Ξενα ρμονία Δ΄

Xenharmonic Bulletin № 4

February, 1975 * * * **Ivor Darreg,** *composer and electronic music consultant*

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Postal Problem

PLEASE CHECK YOUR MAILING-LIST!

WARNING: Mail sent to my former address of 3426 Winslow Drive, that I resided at for 7 years, and that was listed in certain books and still appears on many important mailing-lists (yours?) will not reach me: it may go back to the sender with an implication that I no longer exist.

Miscellany

Time for another issue, and to welcome more new readers, and also those who will consult this some later time. *Xenharmonic Bulletin* is also being bound into Dr. John H. Chalmers' *Xenharmonikôn,* and thus will be available through Xerox University Microfilms and in a number of reference libraries.

Issue-dates and scheduling of *Xenharmonic Bulletin* and *Xenharmonikôn* will not usually coincide—it is expected that this *Bulletin* will appear slightly more often than the issues of *Xenharmonikôn.*

Various articles on xenharmonics and on other aspects of music have appeared in Ivor Darreg's general news-bulletin, *The Exposé,* 37 issues of which have appeared since 1944. Many other xenharmonic and general musical items by Ivor Darreg have been published as leaflets or booklets, and some of these will be kept on hand, while others will be updated and re-issued as circumstances permit.

A limited number of copies of Ivor Darreg's xenharmonic compositions have been printed, but the main emphasis from now on will be on *sound recordings.*

Lecture-demonstration tapes are under consideration--this may take some time to effect, since the recording requirements for such demonstrations are far more critical than those for musical compositions.

COMPARISONS OF TEMPERAMENTS

In 1972, a set of seven large *wallcharts* was prepared by Ivor Darreg, 47 x 145 cm, the octave being as it were put under a microscope with one millimeter on these charts representing one cent, so that an octave occupies 1200 millimeters.

The more important equal and linear temperaments are compared on these charts, with appropriate groups of temperaments being placed on the same chart. All charts show the 12-tone equal temperament at the top, and about 30 just intervals at the bottom, the lines for most of the just intervals being prolonged up the chart whenever this can be done without confusion. The goodness of approximation or the 'unjustness' of a particular interval in a particular temperament can thus be seen at a glance

All intervals are labelled with the number of cents from C as 0; all degrees in the equal temperaments are numbered from the lower C as zero; letter-names are given in most cases for the inter-

Wall-charts, Continued

vals; the just intervals are named as *major third, Pythagorean major third, fifth, eleventh harmonic,* and so on. All *ratios* of just intervals are given, in the improper-fraction form as *7/4, 15/8, 81/80,* etc. For some temperaments, the number of fifths from C is given, as $^{+}27$ or -3.

The charts were redrawn on tracing paper, so that diazo prints or blueprints can be run off by any reproduction firm. Later on, arrangements will be made so that interested parties can order them. Also, simpler charts suitable for lectures or studio use will be prepared. A set of the original charts is posted on a wall of this studio for anyone's inspection.

HARMONICS, OVERTONES, & SUCH

As a composer and designer of new musical instruments, and in connection with my use of more conventional instruments and various other activities concerned with electronic sound equipment, speech, and audible communication, I get ooooooodles of questions about overtones, partial tones, and the harmonic series.

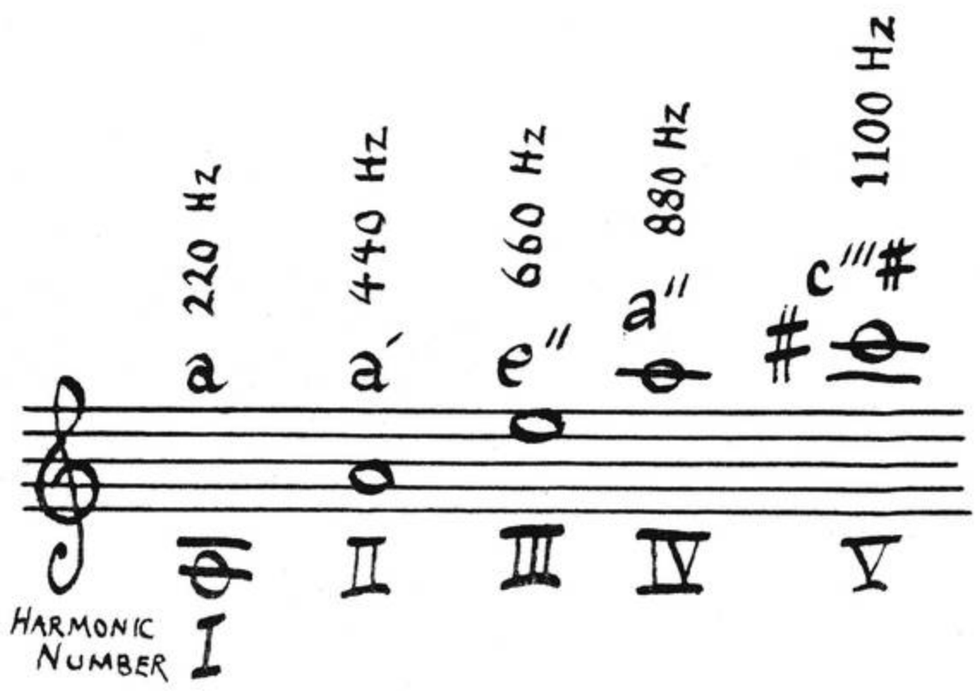
So I don't think it will be out of place to discuss the Harmonic Series in the pages of *Xenharmonic Bulletin.* It might as well be a series of articles.

A normal musical tone is composed of simple tones, not just any components, but a *series* of simple tones which in the ideal case (the mathematician's or engineer's ideal is meant here, not necessarily the musician's) are the successive integer multiples of a given frequency.

For example take what is called 'open A' on the violoncello. 'Open' means the sound of a string on a stringed instrument when the fingers of the left hand are *not* being used to press that string down to the fingerboard, so that the entire useful length from nut to bridge is producing the tone.

If the open A is in tune, its fundamental and nominal frequency is 220 hertz (official designation for what formerly was known in English-speaking countries as 'cycles per second'). The lowest component tone or first harmonic or fundamental is also of a frequency of 220 Hz. The second harmonic is twice this, or 440 Hz, the same as the open A string on the violin or the standard musical tuning-fork that gives A.

The third harmonic is three times 220, or 660 Hz, the same as the fundamental frequency of the topmost, first, or E string on the violin. Note that the *third* harmonic produces the musical interval called a *Fifth,* confusing as that is, alas! A musical fifth is so called because it is the fifth note in the diatonic scale and this has *nothing* to do with harmonics.



