MICROTONAL NEWS

Summer 1990

THE RIM 1989: POLYHEDRAL AND MICROTONAL CONFERENCE

by Jonathan Glasier

Last year, at the beginning of the Rim's season, John Gibbon and I facilitated the Conference on Polyhedra and Microtonal Music. The idea was to show how the two fields interrelated and how participants from two different fields could learn valuable information that was aligned to their own fields.

Without going into detail, the week–long conference brought people in from all over the continent to share their work with new scales and new shapes.

Erv Wilson created a tubulong with seventy tones in two octaves. We created a mounting for the "Hebdomekontany" scale which is the set of pitches derived from the four out of eight harmonics in the fifteen limit (1–3–5–7–9–11–13–15) system. If this sounds like Greek to you, come to the Rim this June (15–17) to participate with Jonathan Glasier and Charles Lucy in the unfoldment of the microtonal process.

EAVESDROPPINGS

This is a conversation recorded between John GIBBON, Jonathan GLASIER, and Charles LUCY on the evening of Friday 4th May at The Crystal House, Tujunga, CA.

GLASIER: We are talking about changing the language of music, and we're starting with the term *dominant*, instead of using *the fifth*, or *the three*, as in "third harmonic".

GIBBON: So the dominant really is a perceptual bandwidth which acknowledges that for various reasons some people might want to set the fifth at 700 cents, as in the twelve note equal temperament system. Some people might want to set it at 702 cents as in the Just Intonation three to two ratio. Others might have various theories based on phi or pi, which would place the dominant in the range of 695 or 696 cents. So, it's more like an Indian sruti. It's a perceptual bandwidth which is what this scale offers.

GLASIER: The reason that it dominates, is that it is the generator of the rest of the scale. That's the reason that it holds the dominant position. A good reference for this idea is Harry Partch's "one footed bride" diagram in his *Genesis of a Music* (da Capo Press, NY, NY)

GIBBON: Okay exactly. That's perfect. And then its inversion, by the way, is the sub–dominant. So the dominant is a harmonic. In terms of harmonics, it's in the vicinity of the third sub–harmonic. It is the exact inversion.

LUCY: This is comparable to the intervals Sa to Pa and Sa to Ma. In the Indian tradition.

GIBBON: So while in the twelve–tone equal scale, this is taken for granted as seven hundred cents, it really is an open question until..... So this is the first question that you want the scalemaker to answer. The second question is *"What is the maximum expanse from your lowest flat to your highest sharp encompassing any notes which may be skipped by your scale itself?"* But in terms of derivation, in continuous steps of your dominant ratio. *"How many steps plus one?"* gives the total possible number of notes.

LUCY: I feel that that should be defined more clearly. It should be defined prehaps as if you considered a string of (in conventional terms) of say fourths and fifths and you were going up in say fourths; it would be the note which has the most sharp signs after it, which you would find last if you were going from say C to G to D to A to E to B. Along that string is going to be one end of that string, and at the other end of that string it's going to be the one which has the most flats on it. So we can count the number of steps to give us the expanse.

GLASIER: You can make a dominant string going up, and you can also make a sub–dominant string going down.

LUCY: It's the same string. It's just a matter of which way you are travelling. It's just like the spiral here. You can go up the spiral or down the spiral.

GIBBON: The significant thing is the number of steps in it. Not whether you're going up or down, because whether you're going up or down demands a point of reference which you haven't yet made.

GLASIER: And what do you call "one"?

GIBBON: That is a later stage. It's two steps later. So before you get to what really is the selection of the tonic, which determines from where you are, where you are going; you want to know the total expanse. But after the total expanse which then defines all the intervals that are almost certainly available to you unless there are a lot of steps that you're going to skip in the final scale. You need to designate which steps are missing. So you might have a expanse of eight or nine or ten, but still want only seven notes in the octave. In which case certain notes are missing. Not the first note or the last note, because that would reduce your expanse. So the number of notes that can be missing are between zero and $x–1$.

GLASIER: What is x?

GIBBON: *x* is the Expanse. So if it was the last note which would be *(x+1)*, then you would be changing the set.

GLASIER: Let's talk about the expanse now.

GIBBON: This is the set of the possible ratios within it; which is basically the dominant ratio raised to the power of *x* and every whole number in between *0* and *x* gives rise to the ratios when adjusted for octave equivalance then it tells you the ratios, your repetoire. This is like your palette. But it doesn't tell you what frequency these ratios occur in, within the set.

