Ξεναρμονία Γ΄

Xenharmonic Bulletin № 3

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UP-DATING

Since the *Xenharmonic Bulletin* has acquired some new readers, it will be in order to provide a little background:

The time has finally arrived for progress beyond the 12-tone squirrelcage. While some of the theories underlying tunings which do not sound like the 12-tone equal temperament and/or which have more resources than it does, have been around for centuries, only recently have certain technical and financial obstacles been removed.

The lifting of these barriers has come so suddenly, and there has been so little publicity about it, that few musicians are yet aware of it. Few instrument-builders are aware of it either; and it will be obvious enough that large-scale manufacturers of keyboard instruments are not going to unfreeze their designs nor are they going to aid and abet inventors, composers, music theorists, or the like.

The tragic consequences of the 19th-century divorce between art and science are alas! still with us; and this has operated to keep artists, engineers, theorists, technicians, and scientists apart.

Furthermore, the rigid training of performing musicians is usually obsessively concentrated on the 19th century and its shibboleths, morēs, and prejudices, so that the 20th-century composer just hasn't a ghost of a chance!

In the United States at least, composers have not been able to hear one another's compositions, nor to get their scores read by one another. They have been kept in ignorance of recent technological advances which are proliferating at a fantastic rate.

In the spirit of the recent attitude sometimes known as 'Consciousness III', I have launched *Xenharmonic Bulletin* as one means of rectifying this miserable situation.

Not competition but complementarity, is the watchword here. Readers of this bulletin who are receiving it bound into Dr. Chalmers' *Xenharmonikôn* will be able to see how well this complementarity is working.

POLICY: To disseminate information about musical scales, melody, harmony, techniques of composition, theory, and especially practical knowhow related to the above and to musical instruments and such musicmaking means as computers, synthesizers, electronic apparatus, etc.

After a certain amount of unusual information, constituting a substantial backlog, has appeared in these pages, the Bulletin will be thrown open to outside contributors. In the meantime, you might direct your contributions in the non-12 field to *Xenharmonikôn.*

Other aspects of policy will become evident as publication proceeds.

As a demonstration of impartiality, a review of the late Harry Partch's book is presented in this issue along with a discussion of the quartertone system, which latter is about as far from Partch's ideals as you can get.

UPDATE, continued

Certain items planned for this issue had to be held over to later issues. One reason is that this issue has had to be composed while moving to a larger house.

Thumbnail Account of Recent Progress:

Ivor Darreg has constructed a new, justly-intoned instrument of the Hawaiian-steel-guitar type. It has 41 strings, disposed about the four sides of a maple board 1400 mm long and 65 x 90 mm in cross-section.

One side has a chord of the ninth; another side, 2 unisons of 4 strings each; another side, major and minor chords; the last side, a harmonic series, N°s 8 through 19. String-length is almost twice that of ordinary Hawaiian guitars.

Recently, two nylon-string guitars were refretted to the 19- and 22-tone systems, respectively.

Ivor Darreg's recent xenharmonic compositions total over 5 hours of stereophonic tape recordings, most of which consists of superpositions, up to four parts. They are in the 19--tone, 22-tone, 31-tone, and just systems, and the instruments used include violin, cello, two differently strung and tuned Hawaiian guitars, electric guitars in the 19; 22; and 31--tone systems, the specially-built electronic organ tuned to the 19 system, and acoustic guitars in the 19- and 31--tone systems.

Earlier tapes included the 17-tone system on the abovementioned retunable organ, as well as on 17-tone guitars.

There are also some tapes in the 22-tone system, performed on a special psaltery.

Besides that, there are vocal and cello superpositions in just intonation.

Book Review

Genesis of a Music, by Harry Partch. Second Edition, enlarged. Published by Da Capo Press, a subsidiary of Plenum Publishing Corporation, NewYork, N.Y. 1974. $12.50.

A sad coincidence: This new, expanded edition of Harry Partch's book (the first edition came out in 1949) appeared just before Partch's death in San Diego, California at age 73.

This makes it all the more imperative that interested parties help in whatever way they can to see that Partch's instruments, compositions, theoretical work, and other items are preserved, and equally importantly, that other composers and builders of instruments be urged to continue from where he left off.

This task of preserving Partch's contributions to the future progress of music is made more difficult because in his reaction to the long-continued tyranny of the twelve-tone equal temperament tuning and its main vehicle, the piano, he went so far as to create a counter-system with a whole battery of special, quite heterodox, instruments, and even a counter-standard of pitch, 392 Hz for the starting-note, which he insisted on calling "1/1" instead of "G".

It thus requires memorization and drill to understand his system, so many people who would like to be sympathetic will not make the effort. This in turn means that some well-meaning persons who wanted to promote his music have caused his system to be misunderstood in one respect or another.

For the purposes of the *Xenharmonic Bulletin*, I will cite one topic as an example:

By this time, there have been a good many mentions in books and articles that Harry Partch used a 43-tone scale. *But* the reader is seldom told that this scale is in just intonation, nor is the reader informed that it consists of unequal intervals. Often one is flatly told that it is a 43-tone equal temperament! The effect of a 43-tone equal temperament would be quite different from that of Partch's system, whereas a 41-tone equal temperament would give a tolerable imitation of his tuning in rapidly-moving passages.