The fourth harmonic of our tone is another A, 4 x 220 or 880 Hz this time. Double octave or called the *Fifteenth* by pipe-organ builders and some organists. (Let's keep that one between us, shall we?)

To even up the score and to get more gray hairs onto electronic engineers' and acousticians' and mathematicians' heads, the *fifth* harmonicgenerates a musical interval called the major *third!* Isn't that diabolical? A musical third is the third note in the diatonic scale, or that formed by spanning three degrees (lines and spaces) on the staff.

The 5th harmonic of our A is a high C sharp, two octaves and a major third above our starting-point, and the tempered C-sharp of the 12-tone system is noticeably sharper than this true fifth harmonic.

Overtones, continued

5 x 220 = 1100 Hz, c‴♯.

The 6th harmonic is another E with a frequency of 1320 Hz.

The 7th harmonic of A 220 is 1540 Hz. This is about one-sixth-tone flatter than an orthodox, conformist G would be. The twelve-tone equal temperament does not have a satisfactory imitation of it, so many conformists hate this tone or ignore it, or claim it is forbidden.

N. Rimsky-Korsakov in his famous treatise on harmony published a century ago, denounced the seventh harmonic (and therefore the musical intervals based on it) as 'useless'. So have other eminent authors. Many say 'it is not in the scale'. But, scale-member or not, it is a normal component of most musical tones and that includes *conventional* musical instruments.

Advocates of just intonation are divided on this subject—many of them were not interested or simply didn't care whether it existed or not; those whose only object was to make old music sound better ignored the 7th harmonic and intervals depending on it. Just intonation eschewing the intervals dependent upon the 7th harmonic for their definition is often called *tertian harmony*. But if a just-intonation system admits the 7-based intervals, it may be called *septimal harmony*.

Partch's terms for the above were *5-limit* and *7-limit* respectively.

Without some seventh harmonic present, a clarinet would lack character, and most brass and bowed instruments would be duller than normal. So would the human voice.

Most people interested in our subject of xenharmonics will be open-minded and hospitable to the 7th harmonic and intervals based upon it. Such temperaments as 22-, 31-, 41-, and 72-tone offer good imitations of this harmonic.

The subminor seventh of ratio 4:7 is more consonant than the minor sixth of ratio 5:8, but it has to be admitted that some of the other *septimal* intervals are harsh.

I give this harmonic so much attention because it can be strange and yet harmonious, which is what xenharmonics is supposed to be in the first place.
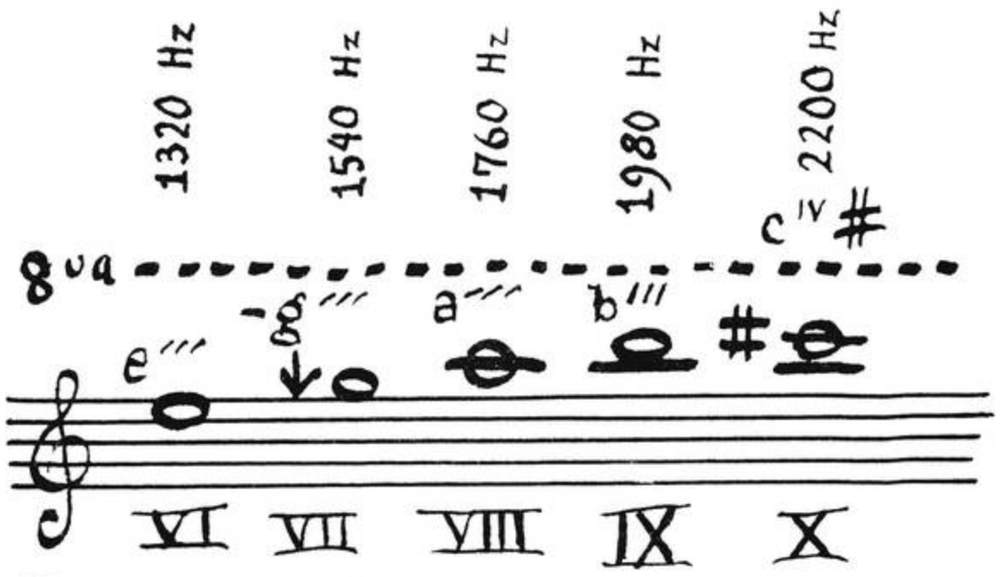
The 8th harmonic of our A is another A, the triple octave, 1760 Hz.

The 9th harmonic is a **B**, 1980 Hz.

This time, the 9th harmonic does belong in what a musician calls a chord of the ninth—just a coincidence. The 9th harmonic is present in many musical tones, giving 'brilliance'.

The 10th harmonic is the octave of the 5th harmonic, another C-sharp, 2200 Hz in the case of our cello string.

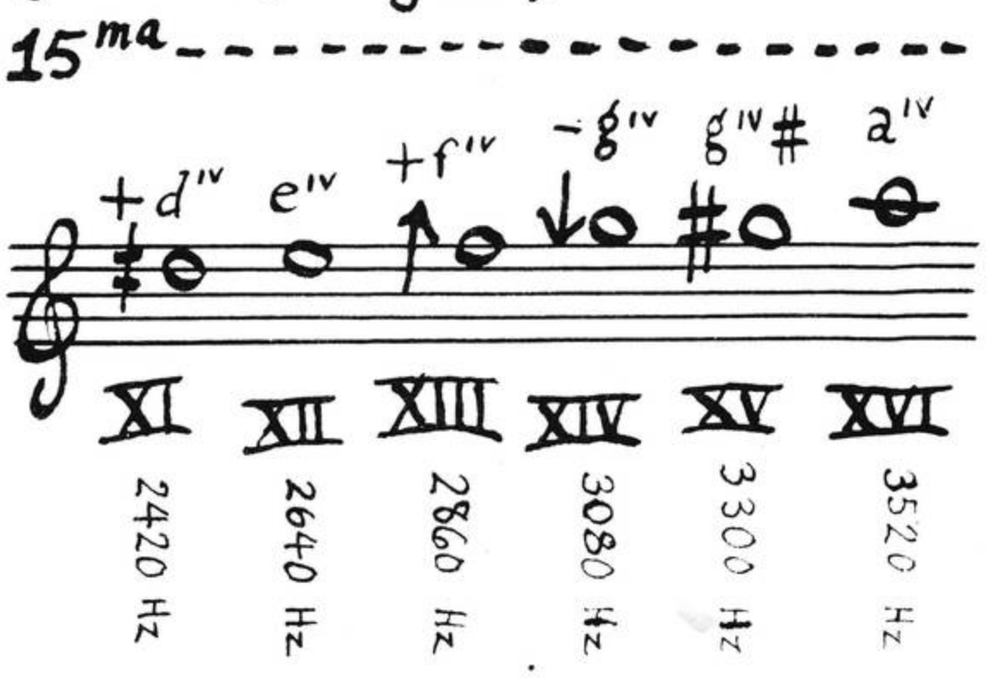
The eleventh harmonic, 2420 Hz, is not for xenophobes or the timid! Intervals derived from this are strange-sounding, the 11th harmonic of our A is D semisharp, falling very close to a quartertone between D and D-sharp.