LUCY: Or what note names they are.

GIBBON: Or what note names, exactly.

GLASIER: Lucy's program will do that though?

GIBBON: Well you have to make further choices, then you have to designate which if any steps are missing. The interesting thing about the Major scale is that no notes are missing. Its a continum. Its an archetypal simplification. So its basically *(x+1) = 7*, and *M = 0*, and *N=7*. It's about as simple as this definition can get.

GLASIER: Where do you get your F, if you're starting from C?

LUCY: You've got the choice. You're starting on a string.

GIBBON: You haven't yet got there. This is all transposed. This is emerging out of the void, so we're calling out of the void, a scale. Certain things have not yet been designated.

GLASIER: The tonic.....?

GIBBON: The tonic has not been designated.

LUCY: Forget about the tonic for the moment. We'll get to that.

GIBBON: It's a modal....So you have *x* and *M*, and *x minus M equals N*, which is the number of notes in the octave, and with *N* it's also possible to compute the relative frequency from which these intervals are available. This is a subset. The set of possibilities is determined by *x* alone, and this has to be well familiar to all the users of the system. The sub-set only effects the frequencies, but that's very important for something like a wind chime, because it lends the flavour or character to it. It's less important for a composer who can wend his way where he wills: but it's still an essential characteristic of any given scale. But it's less important that the *x*, which determines the possibilities of the interval. And then the last question which we need to resolve is "What is your tonic?". And with those four questions you basically define a very practical way of playing music, of scale, which hopefully might sound good.

"so we're calling out of the void, a scale."

LUCY: You see once you've decided your tonic, you can only now define things in conventional musical terms. You've got all the white notes, (all the naturals). If you choose your tonic as being C you are going to produce the Major scale; if you choose D your going to produce the Dorian Scale; if you choose E, you get the Phrygian and so forth; but they are not really scales. They are modes. The scale is all the white notes, and which one you choose as your tonic determines not the scale but the mode.

GIBBON: This method of description, by the way, can handle all equal temperaments. Any equal temperament falls into it very naturally and easily. It's just when does the cycle or spiral of dominants come back on itself? So you take a given number of octaves, divide it precisely (by an integer) and you've got your size of a dominant. And then in the breakdown from this information you can get to the case of five Large and two small intervals. So part of the computation of this is by steps of dominants, but nevertheless you're not limited to seven notes per octave.

LUCY: The Large interval is the difference between the dominant and the sub-dominant. For example in the key of C it would be between F and G, the fourth and the fifth. If you determine either the dominant or the sub-dominant, and assume that your octave ratio is two exactly, you know what all the other things are. You know what the Large is because it's the difference between the dominant and sub-dominant, between F and G, and you know that the small interval is the one between E and F. So you've got your Large and you've got your small, and you know that there are five Large and two small in the octave. Now all the other notes you can find by algebra, because you know what they are as you go along your pattern.

GIBBON: So up to seven, you don't need any minuses. they are either Larges or smalls. Then after you go past seven you may have *(2L-s)* (#II) and so on.

LUCY: Yes.

GIBBON: And this is where the flavour of the ethnic scales enters.

LUCY: Yes, That is what happens in for example; Indian, Jewish, Arabic, Hungarian. You get this interval of the sharp second, which is two Larges minus a small, which does not occur in Western music, because you've always got multiples of *s*'s, *L*'s, or *L*'s, plus *s*'s.

GLASIER: Now how universal can this be? Can we define all the world's scales, by this method?

LUCY: Yes

GIBBON: So it appears that you get a very good approximation, and furthermore if you state the intervals that you want to approximate, then you can decide the size of the

dominant, to spline in with the smallest error to get close to their vicinity.

GLASIER: What about the scales where the scale generator is the median or what is called the third?

GIBBON: Okay, this way of looking at things, the third is a dependent variable on the dominant, so you can actually reverse it and you can say: "I want the third be such. What's the dominant have to be to in order for the third to be such and such?"

LUCY: We know that the third must be two Larges.

GIBBON: So you can work backwards. If you want to work with the Just anything: the point is that they're all locked together and it is transposable. So you are sacrificing something, You can only designate one ratio perfectly, and all the others become dependent from there. But you can designate any ratio you want, a Major third, a minor third, whatever you want. So the interesting ones appear to arise from splining these near hits in the range from 694 to 705, or something like that. That seems to be the range of the dominant.