There is a 43-tone equal temperament which has generated a certain amount of theoretical literature and which imitates the one-fifth--comma meantone system very well. It will be discussed in a later *Xenharmonic Bulletin,* but for the present, just remember that it does not sound like, and is not relevant to, the 43 unequally-spaced just tones of Partch's system! We must get this straight.

Partch was adamant and uncompromising about the accurate tuning of his just intervals, especially the unfamiliar ones like 9/7 and 11/8. The Chromelodeon was capable of such precision, but there must have been considerable deviations in the case of other instruments played fast.

Our next task here is to explain what is meant by Partch's *11 limit.* When one says that Partch's system is 'just', one means that all the intervals it contains can be expressed by *exact* integer ratios, and when such intervals as fifths, fourths, major and minor thirds and sixths, and the harmonic or subminor seventh (ratio 4:7 or 7/4 as Partch would write it) are sounded, they are smooth, steady, and solid; they do not beat. Tempered intervals do beat: they are wavering, restless, rough.

In making his famous complete break with the conventional musical Establishment, he sort of burnt his bridges behind him, or threw away the ladder by means of which he had climbed up, with the result that it is most difficult for other people to follow him. Not only did he use ratio-fractions instead of pitch-names (1/1 for G and 4/3 for C) but he also used these same ratios as 'names' for the intervals, at whatever pitch: 1/1 for the unison or prime, 2/1 instead of 'octave', 5/4 for the major third, etc. In other words, he was using movable-do and fixed-do at once!

Partch had perfectly valid reasons for doing this, but that does not help the neophyte, and puts another obstacle in the way. He gives most of his reasons, so I need not repeat them here. What I will do is urge somebody—anybody—to write explanatory booklets defining all these terms and notions, so that Partch's work will not be lost to future generations.

Now, most attempts at just intonation have been confined to making existing music sound better; new instruments have generally been built—and criticized—by non-composers.

This domination of the field, both pro and con, by non-composers and even anti--composers, has had a most unfortunate effect—one could say catastrophic. I have been thwarted by it for 42 years or so. Readers of Partch's book will encounter the numerous rebuttals and polemics and counter-replies he makes to all the critics and objectors and status--quo-ists.

What concerns us here is the result of concentrating on making existing music sound better, rather than trying to compose novel, fresh music in just intonation.

To improve the sound of existing music, only a small part of the truly-infinite number of tones that just intonation provides is used. Severe restrictions are imposed, with no **real** reason at all for doing so!

This form of just intonation, exemplified in several experimental instruments built during the 19th century, was well described in Alexander J. Ellis' Appendix to his translation of Helmholtz' *Sensations of Tone,* to which you are hereby referred. Ellis labels it 'tertian harmony'; Partch calls it a 5 limit. Anyway, it is an infinite series of tones or pitches derived by tuning perfect fifths, major thirds, and octaves from the starting point, involving the prime numbers 2, 3, and **5**, and *only* those.

How far to carry this series of notes or 'web of fifths and thirds' as it is sometimes called, is determined by the number of $ signs in the experimenter's equations. But 20 to 50 tones per octave would be typical.

A common complaint about this form of just intonation is that it is 'dead', 'insipid'. That is more a reflection of the kind of instruments used to play in it, usually harmoniums or reed-organs, sometimes pipe-organs, which of necessity had few stops, or only one rank; and even more, of the timid Milquetoastian music played on those instruments, such as church hymns and sentimental tunes.

The reed-organ has a definite 'speed limit': and so most just-intonation demonstrations were further handicapped by a boring, dragging, funereal slow tempo. No wonder that aficionados of *allegro* and *presto* were turned off.

Partch met these objections with lively, fast-paced music and with the introduction of new intervals based on the prime numbers 7 and **11**.

Of course there are more primes, such as 13, 17, 19..., but practical considerations, such as mechanical problems in instruments, total number of tones required, and cost, compelled him to stop somewhere. Hence, eleven was his limit.

He proceeded in both directions from his starting-point and tried to get the most use out of each added tone, while keeping within the eleven-limit he had set himself—and he came up with 43 tones.

Since he did not like electronic instruments, and this was long before computers, he was more restricted than anyone starting out today would be.

Today, you could have 4300 or even 43 000 tones if you wanted—far more than you could ever distinguish by ear or even imagine. So, take his book as a mind-opener and stimulant, rather than as a map of the fences beyond which you may not or dare not tread. He broke out of the twelve-tone squirrel-cage and broke free of the piano's despotic bondage, so you and I and the other guy ought to be eternally grateful to this pioneer in xenharmonics who had to endure so much rejection and criticism for so long.

Since I am not an expert in opera, theatre, dramatics, or in certain visual effects, I will have to leave the reviewing of that aspect of Partch's life and work to others. The book is illustrated with scenes from performances of several works and this second edition is much better illustrated than was the first edition of 1949. For the definition and clarification of his private terms such as 'corporeal' and 'Monophony' you had better consult the book itself.