Roman numerals are ordinal number of harmonic.

The twelfth harmonic is another E, at 2640 Hz.

The 13th harmonic, at 2860 Hz, lies in what the orthodox persons will term a No Man's Land between F and F-sharp, and forms an interval even stranger than the eleventh harmonic does. It is alleged by Yasser and others that Scriabin's mystic



OVERTONES, continued

chord contains this harmonic, or is theoretically supposed to. Kathleen Schlesinger, in her treatise *The Greek Aulos,* asserts that Ancient Greek music knew of this interval, especially where it arose from spacing of finger-holes on wind instruments.

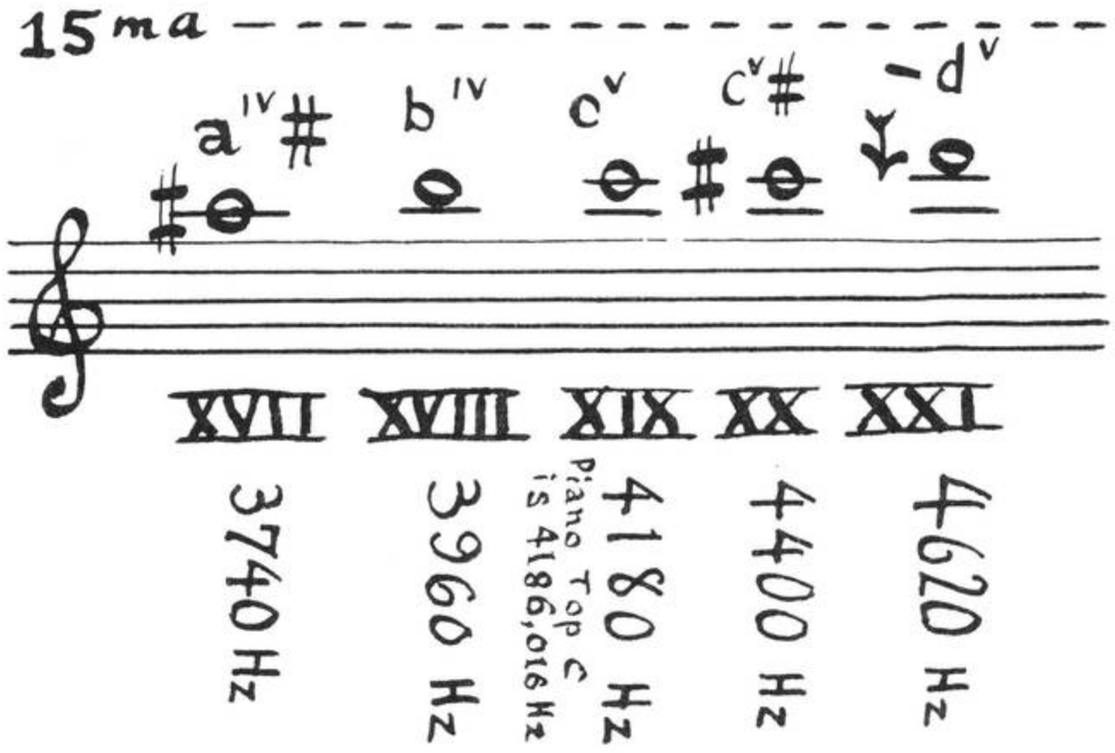
The 14th harmonic is the octave of the 7th, at 3080 Hz, a lowered G, in our hypothetical case.

The 15th harmonic is a major seventh plus 3 octaves, a G-sharp of 3300 Hz.

The sixteenth harmonic is the quadruple octave, another A, at 3520 Hz in the case of the open A of the cello. We are now at the highest key on some European pianos, and only a short distance away from the top C on American 88-note piano keyboards, so it's almost time to stop.

The 17th, 18th, and 19th harmonics of our cello A would be quite close to the 12-tone equal temperament's A-sharp, B, and C, respectively; so that 88th piano note ought to be where the 19th harmonic of the cello open A is--but it just ain't so! Pianos are almost always tuned quite sharp in the top register, for brilliance' sake. This note on an organ would be close to the 19th harmonic of A 220 Hz at 4180 Hz, however.

Because of the nearness of ratios 17:18 and 18:19 to the 12-tone equal-tempered semitone, these ratios are used for locating frets on guitars, banjos, mandolins, etc. The interval 16:19 is a good approximation of the 12-tone system's minor third, one-quarter of an octave.



Above: 17th through 21st Harmonics of A 220 Hz

There! Now we finally *have* reached the point where continuing to discuss individual harmonics of A 220 Hz would become an exercise in futility. After the 21st, they crowd together too closely to represented as notes on a staff, and up there beyond the end of the piano keyboard, it becomes hard to distinguish pitches, although many organs go an octave or more beyond the piano.

Most people can hear as high as 12,000 or 15 000 Hz; some, especially children, can hear higher than that. Nor do the cello's harmonics, and especially those of an open A-string, stop at the twenty-first! The craze for hi-fi and the huge industry of manufacturing and selling horrendously-expensive recording and reproducing equipment are based on the fact that sounds of high frequencies near the upper limit of human audibility *do* matter; high notes on instruments have harmonics up there, and most noise in musical instruments—bow-scratch, xylophone clink, wind-rush, cymbal-clash, triangle-tinkle, goes very high indeed. Laboratory equipment can detect components *beyond* audibility, in the ultrasonic range.

Theoretically, the Harmonic Series goes all the way to infinity, since we never run out of integers to multiply the fundamental frequency by. Practically, the percentage of any given harmonic soon falls below 1 % in any *useful* musical tone, and 'smooth' or 'dull' tones have few harmonics, or just the fundamental alone.

