The Search for Mistletoe Mine (The Erv Euler Expansion) (duration: 1 hour)
Warren Burt, March – June 2020

I was looking at an old piece of mine, "Saturday in the Triakontahedron with Leonhard," which uses a 64 note scale proposed by Ervin Wilson, the Euler Genus 3 5 7 9 11 13, made of harmonics produced by multiplying all sets of 3 or less factors together, as well as 1 and the product of all 6 factors. I had not used this structure since composing the piece back in 2004-6. To my delight, all the software I had used to make the piece back then still worked, and I could recover the elements of the programs and the tunings kind of easily. ("Kind of" meaning I had to search between 3 computers and about 5 hard drives to find all the materials, but they were there.) So using those materials, I made this piece. Along the way, of course, I made a totally different piece than I made back in 2004-6.

HARMONY: A Euler Fokker Genus is a scale made up of a number of factors which are multiplied against each other. So if you had 3 factors, and they each didn't appear more than once, your scale would have these factors:

Table 21: All possible factors in Euler-Fokker Genus 3 5 7

Factors	1	3	5	7	3*5	3*7	5*7	3*5*7

And it could also be expressed as a cube:
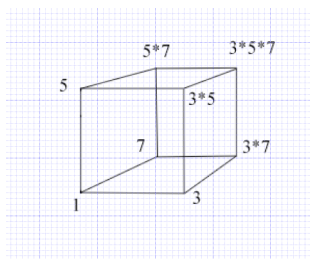
And the resulting scale would be like this:

Listing of Euler Genus 3 5 7, factors, ratios, and cents values

| Scale degree	Factor	Ratio	Cents
0	1	1/1	0
1	5*7	35/32	155
2	5	5/4	386
3	3*7	21/16	471
4	3	3/2	702
5	3*5*7	105/64	857
6	7	7/4	969
7	3*5	15/8	1088
8	1	2/1	1200

Erv's original scale (which I used in the earlier piece), had 6 factors – 3 5 7 9 11 and 13. If you take 6 factors, 3 at a time, you find there are 20 ways of combining those elements.

The 10 ways of combining sets of 3 out of 6 factors

Number	First 3 elements	Second 3 elements
1	3 5 7	9 11 13
2	3 5 9	7 11 13
3	3 5 11	7 9 13
4	3 5 13	7 9 11
5	3 7 9	5 11 13
6	3 7 11	5 9 13
7	3 7 13	5 9 11
8	3 9 11	5 7 13
9	3 9 13	5 7 11
10	3 11 13	5 7 9

Although I didn't use it in this piece, you could make a "cube of cubes," where a scale made of the first 3 elements, for example, could be transposed on 3 axes of the second three elements. This would make a 64 note scale, in which the original 8 note scale appears at 8 different transposition levels. So the 64 note scale can be divided into eight 8-note scales. There are 20 ways that this can happen. Here's Erv's original diagram of one of the 20 "cube of cubes" divisions of the Genus:
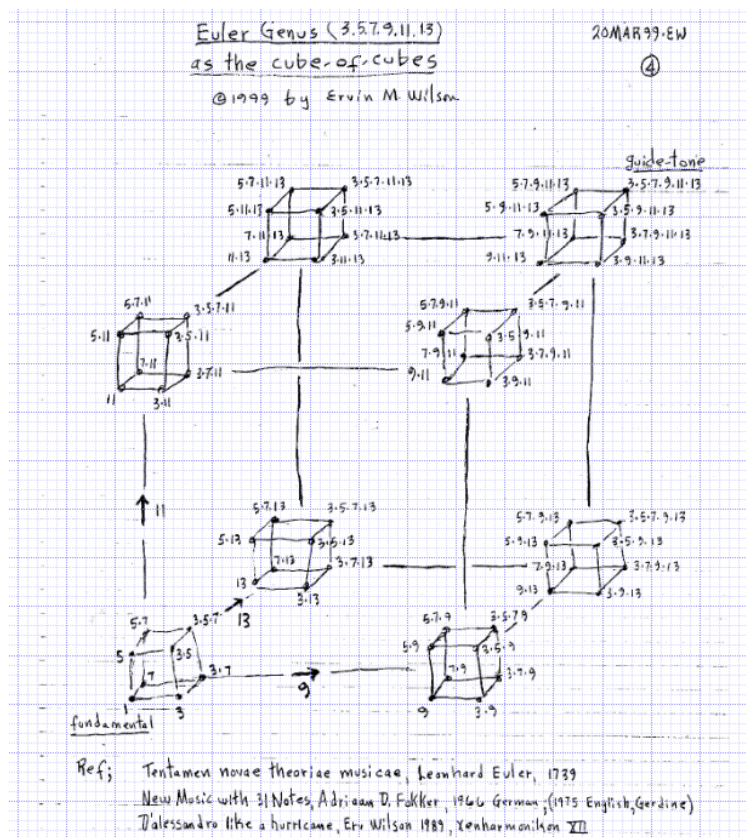
In this piece, I'm only using the lower most left cube, but I'm using all 20 possible cubes made with three factors. As an example, the piece begins with the cube given above (0:00 – 3:00 in the piece), and between 54:00 and 57:00 in the piece, we're using an 8 note scale made from factors 7 11 and 13:
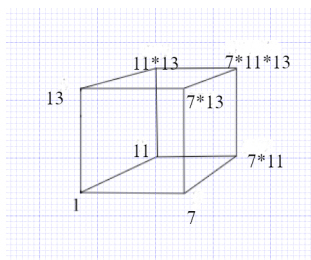

Which listed out, looks like this:

Listing of Euler Genus 2V 7 * 11 * 13 – Factors, Ratios and Cent Values

Scale Degree	Factor	Ratio	Cents
0	1	1/1	0
1	11 * 13	143/128	191.84
2	7 * 11	77/64	320.14
3	11	11/8	551.32
4	7 * 13	91/64	609.35
5	13	13/8	840.53
6	7	7/4	968.83
7	7 * 11 * 13	1001/512	1160.67
8	1	2/1	1200.00

Each scale appears as an ascending and descending sampled acoustic guitar melody, roughly in the middle of its section. So Scale 1 – the 8 note scale made of factors 3 5 and 7, appears at roughly 1:30 into the piece, while the above scale, which I'm calling 2V, appears at about 55:30 into the piece. In each of the 20 sections of the piece, each lasting 3 minutes, one of the 20 possible 8-note scales, made from 3 different factors, is used. The scales are selected with a program I wrote in the late John Dunn's MusicWonk. I have a set of 20 buttons to select the scales. I also have a set of 8 buttons, not used in this piece, in which I can also select each of the 8 possible transpositions of each scale – each transposition being one of the other corner cubes in the "cube of cubes" diagram. (Naturally, this means that if I were to use these, I could make another 7 one-hour pieces, given 3 minutes per scale – as in, piece 2 would use the 20 scales in transposition 2, piece 3 would use the 20 scales in transposition 3, etc. The thought of the work involved in making those additional pieces is easily enough for me to consign those other versions to the realm of "conceptual art," leaving just this one piece in the realm of "music."
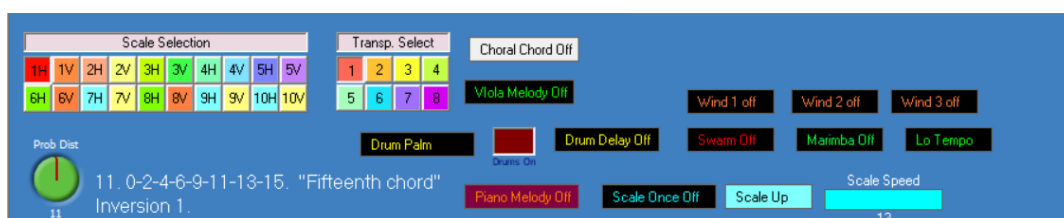
TIMBRE: I really really really hate sampled choir sounds. They really strike me as ultimately cheesy and in bad taste. Looking through the sample list in the Kontakt Factory Samples, which I'd acquired several years ago and never gotten around to using, I saw that they had a large number of sampled choir sounds, some of which would morph between different vowel sounds. Just for a laugh, I listened to this, and actually, to my surprise, liked what I heard. Still cheesy and in bad taste, but it sounded like something I could use. My tastes had evolved from "no I can't use that" to "I think I can live with the cheesyness and bad taste of that." The Kontakt Factory Samples also had a nice sounding piano sample, a good nylon guitar sample and a useable marimba sound. Plus, all of them could be retuned into my 64 note scale using the standard Kontakt tuning script. Other sounds soon presented themselves – SoniCouture was giving away a sample of tube drums for Kontakt. They sounded very good and were flexible, and could take the microtuning. The also reminded me of the tube drums used by Robert Erickson in his "Cradle II" piece, which had greatly impressed me when I was working with him in the early 70s. Time for a homage – why not? Similarly, Decent Samples were giving away a sampled zither, called the Mandolin Guitarophon, which had a wonderful preset of a granulated texture, that was similarly flexible and microtunable. Spitfire Audio had a solo viola, from its Solo Strings sample set that sounded very nice and was microtunable, and also from Spitfire, the massed woodwinds sample set in its Masse set could be microtuned. So as I was working on the piece, this orchestra gradually assembled itself. I made a structure where no more than four instruments at a time were playing (with the constant addition of the guitar playing the scales about half-way through each section), and assigned a differently composed algorithmic melody, each playing at its own tempo, to each instrument. The green knob in the lower left of the control panel shown above, selected different subsets from the 8-note scale of the moment, using a probability distribution to select from the chosen pitches. There are 23 different probability distributions/chords used. This means that I can improvise "chord progressions" in my scale of the moment, should I so choose.

Within the structured elements of the piece (change scale every 3 minutes, use only the timbres chosen for that section), I also improvise. I choose when to play the choir samples, when to begin or end the drum melodies, when to bring in or take out the other instruments, choose what polytempo the marimba will be playing, and what tempo the guitar-sound scales will be playing at. So with the score for the overall structure in front of me, and using the performance interface shown above, I can improvise happily for an hour, making yet another version of the piece. The version that I'm sending around was made on the 9th of June 2020. It was made with the software Plogue Bidule, Kontakt Sampler (using the sample sets described above), and MusicWonk. Hardware was a Lenovo laptop computer and a Korg nanoKey Studio keyboard. (For a suitably large commissioning fee, other individual versions could easily be made.   Mercenary, eh?)

THE TITLE: We live in Daylesford, Victoria, an old gold mining town. We'd been here nearly 10 years, and I noticed on a map a marker to the ruins of the "Mistletoe Mine," about 2 kilometers from our house. So recently we've started looking for it. We've had some lovely bushwalks, but haven't, as of June 11, found it yet. The location given on the map, GPS located and all, has no mine ruins at all. So we're still looking. Meanwhile, this piece was written, and was looking for a title – the union of art and life revealed it self again.

So this is my gift to you – a real-time, improvised, structured, orchestral and choral, sampled microtonal harmonic progressing piece. I enjoyed wandering around this forest of sonic resources as I made it, and I hope you will enjoy doing so too.

11 June 2020 Warren Burt