Partch's musicians are expected to be *seen* on the stage as they walk about and go from one end to the other of the large instruments. Indeed, some of the speciul instruments have elevated platforms or catwalks. This places some performers quite high on the stage and much more conspicuous than is customary.

The performers, Partch explicitly states, are also actors and dancers. No doubt this will set off some union jurisdictional disputes. They are *not* expected to sit stock-still in those atrocious chairs provided in many concert-halls while wearing those dreadful depressing stern cruel black undertakers' evening outfits, which Partch aptly compares to the monotonous row of 7 white and 5 black keys on the piano keyboard. *(Reviewer's Note: I won't wear those evening suits either!)*

A considerable part of the new edition is given over to a description of Partch's many instruments. This has been thoroughly updated and goes into full detail—materials used, dimensions of the parts, kinds of strings: even *modifications* are detailed—the evolution and changes in certain instruments are described.

If you want to copy his instruments or adapt-adopt some of his knowhow and designs, there they are, frank and openly. None of that paranoid security obsession found in factories and research institutions today barbed-wire fences, armed guards, and the rest—none of the "my secrets will die with me" attitude of many inventors—really a very refreshing note in these troubled times. The sources and references are well documented and credit is given where credit is due.

The xylophone has been an extreme treble instrument, and the marimba descends only to the alto-tenor register; but Partch has taken it down as far as he could, with bass marimbas and the Eroica which has a 22-Hz bar. Certainly this ensures him a place in the annals of instrument-building—but there is more—cloud-chamber glass bells, bamboo instruments called Boo I and Boo II for short, various forms of psaltery and so on, most of his instruments falling into the plucked-string and definite-pitch percussion categories. These are augmented by a specially-tuned reed-organ known as the Chromelodeon because of the color-scheme used to identify the keys, and an adapted viola—these instruments being clearly shown and described in the text. The human voice is part of the scheme! We are not dealing here with pieces for a quiet small instrument played by itself in the home or apartment, but rather with visual-vocal--theatrical spectacles—maybe not as large in scale as those of Bayreuth, but I can't help feeling that there was something of a Wagnerian attitude—the co-ordinating all of the arts and the 'music-drama' concepts, for instance.

It should be noted that in one of his lectures, responding to an audience query, Partch said that his records were incomplete—he tried to imply that the listener to records didn't get very much of the picture, so to speak.

Partch was the original Do-It-Yourselfer. Long before the middle classes embraced

that idea from economic necessity, he was building his own instruments—from scratch. Long before Hippies or even Beatniks were 'ever dreamt of, he was Doing His Own Thing. His *own* thing—not what the book said or the Manual that came with the Kit or what his peers considered to be 'in'.

This could explain some of his adversaries' reactions: dilettanti and dabblers and those who wait around to see how the trend will go and those who have a vested interest in musical stagnation do not like to be exposed!

He proved it could be done and said it with hardware, so that all contrary arguments were left in futile smithereens. The cleverest of scholarly hair-splitting is of no avail against real substantial solid instruments that sound and look well. And for which real music, not mere exercises, has been composed.

The book is well-provided with diagrams and tables, and, very fortunately, the sizes of intervals are given in Alexander J. Ellis' *cents* (hundredths of a 12-tone equal semitone) and often this is carried to the tenth of a cent, hence we are told the size within 1/12 000 octave. (While an interval of one cent, let alone tenths of cents, is usually inaudible, calculations have to be made, often to a long chain of steps, and errors of accumulation occur, so that a significant error might creep into extensive computations.)

The theory, as well as the practical knowhow, behind the making of bars for xylophones/marimbas is given in ample detail. The bass marimba is a most useful addition to the orchestra or ensemble of conventional acoustic non-electronic instruments, so whether you agree or disagree with Partch's just intonation notions is quite irrelevant here—he has perfected a needed, missing instrument.

He also exploited the psaltery, which somehow had gotten lost in the musico-historical shuffle. So why not build all manner of psalteries and dulcimers in his memory? As he points out in the book, too many instruments are known to the public only as silent ghosts in locked guarded glass cases. *Hands off! Mustn't Touch! Keep out! Quiet in the Museum! Do Not Handle!*

It would be neither poetic nor justice if such a silent, museum glass-case fate were to overtake Partch's own instruments or compositions. Let us hope that some provision against this eventuality has been made.

Perhaps the appearance just now of this attractive new edition of the book, almost a sequel, with its encouragement to experimenters and invitation to copy his instruments and go on to other kinds of instruments, will help.

He did not try to invent or develop a set of wind instruments for his ensembles, citing the tremendous amount of work Kathleen Schlesinger put in in that department, as shown by her book *The Greek Aulos*, to which he refers.

Maybe I'm doing things backwards, but in conclusion I must call your attention to the stunning book-jacket with color photo of the instruments by Danlee Mitchell.