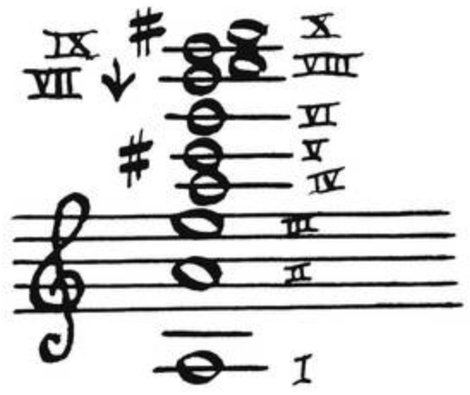
Often, tones which have a high percentage of higher harmonics are called 'noises' by the average person: buzzers, auto-horns, circular saws, planing-mills, neon-sign buzzing, some telephone dial-tones and busy signals, speedboats' engines, propeller-driven airplanes, motorcycles racing, and so on.

Harmonics play the principal, crucial role in the creation of *timbre.* Another article will give this subject the full attention it deserves.

Now why did I take the open A of the cello as my hypothetical case? I did so because cello tone is very complex, having a long series of harmonics in the normal **bowed** mode, and the bowed-string tone

Overtones, continued

would have fairly-exact harmonic frequencies present in it. Not so for a piano tone, or a pizzicato (plucked) cello tone. The open string cannot be accidentally given the vibrato (frequency-modulation in engineerese, rhythmic pitch variation in musicianese), so it would be practicable to analyze this sustained tone with electroacoustical instruments available in some laboratories.



At right: First ten harmonics of A, 220 Hz, written as a chord.

A is the only pitch that is set to an exact integer frequency value on 12-tone tempered instruments, or ordinarily in any other temperament for that matter. If I used a decimal approximation to an irrational tempered pitch such as C 261.626 Hz, this article would be so difficult to understand that you just wouldn't bother! With integers, the idea that the harmonics are exact integer multiples of the first harmonic (fundamental) in frequency is at least clear with pencil-and-paper arithmetic.

You can hear this A 220 pitch on most instruments, such as organs, pianos, guitars, violins, clarinets, etc., so even those who do not have access to the cello tone can experiment to check the above data.

Be it noted that piano, harp, and similar strings have overtones which are near harmonics but deviate from the exact integer multiples of the fundamental frequency that we have given above. Usually this deviation is sharpwards. That was one of the things I meant earlier, where I said that the mathematicians' or physicists' ideals were not necessarily the musicians' ideals: such tones with not-quite-harmonic or actually-inharmonic partial tones may be desirable in certain musical contexts and environments.

Another reason for choosing the cello tone as example is that it contains a normal amount of noise (unpitched sound or random frequency components) and thus is truly representative and typical of the musical tones you would ordinarily hear; it is not an over-idealized or over-abstract theoretical model straight from someone's imagination. Analyses or experiments based on such a tone are therefore likely to be valid.

What the cellist or violinist calls *harmonics* or sometimes *flageolet tones*, are actually still complex tones with some harmonics of their own, but nowhere near as many as the unfingered bowed open string gives.

If the cellist touches the open A string at half its vibrating length, the second harmonic or octave of the fundamental will sound when bowed somewhat more lightly than usual.

The fingertip of one of the fingers of the left hand is brought very carefully to the string with only a feather-light touch: the string then vibrates in halves.

By touching the string this way at either one-third or two-thirds of its length, the third harmonic (with its own harmonic series of course) will be elicited, and so on up to at least the eleventh and higher if one is extremely careful.

One can thus become familiar with the pitches of the members of the harmonic series —the first ten or twelve anyhow—on a bowed instrument. Perhaps someone should make a kind of monochord with electrically-maintained string(s) and elicit the harmonic series this way—up to the 20th ought to be feasible—and publish a tape recording of it.

Several centuries ago, a one-stringed bowed instrument, about the height of a double-bass, was invented for the specific purpose of using the harmonic series on its single string. It had the strange name of *tromba marina* or 'marine trumpet', although it was far more likely to be used by monks or nuns than by sailors.

More about how brass instruments use the harmonic series, in a future article.

Experiments in *synthesizing* complex tones by combining harmonics in different proportions have been going on for quite some time, perhaps beginning with the invention a few centuries ago of *mixture stops* for pipe-organs.

We will return to the harmonic series in a later issue of this *Bulletin*.

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METRICATION POLICY

As everyone knows, the United States is the last major 'holdout' in hesitating to convert to the metric system of weights and measures. At long last this conversion has begun, and may take ten years—or less.

It's a good thing in one way: we will go to the SI or *improved* metric system (SI stands for *Système International d'Unités*) which is in some ways neater and more coherent.

Had the U.S. changed some time ago, there would now be an extensive revision of certain metric engineering standards, with some impact upon the making of musical instruments, so we have been saved from quite a hassle.

The practical meaning of all this for you and me as musicians or composers or people involved with musical instruments, printing and copying of music, and all the new electronic apparatus now used for manifold musical purposes, has to do with changes in the *sizes* of many things, and changes in what we *call* the measurements of most things whose sizes don't change. For instance: Very likely this 8½ x 11" paper size will be changed to the longer and narrower European size; if not right away, then in a few years.

Sheet music and staff-ruled music manuscript paper are likely to be changed. Any change in that awkward 9½ x 12½" size would be welcomed by me with open arms! I can't file either music MSS. or commercial sheet music in standard letter-filing drawers, and special music cabinets have always been too expensive for me even if I had the space to put them.

Sizes of musical strings and the wire for making them will change; various do-it-yourself instructions for building musical instruments and so on will have to be rewritten or at least supplemented with the new measuring-data; we have already begun the uncomfortable but necessary transition period when two measuring-systems will fight it out for a while.

If you have a workshop like mine, for musical instruments, plain and electronic, you will have to get a few new tools and supplies—nothing extensive, but don't be caught short for want of planning.

Music and the making of musical instruments is one of the most international affairs in existence; so now that most of the world uses metric measurements, such particulars as length, breadth, depth, diameter, weight, tension, etc., of musical instruments and related matters ought to be stated in millimeters, meters, kilograms, etc. rather than in feet, inches, pounds, ounces, and so on. It should be possible for someone in any country to fret a guitar or build a keyboard or construct an electronic circuit or lay out string-lengths or pipe-sizes to the new xenharmonic systems from the same working drawings, charts, tables, or numerical data.

In view of the foregoing, I have decided to use metric measurements in the *Xenharmonic Bulletin* and elsewhere, giving the old customary equivalents in parentheses only when absolutely necessary. This bulletin is much more future-oriented than it is historical or antiquarian, and I can be optimistic enough to believe that its information will be referred to, five or more years from now, by which time most of my fellow Americans will not be scared of millimeters, even when they appear in British dress spelled *millimetres*.

