Harmonic dominant 13th chord; the $9:11:13$ triad, contrasted with

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CONTENTS OUTLINE - CONTINUED

XIII INTERVALS AND CHORDS BASED ON RATIOS OF 13 - CONTINUED

the 5:6:7 and 4:5:6 triads; 7:9:11:13 chord and its counterpart with interval order reversed; Further explorations with a view towards turning up musically meaningful ideas

XIV INTERVALS AND CHORDS BASED ON RATIOS OF 15 Traditional "pop" chords such as major and minor 7th chords and the 8:10:12:15:18 and its reverse interval order counterpart chord in just and eqt; The 9:11:13:15 chord; The 7:9:12:15 chord and its reverse interval order counterpart; Further explorations

XV INTERVALS AND CHORDS BASED ON RATIOS OF 17 The 10:12:14:17 just diminished 7th chord and its eqt counterpart - demonstrate; Chord resolutions of the 10:12:14:17 chord demonstrating that different inversions of this chord are called for in different musical contexts; Further explorations

XVI INTERVALS AND CHORDS BASED ON RATIOS OF HIGHER ODD INTEGERS

Chords containing $21/20$ and $25/24$ ratios such as the heavily used in Romantic times 21:24:30:40 chord and the 25:30:40:48 major/minor chord; Melodic runs such as 33-32-31-30-29-28-27 which harmonize with just chords forming harmonic progressions (explore these possibilities); Further explorations

XVII. CONCLUSION Recapitulate journey; There is much new material, many fine nuances, many strikingly different sounding harmonies for the bold composer to work with; A good warm concluding paragraph

MUSIC RECORD

SIDE 1 Just renditions of existing compositions covering a fairly broad range of styles (about two examples contrasting just and eqt versions of well known compositions); A medieval fifths based piece, one or two renaissance works, a Bach example, several Romantic era examples - Chopin prelude in E major, excerpt from Sibelius' Finlandia emphasizing use of the French 6th chord, Debussy example illustrating his use of higher than 9 integer ratio harmonies, blues and jazz examples

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CONTENTS OUTLINE - CONTINUED

MUSIC RECORD - CONTINUED

SIDE 2

Contemporary music - works by contemporary just intonation composers - Ben Johnston, Ivor Darreg, and works which I compose specifically to take fullest advantage of the new harmonic and melodic possibilities opened up by removal of the limitations of eqt.

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WORK PLAN

I PREPARE MASTER TAPES FOR EACH OF THE THREE RECORDS

A Work chapter by chapter on the 17 chapter narrated demonstration (records 1 and 2) and for each chapter do the following:

1. Think through each chapter carefully. What are the key points to be made? Based on this preliminary reflection, prepare a draft outline for the chapter.
2. Draft spoken narrative and prepare draft scores of the musical examples.
3. Prepare notes forming the basis for the text & illustration chapter in the accompanying booklet corresponding to this narrated chapter.
4. Code the musical examples on QUADVOX, documenting thoroughly so as to enable examples to be quickly re-stored and rerecorded (memory backups on cassette etc.)
5. Record draft narrative and musical examples on 4-track tape, logging all recording information and level settings used.
6. Mix down 4 track draft recordings onto an open reel tape, logging all mix down settings and special instructions.
7. Prepare cassette recordings of the chapter for review by others, logging all cassette deck and open reel recorder level settings.
8. Seek review and comments by others on each chapter (each chapter singly or several chapters at a time as the case may be).
9. After draft of entire narrated demonstration is complete and review comments are in, revise each chapter, repeating steps 2 through 5 to create a revised final chapter recording on 4 track.

B Prepare 4 track originals for each number on all music record 3 according to the following steps:

1. Carefully select all presently existing compositions to be presented on the record.
2. Prepare compositions for presentation on the remainder of the record as follows:
 - a. Decide on the number of compositions needed and on the length and general character of each piece to be composed.

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WORK PLAN - CONTINUED

- b. Prepare each composition by drafting its score and coding it on QUADVOX. Prepare draft recordings of each composition and revise the drafts to improve their effect. Prepare final 4 track originals of each composition and prepare final scores corresponding to the recordings. Keep all necessary computer records, make all necessary memory backups, and log all settings used in making the recordings.
 3. Code and make final 4 track originals of each preexisting composition documenting thoroughly as for the original compositions.
- C Investigate options for mixing down the 4 track recordings to create master tapes. Options include mixdown at a recording studio using their special facilities - particularly for noise reduction and reverb - or mixdown at home, possibly using purchased or rented sound processing devices such as dbx noise reduction.
- D Prepare at least three sets of master tapes, logging all device settings used in mix down.