The Quartertone Question Revisited

Just thirty years ago, the present writer sent out several hundred copies of a pamphlet entitled *The Quartertone Question*. Attitudes and circumstances have changed so much in the meantime that a mere reprinting of this article would not be practical. However, there are hardly any retractions to be made. Tha task is rather that of fitting quartertones into a larger context, the outlines of which were barely discernible at that time.

The new set of circumstances is tied in with the popularity of the guitar in all its varieties, the proliferation of electronic organs and synthesizers, especially the newer portable 'combo' organs and mini-synthesizers, the decline of the piano, and strangely enough, the renewed interest in the harpsichord, whose timbre is quite congenial to quartertone music.

As with other xenharmonic tuning-systems, the most spectacular and surprising change has been the virtual disappearance of certain formidable financial obstacles to the use of quartertones in practice.

Two years ago or such a matter, another historical "first" occurred: an ad for a fretless electric bass guitar included quartertones among the advantages of this new model of their instrument.

The sudden popularity of the miniature electronic calculator, along with the continued growth of the computer field and decline in computing cost now permits extensive music-theory and practical instrument calculations that would have been out of the question 30 years ago.

Any one of the above factors might not be sufficient by itself to make a practical difference, but when combined so that they can act in concert, the design of quartertone instruments becomes feasible. This is reflected in the latest editions of reference works, such as music dictionaries and encyclopaedias, in

which articles commenting on quartertone music are much more favorable, or even appear where they had not appeared before.

Let us now consider the advantages and disadvantages of quartertones (24 pitches per octave) as compared with other possible systems, such as 17, 19, 22, or 31 tones in each octave. *Why* quartertones?

Take the fretted instruments, such as the guitar. It is obviously easier to intercalate frets on an existing fingerboard than it would be to remove the frets already in place, or to remove the fingerboard entirely and replace it with another one. If quartertone frets are inserted, they do *not* disturb the configuration of the semitone frets and therefore do not interfere with the performance of conventional guitar music. Nor do they jeopardize the player's investment in an expensive instrument. (Alas! such economic arguments usually take precedence over all others.)

Quartertone pianos usually consist of two standard pianos placed one on top of another, so the ordinary twelve-tone keyboard is and remains standard.

Two-manual organs, whether pipe, reed, or electronic, can be adapted to quartertone music without any overt change in appearance--and again this is accomplished without jeopardizing the owner's often substantial monetary investment.

One should also consider what contemporary computer people call 'software'. In this case, the average musician has been 'programmed' by his or her teachers, and habit-patterns and memory-grooves and routine-ruts have been so deeply etched as to constitute brainwashing.

Such programming, being an investment in time *and* money, will have as much, or more, importance than the financial investment in instruments; furthermore, it determines prejudices and attitudes. Multiply these prejudices and attitudes by several million people who hold them, and you have a most formidable setup! Like religious and political prejudices, these programmed attitudes also make things seem more "reasonable" than others; habit masquerades as "common sense". Thus the duplication of the standard keyboard seems more sensible than the invention of a new keyboard, and the adding of quartertone signs to conventional notation seems more reasonable than the introduction of either a completely new notation or the assigning of new values to the existing notes, such as the manner in which the 17-, 19-, and 31-tone systems distinguish between C-sharp and D-flat, whereas the quartertone system retains the synonymity of such 'enharmonic pairs' of the 12-tone system.

We do not recall reading anywhere about another very important factor which has operated in favor of the quartertone system: Since 24 is twice twelve, any piano tuner can use his familiar twelve-tone tuning-routine twice over to obtain quartertones: he simply estimates a quartertone by ear, or he obtains a tuning-fork a quartertone higher or lower than the standard he already possesses--with a semitone standard of A=440 Hz, this would be 452.89 Hz for A-semisharp or 427.47 Hz for A-semiflat.

There is another alternative available to the tuner, to which this writer has never seen any reference: Since most places in the United States that have pianos also have 60-Hz alternating current, there usually is some device, such as a transformer, radio, motor, or whatever, that hums at the octave above this, or 120 Hz. This 120-Hz pitch may be taken as B-semiflat in the bass register, as it is only a very minute distance away from the theoretically-correct quartertone value. In England and most European countries the power frequency is 50 Hz and the octave of this is 100 Hz, which may be taken as G-semisharp without any grave error.

Some 40 years ago, the present writer didn't have to go to any trouble or expense at all, in order to hear quartertones: he simply asked permission to go in the back room of a large music store, where it didn't take much searching to find two pianos approximately a quartertone apart. Why, their keyboards conveniently faced each other!

However, it might be more difficult at the present time to locate two such pianos, because few stores would have enough pianos in sufficiently good condition to afford a happy coincidence of this sort. Frankly, the effect of two *pianos* a quartertone apart is nothing to brag about, and does not do the quartertone system any justice.