"ILLEGAL" SHARPS AND FLATS

During the period between the tenth and sixteenth centuries, a custom obtained, called *musica falsa*, or later *musica ficta*. The "falsity" or "fiction" consisted in the singing or playing of sharps or flats which were not written down in the notation.

Thus one *pretended* that the music was of a strictly-diatonic nature, when in fact sounds foreign to the 7-tone diatonic scale were performed, heard, and indeed expected.

Ecclesiastical and educational authorities of the day frowned on the practice of inserting such extra tones into the system, but the number of such altered tones gradually increased, till finally the so-called 'accidentals' or alteration

"Illegal" Sharps & Flats, cont'd

signs (sharp, flat, natural, double-sharp, double-flat) explicitly calling for higher or lower pitches, were invented, evolved, and accepted.

I could bore you with multitudinous tiresome details of music history, and how the classical and romantic major-minor tonality system developed from those beginnings; and how twelve-tone serialism is the suicide, or the reïncarnation!, of the classical/romantic tonality scheme, as you prefer.

But that is not too relevant here. What is relevant is, that the practice of *musica ficta* was a kind of trade secret or professional 'know-how', transmitted from teacher to pupil by word-of-mouth, example, or a sort of osmosis. According to one writer, it would have been insulting for the composer or the copyist to have inserted all the flats or sharps which the competent singer was supposed to know when and where to sing instead of the 'safe' Establishment naturals.

Today, microtones are in a parallel position: The composer writes naturals, sharps, flats, and very rarely double-sharps and double-flats; these are conventionally mapped onto a set of twelve equally-spaced pitches (sometimes pitch-classes; compare allophones and phonemes in modern linguistic theory); and all of us are *expected to pretend* that 12, and only 12, pitches exist in any one octave—any other pitches are out-of-tune or illegal or forbidden, or maybe if you ignore them hard enough and long enough they will go away. That uncompromising rigid attitude is that of 12-tone theory and certain instruction-books and teachers.

The real-life performance involves all kinds of deviations from the alleged 12 equally-spaced pitches, sometimes because the instrument is built out-of-tune in the first place, sometimes because it goes out of tune with age, sometimes because the tuner didn't do his job quite in the 'standard' way; sometimes because the performer does as he was taught to do for added expression (violinists, for instance) or the performer simply was careless.

In the real world out there, of course, there is much *tolerance*, both in the philosophical and the engineering senses of that term.

A ten-thousand-ohm resistor in an ordinary piece of electronic equipment may actually be as much as 11 000 ohms or as little as 9000 ohms and still be called "10 000" and be so marked in the color-code, and function well in the circuit.

Similarly, the Middle C on a piano or organ which is supposed to be 261.626 Hz may be, and often is, somewhere around 259 or even 255 Hz without anyone sending for a tuner. That's for digital, or allegedly-fixed-pitch instruments. When we come to violins, horns, trumpets, tubas, and bassoons, it is ridiculous to talk of precision or close tolerances!

Your attention, please! I am not discussing vibrato, organ tremulant, the piano tuner's stretched octaves, or the organ, harmonium, and accordion makers' voix céleste and unda maris effects here--they belong to another kettle of fish I will serve up later, sometime.

What I am driving at here is that some 12--tone serialists are using mathematical symbols to terrify average musicians with a formidable array of scholarly erudition, while also creating an impression of numerical precision which actually is not there at all! A bassoon part *on paper* may look like some cold and calculating computer printout, but the sounds actually issuing from a bassoon will be anything but precise in pitch, and totally unlike the serialist's mathematical idealization. The same applies to most other conventional musical instruments, in different ways and to different degrees, of course.

So much for the accidental or unintentional deviations from an ideal 12-tone equal temperament at an ideal standard reference pitch such as A 440 Hz. Now we come to something closer to the *musica ficta* situation of long ago: pitch-deviations indulged in by conventional musicians, but which are not supposed to be discussed in public, and above all are not supposed to be written down in scores.

Organists and pianists have all their tuning and voicing done for them, on an 'or else', take-it-or-leave-it, like-it--or-lump-it basis. Because of the domination of composers' lives for the last century and a half by the piano, it is

"Illegal" #'s & ♭'s, cont'd

all too easy for composers, arrangers, teachers, music-textbook-writers, and others to extrapolate the digital rigidity of the piano's standardized tuning scheme to the *entire* musical scene, never mind the realities or the facts, just go on writing for and writing about violins, trombones, and sopranos as though they all had keyboards.

The carefully-ignored and studiously-left--unmentioned conflict between the violin fingerboard and the piano keyboard—between analog and digital treatment of the pitch continuum if you will—has escalated, from several causes:

The progress in technology and mass-production during the last century or more has brought with it ever more precision and standardization. This in turn has created a concomitant mental atmosphere of ever more rigid thought-patterns and the unthinking worship of cold abstractions and the 'inhuman' ideal of thousands, myriads, even millions of identical articles or identical copies or identical educations or identical programmings of anything and everything, of anybody and everybody. Since we are surrounded by such identical things and ideas in huge quantities, we cannot help thinking and behaving along robo-cultural lines.

This is the environment in which 12-tone serialism has grown up, although the first atonality didn't start out with the present goal in mind.

Let's put this another way: Many composers and their teachers have been conditioned to think in piano-keyboard terms, so that they either do not know or do not care that such instruments as the cello, violin, trombone, and the human voice can produce *any* pitch, or even a steadily-gliding pitch, within their respective compasses.