II PREPARE ACCOMPANYING BOOKLET

The recorded narrative for the demonstration is to be kept as brief as possible to allow maximum time for the actual musical examples. The booklet is for more extended derivations and explanations as well as for the written scores for the examples. Also the booklet is the only source of explanation for the compositions on record 3.

- A Investigate printing options for a booklet to accompany a three record set - form in which material is to be submitted, costs, booklet cover options, effect of length of booklet on cost and packaging considerations. Select a booklet printer concurrently with steps B, C, and D of this item.
- B On the basis of chapter narratives, text & illustration chapter notes, and in the case of record 3 drafting from scratch, prepare a complete rough draft of the accompanying booklet.
- C After finalizing the master tapes, finalize the booklet manuscript. Include a detailed table of contents with playing times for the items on each of the records. Prepare "camera ready" illustrations.
- D Prepare a reduced accompanying booklet to accompany record 3 alone when this latter is sold as a single record.

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WORK PLAN - CONTINUED

III ARTISTICALLY DESIGN RECORD LABELS, A BOX FOR THE THREE RECORD SET, AND A JACKET FOR RECORD 3 WHEN SOLD AS A SINGLE

This should be co-ordinated with market investigation. The box, labels, and jacket should conform to the requirements of the record manufacturing/packaging operation. Artwork cost/options need to be investigated.

- A Obtain cost quotes and input requirements from potential box/jacket manufacturers. Choose a box/jacket manufacturer concurrently with steps B, C, and D.
- B Determine what essential written information should be included on record labels, on record set box, and on record 3 jacket.
- C Draft an overall plan for the drawings, photographs, or diagrams to be placed in the available space in conjunction with the written text.
- D Prepare camera ready artwork, utilizing professional help where desirable. Obtain any required permission for use of existing pictures.

IV INVESTIGATE ALL POSSIBILITIES FOR OBTAINING ENDORSEMENTS OF MY RECORDINGS FROM INDIVIDUALS WELL KNOWN IN THE FIELD, FROM EDITORS OF RESPECTED PUBLICATIONS, OR FROM RADIO MUSIC SHOW HOSTS.

V PREPARE A MARKETING PLAN GEARED TOWARDS REACHING AS MANY POTENTIAL CUSTOMERS AS POSSIBLE THROUGHOUT NORTH AMERICA AND THE WORLD.

- A Perform investigation to characterize the market - what people are likely to be interested in purchasing 1. the three record set or 2. the single record consisting of old and new just intonation music?
- B Investigate potential sources of publicity and advertising media for breadth and depth of outreach to various target audiences and at what cost.
 - 1. Magazine/journal advertising - investigate all magazines having good potential for advertising my product - Keyboard, Computer Music Journal, music education journals, magazines for a wider intellectually curious audience - Scientific American, Science News, Psychology Today, Discover, Science Digest, computer journals, etc.
 - 2. Possibilities for achieving publicity through journal articles and even newspaper articles

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WORK PLAN - CONTINUED

3. Possibilities for achieving publicity through radio play of portions of my records and through discussion and review of them on radio talk shows devoted to new music.
4. Direct mail advertising to highly selected groups especially likely to be interested in the recordings - eg. college music theory instructors etc.
5. Radio advertising.
6. Sales at lecture/demonstrations which I give at colleges and elsewhere

- C Investigate mechanics and potential for sales in record stores. Is record store sales volume likely to be comparable to or greater than mail order sales volume? The answer to this question would have a bearing on the relative importance of the record set box or record 3 jacket in the overall sales picture.
- D Decide on a detailed (but flexible) pricing scheme for the record 3 single and the record set including postage and handling charges, sales tax, overseas postage, etc.
- E Based on these investigations and available finances, decide on a co-ordinated marketing plan utilizing all highly promising channels and timed to mesh with the completion of record manufacture.

VI PREPARE RELATIVELY DETAILED ESTIMATES OF INITIAL MANUFACTURING AND MARKETING COSTS FOR VARIOUS OPTIONS. MAKE ROUGH ESTIMATES OF ANTICIPATED INFLOW OF FUNDS FROM RECORD SALES. REFINE THESE ESTIMATES BASED ON PROJECTIONS MADE FROM INITIAL RESPONSES TO VARIOUS ADVERTISEMENTS (SEPARATE OUT ORDERS BY ADVERTISEMENT CUSTOMER IS RESPONDING TO BY DISTINCT ORDERING INSTRUCTIONS BY ADVERTISEMENT - IE. P.O. BOX NUMBERING, DISTINCT ORDER BLANKS, ETC.)

VII RAISE INVESTMENT CAPITAL NEEDED TO COVER INITIAL MANUFACTURING AND MARKETING (ADVERTISING) COSTS.