The timbre of the piano evolved during the early 19th century in such a direction as to make it progressively *worse* for the intervals involving quartertones. Thicker strings and hammers with better padding, and a more 'mellow' tone in keeping with the ideals of the Romantic Period, all combined to attenuate the higher overtones, and to get further and further away from the thin strident tone of clavichord and harpsichord. Also--this is most important--trial-and-error, cut-and-try engineering brought the hammer-striking-point to about 1/7 the vibrating string-length, which almost eliminates the seventh harmonic. The intervals having the number 7 in their ratios, such as the subminor seventh, ratio 4:7, and the subminor third ratio 6:7, --these intervals are about a sixth-tone flatter than the corresponding ordinary minor seventh and third--are thus deprived of their definition, of their clarity. In consequence, they become vague, nondescript, wishy-washy, characterless, blurred. Is it any wonder, then, that quartertone *pianos* have not taken the world by storm?

From the piano- and organ-tuner's point of view, the familiar twelve-tone tuning-routines, learnt at the cost of so much patience and practice, can still be used (twice over) to provide the 24 quartertones--thus furnishing the tuner with a powerful persuader which he will surely use to discourage his clients from experimenting with any other 'new' system than 2 x 12 (or just possibly 3 x 12, the sixth-tone system).

Many tuners do not know of any tuning routines other than those for the twelve-tone equal temperament (these routines, as we said in a previous Bulletin, give a second-order or tempered temperament). No ordinary tuner would be willing to learn a radically different routine for such temperaments as 17, 19, and 22, although a demand for meantone routines has begun, due to the revival of the harpsichord.

It must be remembered, of course, that all this timbre-change in early pianos to the detriment of septimal intervals was unintentional, accidental, and quite subconscious. It was done--again, subconsciously--to improve the sound of the major sixth and other familiar intervals, and it did so improve them. Some more recent pianos have a striking-point not quite so close to 1/7, and in them a trace of seventh harmonic is audible. Also, the hammer-striking-point in the bass register is often more nearly 1/9 or even a lesser fraction.

To sum up: The piano is just about the worst possible instrument for quartertone music, even though it might work well in the 17-, 19-, and 18-tone (this latter being Busoni's and Carrillo's third-tone) systems. The piano has thwarted any progress in quartertone composition and performance during all the 120 years it reached its plateau of development and became a triumphant example of the First Industrial Revolution's mass-production expertise. Any and all quartertone pianos are thus abortive mutations.

The solution is simple enough, and feasible at the present time: design a quartertone harpsichord or clavichord or new technological variations of these ideas. Harpsichord jacks can be narrower than piano-action components; so can clavichord tangents. The strings are thinner; the resulting tone-quality is richer in high overtones, and hence the seventh and eleventh harmonics, upon which many quartertone intervals depend for their clarity. Such instruments can be amplified, and thus brought up to loudness-levels

equal to that of the piano.
Modifying clavichord or harpsichord design does not entail such formidable problems as the slightest change in piano design would. Nor does it involve such fantastic expense as a redesigned piano would entail.

Of all the mechanical-engineering entities in this world, the piano action must be the most frozen, rigid, inflexible, unbudgeable design. For just over a century, it has surpassed even religious rituals in its mulish refusal to progress. If anything, it has retrogressed.

This stick-in-the-mud-ishness, while largely due to physico-mechanical necessities, also derives from ultra-conservative attitudes, fear of change, and economic factors of the crudest sort.

Organs, whether pipe, reed, or electronic, do not present such difficulties with respect to quarter-tones as the piano does; the only real obstacle having been the doubled expense. Happily, the electronic organ will obviate this aspect of the problem.

Several quartertone keyboard designs are available, so that problem reduces to one of choice among an embarrassment of riches.

The development of the so-called electronic music synthesizer will make quartertone music much more accessible. A tuning-principle embodied in most synthesizers permits quartertone tuning almost automatically, without need for tuners' skills or expensive precision reference pitch-standards. This should give xenharmonic music a powerful boost.

Some other kinds of electronic instruments can be fitted with a key or button which flattens or sharpens the pitch of the keys of its semitonal keyboard, thus obtaining quarter tones or microtonal intervals with ease. The author's electronic keyboard oboe has had this feature since its construction in 1936.

Quartertone performance on violins and other bowed-string instruments is simply a matter of 'reprogramming', to use the currently-fashionable computerese jargon. It is thus a psychological and educational problem, a matter of attitude.

No need here to belabor the point that it is going to be easier to superpose a quartertone 'program' upon a violinist's or cellist's semitonal training than to 're-program' him or her for the 19-, 22-, or 31-tone systems.

The double-bass and violoncello have wide spacings between adjacent quartertones than the violin and viola do, so getting a cellist to play quartertones is much easier than persuading a violinist to practice these small intervals. Perhaps the composer's best gambit is to make it a matter of pride!

The set of 24 quartertones consists of *two* circles of 12 fifths each, *not* of one circle of 24 fifths. This means that it is impossible to get from one closed circle to the other without using unfamiliar intervals. In consequence, we have twelve familiar tones isolated from twelve new strangers. This set or set-up immediately implies the makeshift expedient of two pianos tuned a quartertone apart, with the advantages and disadvantages already discussed above.