The 'division of labor' principle so beloved by manufacturers, and the specialization principle which has been even more widespread in our society, have kept pianists (and thus many composers) from knowing what goes on in violin lessons between teachers and pupils, and so for any other non-keyboard instruments. 'Shoemaker, stick to your last!' 'Don't go poking your nose in other people's business' and similar snide remarks are directed at the poor composition student when he gets legitimately and naturally curious about what goes on in the non-piano segment of the musical world.
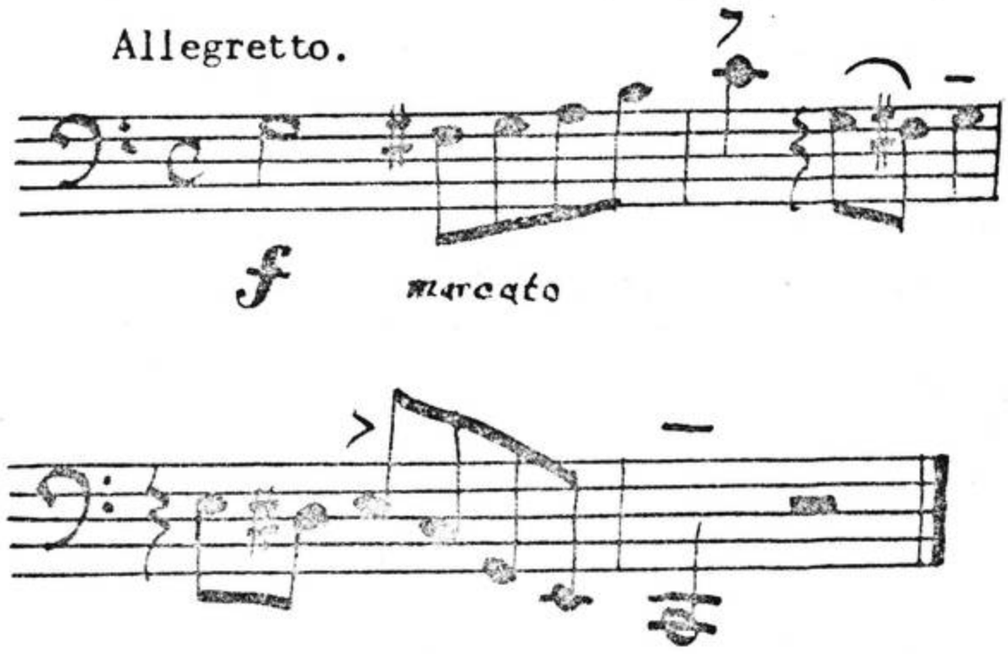
Why, the pianist is not supposed to even *want* to know, much less to find out, what the tuner does to his piano nor why he does it.

The overall picture, the general view, the musical scene as a whole, is 'put down', and the musician or composer is supposed to stay within a narrow tight circumscribed pigeonhole-niche for life. Or, at least, this *has been* the ideal for 100 years.

The foregoing explains why smaller intervals than the semitone have been neglected in occidental music during that period.

Paradoxically, violinists and cellists have been playing such small intervals or deviating from the idealized 12-tone equal-temperament standard during all that time. They have been instructed by their teachers to do so, or certain of their accidental deviations have been tolerated or even condoned.

A basic principle taught cellists, violinists, and many other non-keyboarders, is that *leading-tones are played sharper than 'standard' or 'normal' when they tend up, and flatter than 'normal' in those less-common instances when they tend down.* For instance, assume a cello is playing the following melody in the key of C major:



The notes F♯, B, and D♯ in the above example would be played noticeably sharper than the corresponding notes on the piano, and they might even be played sharper than the theoretical values for those pitches in the Pythagorean tuning-system.

"ILLEGAL" SHARPS & FLATS, cont.

As a cellist, I myself would play these notes sharp even though I were being accompanied by an instrument accurately tuned to just intonation or meantone temperament, in which latter systems these leading-tones are *flatter* than they are in the twelve-tone equal temperament. I would play them sharp even though my B made a discord with the B played by the accompanist.

Thus I would let the conflicting requirements of melody vs. harmony stand, instead of forcing either to conform to the other.

Other cellists, violists, violinists, singers, trombonists, trumpeters, or composers programming their compositions for performance by a computer might play such tones sharper or not so sharp as I would. This is why I have not said *exactly how* sharp I or they would play such a tone.

We might play it sharper at one time than another, *even for a repeat of the same passage in the same piece.* That is, the 'modern musica ficta' deviation may be superimposed upon other deviations due to carelessness, malfunction of the instrument, or normal tolerances, and these intentional deviations and unintentional deviations may add or subtract.

My example above, of course, is assumed to be run-of-the-mill 19th-century European stuff, composed during the time when the major and minor modes were almost the only ones in use, and the chromaticism of Wagner had not yet led to Debussy's whole-tone scale. In another part of this issue, I will be discussing George Whitman's citation of Tchaikovski's violin concerto in re 'expressive intonation', and that, too, comes under this heading.

Leading-tones are assumed to be of the *do-ti-do* or *sol-fi-sol* or *fa-mi-fa* variety; i.e. the 'musica ficta' I had in mind above was conforming to the classical or romantic key-system. The downward-tending leading-tones are rarer: they might be *sol-le--sol or la-te-la* for instance. (I am using U.S. style movable-*do* syllables here; English Tonic Sol-Fa-ists and European Fixed-*do* People will please understand that I have no objection to them Doing Their Thing with *doh ray mee* or *1-2-3, but in turn they must allow me the same privilege.)*

It can readily be seen (I hope!) that when this sharpening-the-upward-leading--tone practice, which was and is so satisfactory for violinists playing 19th-century music, came face-to-face with 12-tone serialism, where all 12 semitones are supposed to be equal and of *equal importance:* F-sharp is not a modified F but a fundamental full member of the twelve-tone scale in its own right, it wasn't so satisfactory any more for violinists to sharpen leading-tones or what were called chromatic tones before dodecaphony was accepted as The *In* Thing.

What *isn't* so obvious is that in the Good Old Eighteenth- and Nineteenth-Century days the violinists were microtonillating sub rosa and covertly and only their teachers knew or suspected; whereas the new current of Dodecaphony and 12-tone Serialism and the 7th of the 12 Tones no longer being a sharped F or a flatted G, but Equal Citizen Number 7 With Equal Rights, this equality imposed by keyboard, fretted, and free-reed instruments (reed-organ, harmonica) bar instruments (xylophone, glockenspiel, marimba, orchestra bells) and all manner of tuning-forks and electronic standards, is reacting back upon the hidden, *sub*liminal, 'underground', behind-the-scenes, never-notated practice by the players of flexible-intonation instruments.

Not only are the twelve theoretically-fixed pitches being urged upon violinists et al. with hitherto unheard-of severity, but at the same time the diatonic major and minor scales of the melodic and tonality systems of the Classical and Romantic periods are taking a terrible, unmerciful beating from the atonal and serial composers. With the decline of the key-system, the feeling of leading-tones, resolutions upward or downward, of tones in a melody 'tending' or 'wanting to go somewhere', in particular the melodic progressions such as *fa-mi* or *ti-do,* no longer have a secure harmonic basis --in effect yanking the violinists' and singers' rugs out from under them.

