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# JUST INTONATION ARRAYS

Until recently, progress in music so far as exploring new tuning-systems and scales is concerned, has been severely frustrated by mechanical shortcomings of conventional musical instruments. Now that electronic musical instruments and computer music have come of age and reached a certain point in development, Xenharmonics, i.e., any tuning or scale which does not sound like standard 12-tone equal temperament, is free to forge ahead.

Xenharmonics includes a very large array of equal and unequal temperaments--these have been treated elsewhere. Xenharmonics also includes various forms of just intonation, i.e. scales whose intervals have ratios expressible by rational fractions usually employing small integers.

Theoretically, just intonation includes a multi-ordinal array of pitches, infinite in number. Obviously, an instrument having infinitely many keys and infinitely many pitches would take forever to tune and would be as big as the Universe! We have to stop somewhere.

The standard procedure for the last century, with keyboard instruments, has been to select 12 and only 12 just pitches per octave and put them on a harmonium or a piano or some kind of organ and then try to play some music on this crippled truncated array and then complain that it cannot modulate to any other keys than the one key to which it has been tuned, and use this as a powerful, crushing, and devastatingly final argument to condemn just intonation and give it up --usually with a grandiose renunciatory masochistic gesture, something like the self-sacrifices demanded by most religions.

Twelve or Infinity and nothing in between? This is ridiculous. It is now practical to set up retunings of a number of electronic instruments, or to program computers to produce pitches needed for just intonation, so one can construct arrays of notes so related that modulation is possible over a lesser or greater range.

A logical place to begin is with 24 notes per octave. We might cite Prof. Helmholtz's scheme for a 2-manual harmonium--it had 24 notes per octave and enough modulation capability to take care of much of the music existing at the time that organ was built. That, of course was over a century ago! It turned out to be quite practical to take two transistorized electronic organs and put Helmholtz's scheme on them and it worked about as the claim made in the well--known *Sensations of Tone* book for it. Maybe a little better than Helmholtz's original harmonium since harmoniums are notoriously slow in attack and of course, so are American reed-organs, their nearest counterpart in this country. The electronic organs now available are usually much quicker in attack than the free-reed instruments.

Even though electronic organs proper are now getting obsolescent, i.e. electronic organs and synthesizers have merged into a new label or class called ELECTRONIC KEYBOARDS, many of them are still around or could be rebuilt and many of them have two keyboards and therefore the idea of making maximum use of such a ready-made set-up for 24 notes per octave continues to be valid.

The majority opinion of those in the Xenharmonic Movement today inclines to Generalized Keyboards--i.e. new keyboard designs which are flexible in that they will work well for a number of possible tunings. However, there are so many instruments now extant having standard 12-tone 7-+-5 keyboards that using two of them mounted or re-mounted very close together, and a 24-notes-per-octave just intonation array, makes good sense while we wait for the price of better keyboards for all xenharmonics comes down and permits us to go some distance beyond 24 pitches per octave with our just arrays.

We have to be financially realistic--this is why this intermediate point is so important at this time. We cannot afford, on the other hand, to accept the ideas of perfectionists who do not want us to play or hear anything till the Perfect Master Ultimate Keyboard is everywhere --and frankly, few of us will be alive then, because that is far far away. Certain Generalized designs will arrive soon because they have been the subject of much planning and thinking.

Helmholtz's experiment with a two-keyboard harmonium (European reed-organ) is almost 120 years old! Bosanquet's and James Paul White's keyboards are older than that! It's high time. But we have been so intimidated by socalled Authorities and Experts for a whole Century that progress in music and the very idea of really new things for Composers to Do, has suffered almost mortally.

Patience is no longer a virtue.

Hence our constructing some Just Arrays and Meantone and Equal and Unequal-Temperament affairs with MORE than 12 pitches per octave now that they can be and have been actualized in sound recordings.

Besides the tiny slightly-less-than-2-cent interval called the skhisma by A. J. Ellis, which permits practical keyboard instruments to reduce the formidable array of 5-limit just pitches to manageable proportions, there are some other almost-as-small intervals which can cut down the number of septimal or 7-ratio notes required for reasonable modulations in a 7-limit array. Some of the above-mentioned Perfectionists and Nit-pickers want to stop us from enjoying new music by trying to restrain us from making compromises of this sort at the outer reaches of a just array. Yet many of these same persons offer a crippled just instrument with only 12 pitches per octave and thus compulsory Wolves, whereas many of these skhisma and septimal compromises would never be heard at any conceivable performance place.