Melodically, this two-circle situation does not matter; the quartertone is a useful and effective melodic interval. Furthermore, it offers the advantage of being able to cut the fifth, fourth, and minor third of the twelve-tone equal temperament into exact halves. This is not a negligible resource! Also, it permits of dividing an octave into eighths, and the 8-tone scale or ¾-tone scale, is a pleasing variant and logical evolutionary step beyond Debussy's equal 6-tone or whole-tone scale. Three such sets of 8 tones are of course available within the twenty-four quarter-tones.

We thus get a situation wherein several sets of constraints have been operating, some in favor of the quartertone system and others against it, but all or nearly all of these constraints have been operating below the conscious-awareness level. The result until just recently has been the use of pianos, two standard or one special, for quartertone music, and most of such music 'hasn't gotten off the ground'; there has been something vaguely wrong with it, but nobody knew why nor what.

The idiosyncrasies of the piano have operated to the quite undeserved detriment of the quartertone system, and we have already given you some of the reasons. Thus the future of quartertones looks considerably brighter than the past, albeit with this reservation: 24 is merely one of a considerable number of tuning systems, and each system has its own *mood!*

The two-pianos-tuned-a-quartertone-apart idea has, predictably enough, spawned the idea of bi-atonality or two separate 12-tone rows in competition, something like the Chess Masters who play two opponents on two boards simultaneously. So much for the serialists! Now let's get back to harmonic considerations.

It would at least seem logical to progress systematically, exploiting the overtones in the harmonic series in sequence..

First the fourths and fifths, which depend upkn the third harmonic; then the thirds and sixths, which depend upon the fifth harmonic; then the subminor seventh and related intervals which depend on the seventh harmonic; then of course the eleventh harmonic, and so on through the series of prime-numbered harmonics.

The doubling of 12 tones to 24 does not improve the sharp, harsh major thirds of 12-tone, and it does very little for the seventh harmonic, but it provides a superb representation of the eleventh harmonic. Thus one has two poor representations interposed between two good ones, implying an awkward mental 'jump' from the primitive fifth to the mysterious, strange, exotic eleventh harmonic and its derivatives. To bridge this gap properly would require twelfth-tones instead of quartertones, i.e., 72 notes per octave, if one insists on systems which keep the 12-tone system and subdivide it.

Obviously, the 72-tone system entails a great deal of complication in keyboards and instruments, so it will require computers and other such means for its effective realization. We will take up this subject of really-microtonal systems at a later time.

We might mention that Hába mentioned it and Carrillo actually built an instrument for it. The 72 tones form six circles of twelve fifths each, not connected by fifths, but in this case the 72 tones are tied together by major thirds and subminor sevenths. So far, alas!, we have not encountered any actual use of the 72-tone system for its better major and minor thirds, but only discussions of its possibilities as the union of the quarter- and sixth-tone systems.

For many kinds of music, it will not be necessary to tune the quartertones extremely accurately. In quite a number of cases a rough-and-ready interpolation by ear will suffice. That is, the wide

tolerance now allowed for mistuning of the conventional twelve semitones gives some indication of how much tolerance will be permissible for pitch-deviation in quartertones.

A further indication of the extent of this tolerance is given by the widespread practice of calling almost any interval between an eighth and a third of a tone, a 'quartertone'. What we said in a previous article about tempered temperaments applies to quartertones as well as to other systems.

Moral: don't let the nitpicking perfectionists spoil your fun.

The eleventh harmonic, which misses an exact quartertone point by only one-thousandth of an octave, is of course attenuated in normal piano tones by the heavy felting of the hammers and the relatively thick strings of the modern piano. It can still be heard in the bass register of a piano with new strings and brilliantly-voiced hammers, but how many people can afford restringing or voicing nowadays? Most pianos are dulled in tone with age and neglect, so let's be realistic and talk about the kind of tone-quality that would be heard under average conditions of performance at the present time.

When we come to the practical convenience of using *two* pianos tuned a quarter tone apart, often with two performers faced with the formidable technical problem of dovetailing successive quartertones in a melodic line, one is inclined to despair—it is just too much to ask of human beings who have been twelve-tone-programmed for years on end, to make two sets of 12 tones sound like one smooth set of 24.

Furthermore, two spatially-separated instruments cannot have any appreciable sympathetic vibration between them. Sympathetic vibration, when the piano's damper-pedal is operated, is the very 'soul' of the piano as Romantic writers were glad to keep on affirming and reaffirming. If a piano were built with all 175 notes (and their nearly five hundred strings!) all in one single line and on one level, the sympathetic vibrations from its huge soundingboard about 2 meters 39 cm or 7 ft. 10 in. wide, would be magnificent and thrilling indeed.

Alas and alack! Such an instrument would cost too much; it would not go through most doorways; and only a giant could span a double-width keyboard. Of course there are alternatives: Put one grand piano on top of another, as for instance Hans Barth did in the late 1920's. Several others had such double-pianos built, but the keyboards necessarily have to be so far apart that semitones are too easy and quartertones too awkward. There are usually two soundingboards which may not be too well intercoupled; and the trials and tribulations for piano-tuners (and piano-movers!) can readily be imagined.