If the tonic, or rest-point, has been abolished, then there is no tendency or pull toward it, and therefore no leading-tones trying to reach it. In turn, this

ILLEGAL SHARPS AND FLATS, cont'd

will mean that the sharpening or flattening of such leading-tones has been abolished also! and this without notice!

Since the flexible-instrument players have been musica-fiction-eering all this time without the knowledge or consent of the Staff-Notation Standards Authority, they have no valid defense for their actions when or if it comes to court.

That is to say, under the classical and romantic period régimes, the composer was not supposed to know or to care whether certain orchestral instruments played some notes in certain contexts sharper or flatter than their official pitches. It was none of his blasted business! The man who created the music in the first place was not allowed to control this aspect of its performance. The most he could do was to write *espressivo, con fuoco, con amore,* and with luck such fantastic directions might result in greater-than-average pitch deviations. On the other hand, they might result in too much.

The direction and amount of deviation is determined entirely by the training of the performer, not by anything the composer says or doesn't say in the score: i.e. the composer can neither ask for a deviation nor can he ask the performer *not* to deviate!

The training, or as we would now say, the PROGRAMMING of the performer, has been such as to condition him to respond to certain *cues* or *clues* having to do with conventional harmonic and melodic patterns which resulted from the Classical/Romantic key-system. When those cues or clues are absent, as they are missing in '12-tone' music, the performer is in the position of Pavlov's famous dogs when they were confronted with ambiguous stimuli. No wonder so many ultramodern 12-tone pieces sound so sour! (We must expect that certain xenharmonic scales, especially the inharmonic systems like 13-tone and probably 21- and 23-tone, will provide no clues to violinists. We might evolve 'artificial clues' for when to deviate.)

In my article of 30 years ago, *The Quartertone Question,* I mentioned these performers' deviations and toyed with the idea of some future theorist systematizing them. I'm not so sure now. Go to a really *micro*tonal scale like 41 or 53 or 72, and you could write out all deviations; go to a larger-step scale like 17 or 19, and *musica ficta* could continue almost on the present basis.

I don't think I have to jog your imagination too hard to get you to imagine what happens when a performer goes on using deviations of a size satisfactory in the cracks between the Twelve Sacred Tones, when the music is written in quarter- or sixth-tones. (24- or 36-tone.)

Deviation is not a bad thing; don't get me wrong. The only bad thing about it is the "gentlemen's agreement" not to discuss it. Smaller intervals in the new systems should not be used as arguments to abolish deviation! Nor should the existence of deviations from 12-tone be used as a sophistic trick of argument to claim that we need not experiment with finer divisions of the octave.

I have been unexpectedly gratified with my trials of elastic temperaments and flexible tuning and performance. So I plead for tolerance in both senses at once.

A natural and forgivable misunderstanding has caused some of the computer-music to try *random deviations* in the attempt to imitate performers' variances from what is written down in a score. Since deviation or modern *musica ficta* has been sub rosā and underground and clandestine and unmentionable for so terribly long, we have to excuse composers experimenting with the computer medium if they assume performers deviate *at random:* no one ever told anybody anything different, for the excellent reason that they didn't know it themselves!

Caution: Do not take the above as a criticism of random vibrato. That's another matter to be discussed some time later.

In a recent composition, I took recorded piano tones and deviated them by speeding up and slowing down the tape while re-recording, with amazing results.

Thus the last stronghold of fixed pitch has been breached, and the inflexible has been bent at will. Other composers have deviated the pipe-organ by tampering with the wind supply.

This is not the place to consider the champion, the arch-deviant Thereminvox—I'll let

ILLEGAL SHARPS AND FLATS, *concluded*

your imagination elaborate on that one.

Most deviations are microtonal; only some of them are xenharmonic. At this initial stage, let's not be too punctilious about semantics and formal legalistic definitions.

As I said before, the *real* world out there has considerable tolerance; real hardware is not quite so perfectly identical as mathematicians, engineers, and manufacturers idealize it to be. This has till recently saved the day.

The newest precision electronics has brought into the real world a frightfully-close approach to dead, cold uniformity and near-identity: new synthesizers and electronic organs and imitation-pianos rolling off the assembly lines. Is this a serious threat? Can we avert it?

I think we can—electronic gizmos can be home-modified and individualized. We have other kinds of living *musica ficta* I haven't mentioned before: 'blue notes' and bending the tones; the bottleneck slider used by rock guitarists to get between the frets, and there will always be singers, and the human voice cannot be rigidly digitalized.

Strict uncompromising dodecaphony has not taken over the entire musical world. It will be around for centuries to come, but may not conquer much more territory than it already holds. There are too many other viable, interesting styles around. New schools are springing up. Nor does Serialism have to be 12-tone; it can be 13 or 16 or something else.

BOOK REVIEW

INTRODUCTION TO MICROTONAL MUSIC, by George Whitman. Distributed by British and Continental Music Agencies, Ltd. London, 1970. 16 large pages.

According to the first page, George Whitman is a Prague Conservatory graduate, from the composition class of Alois Hába. His approach, as one might infer, is to take for granted Hába's subdivisions of the 'tone' (whole-tone, whole-step, major second, one-sixth of an octave, two semitones of the 12-tone equal temperament). As you already know, most of Hába's composing was done in quartertones and sixth-tones, i.e., the 24- and 36-tone systems.

A chart extending the width of pages 2 and 3 shows a few Greek scales, four Arabic scales, and the śrutis of India. Then the half- third-, quarter-, fifth-, and sixth-tone scales appear at the bottom of this chart. Nothing is said about the equal temperaments which do not have multiples of six tones to the octave, i.e. such systems as 19-, 22-, and 31-tone.

Otherwise stated, the harmonic series is not paid much attention, and a better intonation of major thirds and sixths, or of the seventh and eleventh harmonics, is not sought.

I already discussed the quartertone system at considerable length in *Xenharmonic Bulletin No. 3*, so it might be irritating to repeat myself here. It should be pointed out that Alois Hába had a quartertone piano made, and several other instruments, such as a quartertone clarinet.

While this is not too explicit, the implication is that Whitman is a violinist and not as piano- or keyboard-oriented as Hába had been. Whitman gives all examples with the utmost impartiality possible, for violin and cello. He intimates both in the subtitle and in several places in his text that electronic instruments will realize the third-, quarter-, fifth, and sixth-tones easily enough and that they will also serve as the ear-training standards.

The main stress of the book is on exercises to be practiced by cellists or violinists in order to reprogram themselves to hear and to perform in the 18 third-tones, the 24 quartertones, and the 36 sixth-tones. The fifth-tone or 30 system is not provided with exercises, the implication being that there hasn't been enough time to investigate it with the thoroughness it deserves. He mentions that Hába used the fifth-tone (30-tone) system in his String Quartet No. 16.

