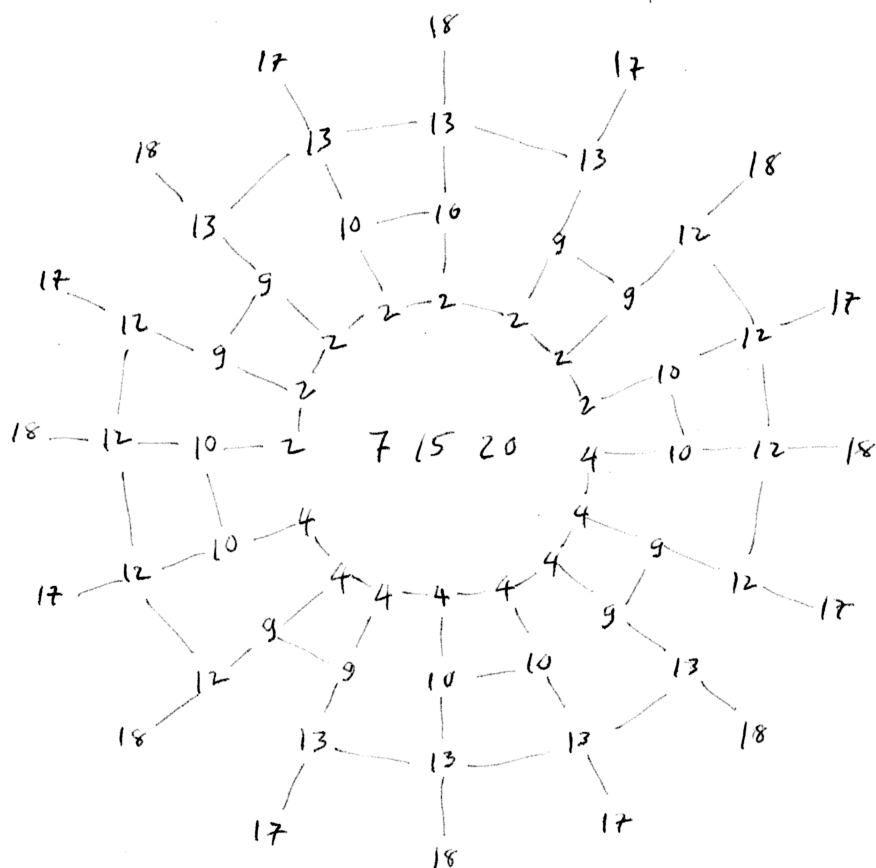# Tom Johnson

Septet II:
16 Scales

Septuor "Seize gammes." Three voices
unchanging and four alternating between two notes.

Tom Johnson 2016

Introduction

A combinatorial design is a configuration of numbers placed in a rigorously symmetrical pattern. The classic example, the one you find at the beginning of almost every text on the subject, can be clearly seen in a geometrical form :
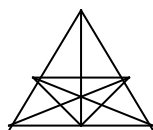
The seven points are covered by six lines and one little triangle that is considered a seventh line. Each line covers three points, each point intersects with three lines, each pair of points comes together on one line, each line shares one point with each other line, and this information can be summarized by saying simply that it is a (7,3,1) design. One can make combinatorial designs with almost any number of points, but it is rarely possible to represent these formations geometrically as neatly as one can with (7,3,1).

When I began learning about combinatorial designs, or "block designs," the (7,3,1) formation particularly fascinated me, because it seemed obvious that one could form extraordinary symmetrical harmonies simply by selecting a seven-note scale and forming seven three-note chords in this way. I tried this with different scales and I liked what I heard, but I always had the feeling that the result would be better if I could just find exactly the right notes, though in fact, the mathematics is strong enough to structure almost any set of notes.

Septet II is essentially a demonstration of this. Every phrase, every measure, is a (7,3,1) combinatorial design, and each one has this rigorous structure with all the notes and pairs of notes occurring equally, but each time the details are different. The music turns around on 16 different scales, with the seven notes permuted differently each time, and the orchestration of the seven instruments is constantly changing as well. By the end of the piece, lasting 12 minutes or so, we have heard 128 different (7,3,1) formations, only a fraction of the those possible, but hopefully enough to hear the mathematical symmetry that is common to all of them – and to countless others that are not heard.

As I was calculating all this, I found that the results often surprised me. Each new set of seven chords, each new scale, seemed like something I had never heard before. It was hard to believe that this was really my music, as it seemed to be coming from somewhere else, perhaps from that idealistic zone that Plato defined as *pure numbers*.

Performance Notes

The goal is to match dynamics and intonation as exactly as possible, and to hear the harmonies themselves, without calling attention to voice leading and inner melodies. In general this implies detached playing at *mp*, though this depends on the players and the acoustics. To help individual players enter into the logic of the music, it may help to think:

In each measure I play three of the 7 notes of the scale.

Each of the seven notes occurs three times in each measure.

If I play, for example, a B-flat, I want the dynamics and intonation to be as close as possible to the two B-flats played by two other players in that measure.

By the end of the seventh measure, I will have played on the first beat exactly three times, on the second beat three times, on the third beat three times, etc, and the other six players will have done likewise.

By the end of the seventh measure, I will have played each of the 7 notes about the same number of times and will have played at the same moment as each other player about the same number of times.

The eighth measure, the one in 5/2, is always a repetition of the first measure of the phrase.

Each time the music goes back to 4/2, two notes of the scale are different and the music has a new atmosphere, but this is a mathematical variation and not an expressive modal change.

We are striving for mathematical precision, though in a human rather than a mechanical way. Think of a fine corps de ballet or the best string quartets.

Septet "Seize gammes"

Tom Johnson

Septet II

2

Septet II

7

Septet II