VIII EXECUTE INITIAL MARKETING PLAN

- A Prepare and submit all decided upon advertising text, camera ready art work, and ordering instructions to the journals selected accompanied by payment.
- B Prepare text and camera ready artwork for the direct mail advertising campaign. Obtain mailing list of prospects. Have brochures printed and mail them to the prospects.

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PROGRESS REPORT: MARCH 6TH, 1985

On October 27th, 1984, I made the decision to produce and market a three record set having the above title. The first two records are to contain a narrated demonstration presenting the theoretical basis for and the sounds of just intonation harmony in considerable depth and detail, comparing and contrasting the sounds of intervals and chords in just intonation with the sounds of their equal temperament counterparts. The third record is to be all music, with side 1 devoted to just intonation performances of music of previous periods and with side 2 devoted to contemporary music which exploits just intonation resources not accessible via equal temperament - eg. chords based on frequency ratios of 11, etc.

Between Oct. 27th and Nov. 21st, I made several draft outlines of the proposed contents of the record set. I also developed several tentative work plans and made initial estimates of the time required to produce the record set. I contacted two independent record manufacturers and obtained two sets of time and cost estimates for the production of a run of 1000 records to be made from a master tape supplied by me to the manufacturer.

Based on this initial research, I estimated on Nov. 21st that production and manufacture of an initial run of record sets would require a year's time and cost \$13,630. in initial expenses directly related to record production, manufacture, and marketing. The \$13,630. breaks down to \$6000. in record manufacturing and packaging costs for 1000 three record sets, \$5000. in initial advertising expenses, and \$2,630. in production costs including recording equipment, 48 1700' reels of quarter inch tape, and running incidental expenses.

Sale of 1000 record sets via mail order at \$24.00 per set plus postage, handling, and sales tax where applicable would yield \$24,000., which would cover the initial run costs and leave a profit of \$10,370. Profits from record store sales would be considerably less (roughly half) per record set sold, but could add appreciably to the total earnings. It is hoped to sell considerably more than 1000 record sets. In addition, it is hoped that sales of the third all music record will exceed sales of the 3 record set several fold.

On Nov. 21st, I began to log all expenses and log time spent and work accomplished on a daily basis. Also on Nov. 21st I undertook a major upgrade of the music production software controlling my QUADVOX synthesizer. This software upgrade was completed on Feb. 25th, 1985 and consisted of the following system improvements:

1. Upgraded main music play program Harmony I to the more efficient program Harmony II having these advantages over Harmony I:
 - A Easy to use pitch glide capability
 - B Vibrato capability with variable vibrato depth and speed
 - C Improved flexibility in use of repeating notes and passages

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PROGRESS REPORT: MARCH 6TH, 1985 - CONTINUED

- D Ability to easily change pitch separation of voices and time delay between voices in the course of music play
2. Modified note duration tables permitting a more practical to use music code.
 3. Doubled speed of wave table generating program permitting more rapid changes of timbre from one track to the next during the music recording process.
 4. Improved quality of string and brass timbres in the bass region.
 5. Wrote a checkout program to rapidly test all frequently used facilities of my software system.
 6. Added three utilities to improve ease of system use.
 7. Completed all needed documentation for the upgraded system and made cassette memory backups of the upgraded system.
 8. Added a small table on wheels to my studio furniture layout to allow me to have reference materials close at hand while coding music on QUADVOX

Also between Nov. 21st and Feb. 25th I prepared a recording of Tallis' 5 part O Nata Lux de Lumine on 4 track (5 days) and made up 8 additional SOUNDS OF JUST INTONATION packages (8 days). I donated a SOUNDS OF JUST INTONATION package (cassettes plus accompanying scores and written materials) to the newly formed Just Intonation Network and received very favorable comments on it. Pieces of music in the package are being considered for inclusion in an all just intonation issue of the experimental music subscription cassette Tellus.

From Feb. 26th through Mar. 6th I have much more firmly laid down plans for the production, manufacture, and marketing of the record set. I have prepared PROPOSAL, BACKGROUND, and PURPOSE statements explaining the proposed contents of the record set, discussing the need and market for the record set, and stating overall guiding objectives which it is intended that the record set fulfill.

These general statements are accompanied by a CONTENTS OUTLINE setting forth in some detail the planned contents of the 17 chapter 2 record narrated demonstration and the all music third record of the set.

A WORK PLAN lays out in considerable detail the many steps which must be accomplished in order to get the records onto the market and into the hands of all those who can best use and appreciate them.

This PROGRESS REPORT summarizes work done thus far.

The next step will be to complete a draft recording of one of the chapters of the narrated demonstration for time calibration purposes and work procedures check out. Concurrently work will be undertaken on market investigation and other items in the WORK PLAN.