Another obvious alternative would be to narrow the keys and hammers and other parts to half their present width. The properties of wood simply do not permit this course for a piano action. The many parts could not bear the stresses of normal playing, and would be extremely cranky and temperamental. No action manufacturer would be willing to design such an action in the first place.

Another alternative was realized by Julián Carrillo: The conventional 7¼-octave span was 'enciphered' by arranging 88 quartertones in the space normally occupied by 88 semitones, or, the total compass of this quartertone piano was *halved* to 3-5/8 octaves or so, while retaining the deceptively-normal keyboard appearance. This approach has the definite advantage of conserving familiar playing-technique while fully integrating the 24 tones, but this advantage comes at a price: the restricted compass cramps the composer's style, and it also spoils the sympathetic-vibration damper-pedal effect now that so many bass strings are missing.

The fact has already been mentioned that the 24 quartertones form two isolated, non-connected circles of twelve fifths each, not one large circle of twenty-four. The 'tonal' composer, therefore, cannot modulate outside either one of these twelve-fifth circles by any conventional means, but must use unconventional if not drastic methods to escape Twelve Tone Squirrelcage I for Twelve-Tone Squirrelcage II, of vice versa. The 'atonal' or 'serial' composer will of course be much better off. The unfamiliar intervals especially if present in a tone-row may actually assist to avoid the customary key-associations. One might well try a row composed of the 8 tones, ¾ tone apart. Or 12 tones which *do not* all belong to one of the 12-tone circles of fifths, but arbitrarily take from *both*.

'How do you write quartertones?' is a very frequently-asked question indeed. While there are not quite as many answers as there are composers, arrangers, and theorists, the notation affair is very far from being standardized, and we may confidently predict that this condition will continue for quite some time to come.

The main reason, of course, for lack of standardization is the deplorable lack of communication among contemporary composers, a condition which has endured through all of the 20th century so far! If we are not able to consult with one another, nor to hear or even read one another's compositions, it is obviously all the more likely that in such an unconventional matter as quartertones that we shall have no way of reaching any agreements on either notation as such or on names to designate quartertones and the intervals they generate.

Taking Mildred Couper's compositions as typical of the two-pianos-tuned-a-quarter tone-apart principle, it is obvious enough that there is no notation problem here: her convention was that Piano II was a quartertone higher in pitch than Piano I, throughout its scale; and therefore whatever pitch was written for on Piano II's pair of staves, the pitch a quartertone above that value would actually be sounded. The most divergence that might occur would be that some composers, including the present writer, might prefer to have Piano II tuned a quartertone *lower* than Piano I instead of higher; and in our case this is for several practical reasons, such as the terrific strain put on a piano's frame and strings by a rise of a quartertone in pitch.

Since the average tension on a piano string comes to 80 kg or nearly so, raising that piano by a quartertone in pitch entails adding about a ton of tension. Our second reason for preferring that Piano II be a quartertone lower is simply the widespread availability of pianos which have been allowed to go below pitch by that or a greater amount.

Getting back to notation, most of the quartertone notations we have been able to collect seem to be of nearly equal merit; it is hard to choose between them, or to predict which candidates are most likely to win out. We know there must be far more such systems than we have been able to collect during our 40 years' interest in this subject, and furthermore it is quite possible that some unheard-of and unpublicized system may turn out to be the best solution to the notation problem.

Concerning Hába's notation, it should be remarked that since he went in for sixth-tones, he felt that the quarter- and sixth-tone notations should have distinctively different signs so that it would be apparent at a glance which system a given piece of music was in.

Penderecki's notation utilizes the idea of a black flat-sign for a quartertone flat, on the principle that if a quarternote has a black notehead and a half note a white or open notehead, why not extend this principle to the quarter- and halftone?

We earnestly hope that no-one attempts to standardize quartertone notation until the effects this might have upon notations for other xenharmonic systems, especially upon the 19-, 22-, 31-, and 36-tone systems, has been carefully evaluated.

Ivor Darreg has been using Mildred Couper's modification of Vyshnegradski's notation, as follows:

(in fractions of a "tone" or whole-step)

¼ flat 𝅀, ¾ flat 𝅁,

¼ sharp ♯, ¾ sharp 𝄪.

The original Vyshnegradski notation is this:

¼ flat 𝄳, ¾ flat 𝄫,

¼ sharp ♯, ¾ sharp 𝄪.

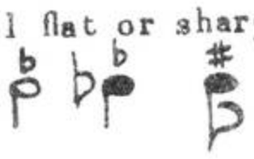
Hába's usual quartertone notation follows:

¼ flat 𝄲, ¾ flat 𝄬,

¼ sharp 𝄰, ¾ sharp 𝄲.

Julián Carrillo recommended numbering the tones, 0 through 23.

There have been some proposals for a 'universal diacritic' to flatten by a quartertone such as this one ▼ .

Sometimes a small flat or sharp sign is used *above the note:* 

In some Persian music, approximate quartertones are represented thus:

¼ flat 𝄭,

¼ sharp 𝄲.