LUCY: Not only can you change the size of the *L*, but you can also change the size of the octave ratio. If you want a scale which is like a stretched octave, you might decide to choose an octave ratio of 2.15 or some small figure above two. So you're stretching your octave each time.

GIBBON: That's if you don't want the octave to be sacred and untouchable. So you're mediating between the claims of all the numbers, and depending upon which numbers you want to mediate between then you might make a particular choice of dominant that varies by a cent or two. There's no point trying to hit "bull's eye" on ratios that you're not interested in, because they don't occur in the music.

GLASIER: Right!

GIBBON: So if you're not involved with seven to eight, who cares where it is?

GLASIER: But if you are, then it's very easy?

GIBBON: Then it's taken into account and it may shift your choice of dominant by a cent or two. So you can hit it right on the nose, and remain transposable.

LUCY: The way that pi comes into this is that my personal preference uses the radian angle as the interval between the fourth and the fifth.

GIBBON: And the amazing thing is that as you unfold this past the seventh step, it starts giving you wonderful harmonic seventh ratio approximations: and as you go back five more steps it begins to produce an eleven to eight. It's amazing.

GLASIER: And then does it give you good thirteen and fifteens, too?

"There's no point trying to hit "bull's eye" on ratios that you're not interested in....."

GIBBON: No, there's a limit, well it would sooner or later, but it doesn't necessarily go in a straight line. We worked it out one time and I think there is one thirteenth harmonic, but it's way out there because you've got to take care of the other ones first.

LUCY: If you use a number other than pi, you have a problem for it will recur after so many steps. But since your using Pi which is a transcendental number you can go around the clockface and it will always land on a new angle, and hence cover every possibility.

GIBBON: So this gives you four parameters

LUCY: Notes which are adjacent are extremely consonant, and the more steps of fourths and fifths you have between two pitches the more dissonant they become. So you have complete control of consonance and dissonance. If you want to produce a totally consonant scale you should have the notes as close as possible to eachother, hence a short continuous string. For a dissonant scale they should be as far apart as possible.

GIBBON: So the most consonant seven note scale is the natural major scale, because there are seven contiguous steps. So the ethnic ones which have more and missing notes and are more exotic are less consonant than the major scale., which is the point of departure so to say.

GLASIER: Earlier we talked about the letter *M*.

LUCY: *M* is the number of missing notes in the expanse of dominants and sub–dominants. You may have a expanse, which is twenty steps long, and say you've got three of them missing. So you had twenty–one notes but you are only using eighteen of them.

GLASIER: Earlier we talked about the missing notes

LUCY: You may have an expanse, which is twenty steps long but you're only using eighteen of the twenty–one possible notes. So you have three notes missing (M); then you can build permutations and combinations, and say, number two is missing, and number three is missing, plus say five, or six, or seven and so on, which allows you to produce dozens and dozens of permutations and a vast number of possible scales of eighteen notes, and you can show them in terms of note names and intervals described by additions of Large and small intervals. Then you can produce thousands of modes by using each of the different starting points as the tonic.

GIBBON: We are used to thinking of scale as including mode in the West, and I think that maybe that's the terminology which we should continue. So prior to scale you have set (expanse) which is determined by *x*; sub–set (*N*

A Weekend of Musical Exploration

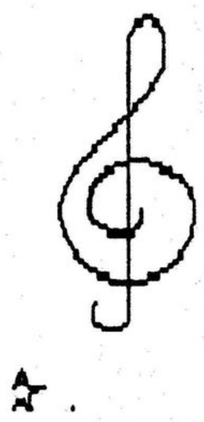
Explore a mountain retreat weekend of hands–on music making, including building a musical instrument, singing harmonics and playing music in the evening. Glasier and Lucy are acclaimed music experimentors, researching and developing the tools to create new instruments and scales for the future. This will be the only public opportunity this year to work together with these individuals and ideas.

Jonathan Glasier is the editor of *Interval* the microtonal magazine. He is an innovative musical educator and instrument builder, who is currently designing and building a musical playground for the San Diego School District.

Charles Lucy is a systems analyst, engineer, and musician, who explores the relationships between music, mathematics and physics. His book, *Pitch, Pi, and Other Musical Paradoxes* shows how all musical harmonics may be mapped to produce an infinite variety of musical scales.

Schedule of Activities

Introduction and idea exchange
Sonic Choir
Instrument building (monochords and tubalongs)
Instrument modification (refretting and software)
Computer modelling and scale generation
Evening of music making
Improvisization and singing



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