As a cellist for more than forty years, I can understand some of Whitman's reasons for writing as he does. The choice of violin and cello as 'model' instruments to introduce the newcomer to microtones is very practical, economical, and realistic.

The restrictions of the instruments of the violin family combine with the Pythagorean tuning system that violinists and cellists normally use in unaccompanied melodic passages to produce a certain attitude toward the possibilities now available.

If certain intervals are not practical on the violin, then Whitman is not going to put them into his exercises, however important they may be theoretically. This is quite understandable, in an *Introduction* to microtones written from a strictly violin-&-cello point of view.

But the subtitle of this book reads: *For Composers and Instrumentalists in Conventional and Electronic Media*. Electronic instruments such as the various makes of synthesizers and special electronic organs do not have the violin's restrictions, and they do not have those of the quartertone pianos either!

It is almost superfluous to add that the automatically-played electronic instruments and the computer will have only such restrictions as are imposed by the listener.

Whitman alludes to this indirectly by saying that finer subdivisions than the sixth-tone will belong to electronic instruments. I agree that they are very difficult for conventional instruments.

As a composer, I do not like it when Whitman tells me and my colleagues that we must not write the intervals of the single quartertone or sixth-tone, nor

>> *Book Review, Continued* <<

any of those intervals which are only a quarter- or sixth-tone distant from the octave or the fifth. I do agree that such intervals are difficult to produce on the cello or violin, and that we cannot expect them to be well-performed on the violin, cello, doublebass, viola, flute, horn, trombone, etc.; and we wouldn't dare ask a chorus to *sing* those intervals.

What I am squawking about here, pretty loudly, is that the average reader of Whitman's book is going to extrapolate these prohibitions to other instruments where they need not apply at all!

Synthesizers, pianos tuned a quartertone apart, midget portable electronic organs tuned a quartertone apart, Hawaiian guitars with quartertone or sixth-tone charts placed underneath their strings, or regular guitars re-fretted to the quarter tone or sixth-tone systems, and other things I haven't space to mention here, can all produce these intervals quite easily. In the real world out there, the shoe is on the other foot: the problem is often how to keep these intervals from being heard when we do not want to hear them! Quite possibly, Whitman is correct in advising composers just entering the beyond-twelve field not to use these 'mistuned' unisons, fifths, and octaves at the very first.

I count those intervals he proscribes among my most powerful and poignant tools of expression. Why go outside the ordinary 12-tone scale at all, if you are to be prevented from enjoying the full and unique resources of what you have just gone to so much trouble and expense to acquire?

The guitar is not mentioned at all in Whitman's book—nor is any other fretted instrument, for that matter. This is most unfortunate, since it is within the average person's means to get a guitar and have it re-re-fretted to any system whatsoever, equal or unequal, until the frets get too close together somewhere beyond the sixth-tone system of Hába.

Such a guitar or set of guitars will be much easier for the average person to obtain than microtonal electronic frequency-standards, at least for a while. I feel dubious and uneasy about those violinists and cellists who have never practiced microtonal intervals before, attempting to produce such intervals off the printed page without something to serve as a measuring-rod. A guitar with third-, quarter-, or sixth-tone frets would fill the bill nicely.

Without some audible guide, the very real danger exists that the violinist would practice mistakes until they became impossible to rectify, and the ordinary music teacher would also be at the same beginning-point as the pupil, so far as microtones are concerned.

As arguments for microtones, Whitman uses the prophetic ideas of Ferrucio Busoni, who proposed 'tripartite tones' or third-tones, and who then suggested putting two sets of third-tones a semitone apart, giving a basic sixth-tone scale. Indeed, Hába also did this, and now Whitman continues in this same direction.

An important contribution of Whitman's to the understanding of what I called 'deviation', or 'modern musica ficta', elsewhere in this issue, is presented in his Chapter 6, where he discusses the third-tone. He claims that in much of the romantic-period musical literature, abundant instances appear where the semitone is contracted into a third-tone.

Whitman quotes a few measures from the Introduction to a violin concerto by Tchaikovski and adds arrows pointing up and down to indicate expressive alterations of pitch of the kind that soloists usually would make.

Thus my *musica ficta modernized* notion is not too far from Whitman's ideas on this point. The performers on flexible-intonation instruments have been altering the pitches of certain notes even though absolutely nothing in the score indicates or suggests or implies this.

If you happen to be a violinist, violist, or cellist, Whitman's exercises and examples will fit your instrument and help you to go beyond the limitations of the standard twelve-tone training program. It will not give you the complete world of microtones and mini-tones, however, just the three systems which start with the six whole-steps of 12-tone temperament and split them into three, four, and six parts. Still it is a practical way for bowed-instrument players to begin.

Please note very carefully that quarter- and sixth-tones *RETAIN* all the conventional rigid twelve semitones, whereas 17-, 19-, and 31-tone tunings avoid the twelve tones and also break up the excessive symmetry of the 12-tone master-pattern.

Remember, however, that the violin family is one composed of *flexible* instruments, not rigid as a quartertone piano or xylophone would necessarily be. Though he does not explicitly spell it out, Whitman implies that the actual performances of microtonal music on violins and so on will deviate from the theoretically-fixed pitches just as the quoted Tchaikovsky passage deviates from the way a Hammond organ controlled by a player-roll would play it.

I hope I am not assuming too much: if the performers will be allowed some latitude, the dryness of the theories can be mitigated.

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"The Bewitched"

On Saturday evening, 4 January 1975, a memorial program in honor of the late Harry Partch was presented at Royce Hall, University of California at Los Angeles.

A group from San Diego put on Partch's *THE BEWITCHED*, which came over like a set of vaudeville acts, but to a much higher standard than old-time theatre vaudeville, of course.

The costumes and the stage-lighting were, in effect, the stars or soloists of the show, so that the audience (a full-capacity house) could enjoy the stunning visual phenomena, whether or not they understood the theory of Partch's 43-tone justly-intoned scale.

Quite as Partch's ideas in his book prescribe, the orchestra is not hidden in a Stygian pit but instead is brilliantly lighted on the stage and the actors and dancers move right in among the instruments. The musicians dance and the instruments get the spotlight.

Instead of conventional vaudeville songs with silly words, singing is without words, creating an impression of magical incantations, so 'The Bewitched' is an accurate title—and there is a Witch.

Those marvelous glass bells of his, reflecting the changing moods of the lights—they will go down in history.

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