Some Penderecki scores show this:

¼ flat 𝄭, ¾ flat 𝄫,

¼ sharp ♯, ¾ sharp 𝄪.

On many occasions, some persons will wish to speak of *11 quartertones, 13 quartertones, 18 quartertones*, etc. There is no reason for not doing so. Also, this fits in very well with Julián Carrillo's system of numbering the quartertones from 0 to 23.

We might as well quote the French names given by Vyshnegradski in his *Manuel d' harmonie à quarts de ton* (of which we made a still-unpublished English translation in 1942) : *demi-dièse* and *demi-bémol; dièse et demi* and *bémol et demi*. In Hába's German textbook on microtones, he used such terms as *tief C* and *hoch cis*.

So far as we know, no set of quartertone solfa syllables has been published, but it may be confidently expected that someone will take one of the existing sets of syllables coined for 12-tone and expand it.

Note that no adverse opinion is intended toward any quartertone notation system not mentioned here. It is simply that information on this subject is extremely hard to find, and the assistance of our readers in this respect will be appreciated.

An adequate treatment of *quartertone keyboards* and similar devices would require an article all its own, so that has not been attempted here.

Let us conclude by taking up the subject of *names* for signs, pitches, and intervals.

For English-speaking countries, we suggest that the various signs for raising the pitch a quartertone be called *semisharp* and the various signs for raising the pitch by three quartertones be called *sesquisharp*.

Accordingly, the various signs for lowering by a quartertone will be called *semiflat* and those for lowering the pitch by three quartertones will be known as *sesquiflat*.

Now that that is more or less settled, let us go on to names for intervals. Our recommendations are as follows: Certain intervals come in *major* and *minor* forms, such as major sixth and minor sixth. Let the quartertone interval between them be called *neutral:* neutral third, neutral sixth, neutral seventh, etc. Some other intervals come in *augmented* and *diminished* forms. Let the additional intervals due to the introduction of the quartertone be called *semiaugmented, semidiminished, sesquiaugmented, sesquidiminished*.

Some persons at some times will wish instead to speak of 7 quartertones, 11 quartertones, 13 quartertones, etc. There is no reason why they should not do so.

Alexander J. Ellis, in one of his Tables, used an upside-down flat-sign for the next higher quartertone, as *C* 𝅀 for C semisharp and *C* ♯ 𝅀 for C sesquisharp. The inverted flat resembles a small *q* standing for *quarter*. q

Lyman Young, inventor of a 'decatonic' keyboard for quartertones, used such names as *C-sharp plus* and *D minus* for the new pitches. This seems to have occurred to other innovators also—it may be considered acceptable. + −

Some topics relevant to the quartertone question have been omitted here because they also pertain to xenharmonics in general and are not limited to quartertones in particular. They will all be dealt with in due course.

Since there are twenty-four letters in the Greek alphabet, why not name the quartertones by those letters? Why not sing them for solfa?

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GUITAR FRETTING TABLE 19-TONE 650 mm

NAME OF NOTE ON E STRINGS	FRET NUMBER	DISTANCE FROM BRIDGE	DISTANCE FROM NUT	DIFFERENCES
e	0	650.0 mm	0.0 mm	
f♭	1	626.7	23.3	23.3 mm
f	2	604.3	45.7	22.5
f#	3	582.6	67.4	21.6
g♭	4	561.7	88.3	20.9
g	5	541.6	108.4	20.1
g#	6	522.2	127.8	19.4
a♭	7	503.5	146.5	18.7
a	8	485.5	164.5	18.0
a#	9	468.1	181.9	17.4
b♭	10	451.3	198.7	16.8
b	11	435.1	214.9	16.2
c♭	12	419.6	230.4	15.6
c	13	404.5	245.5	15.0
c#	14	390.0	260.0	14.5
d♭	15	376.1	273.9	14.0
d	16	362.6	287.4	13.5
d#	17	349.6	300.4	13.0
e♭	18	337.1	312.9	12.5
e	19	325.0	325.0	12.1
f♭	20	313.4	336.6	11.6
f	21	302.1	347.9	11.2
f#	22	291.3	358.7	10.8
g♭	23	280.9	369.1	10.4
g	24	270.8	379.2	10.1
g#	25	261.1	388.9	9.7
a♭	26	251.8	398.2	9.4
a	27	242.7	407.3	9.0
a#	28	234.0	416.0	8.7
b♭	29	225.7	424.3	8.4
b	30	217.6	432.4	8.1
c♭	31	209.8	440.2	7.8
c	32	202.3	447.7	7.5
c#	33	195.0	455.0	7.2

Nineteen-tone Equal Temperament as applied to a guitar or similar instrument with active string-length of 650 mm. This is a frequent value for standard-size guitars.

Compiled by Ivor Darreg, August 1974 from John H. Chalmers' equal temperament tables.

Differences are for checking distances between adjacent frets.

More tables for different-size fretted instruments and for other tuning-systems will be forthcoming.

IVOR DARREG