Cover Page

Universiteit Leiden

The handle http://hdl.handle.net/1887/66269 holds various files of this Leiden University dissertation.

Author: Bok, H.J.
Title: The deep-rooted microtonality of the bass clarinet
Issue Date: 2018-10-17

CHAPTER 4

Microtones: unequal divisions of the tone

4.1 31-tone tuning

In May 2014 duo Hevans was invited by the Huygens-Fokker foundation to perform in their microtonal concert series at the Muziekgebouw aan 't IJ in Amsterdam. We were told that the 31-tone equal temperament Fokker organ, which is housed in the building, had to form some part of the programme. Although the organ could have played solo, it was our choice to try to perform in a chamber music setting together with the organ. We consulted the list of works documented by the Huygens-Fokker foundation and found that neither bass clarinet nor tenor saxophone were mentioned in connection with 31-tone music (Stichting Huygens-Fokker, n.d.), which was an additional motivation to start our research in this area. We wanted to come up with a pitch range that suited both instruments well, so that the composers who were going to write works for this concert would have many options to choose from. Therefore, we started performer-led research into which 31-tone fingering patterns are possible on our closed-key single reed instruments.

4.1.1 The Fokker organ concert

4.1.1.1 31-tone fingering pattern chart

American composer Julia Werntz writes:

> In the Netherlands in the 1950s, Dutch physicist Adriaan Fokker initiated a revival of the 31-note equal temperament of 17th-century scientist and theorist Christiaan Huygens. . . .Although today the government-funded Stichting Huygens-Fokker (founded by Fokker in 1960) provides a forum for a variety of microtonal disciplines, the influence of Fokker's ideas is apparent in the high number of Dutch (and some non-Dutch) musicians who write or perform in 31-note equal temperament. (2001, p.162)

Our initial work on finding suitable 31-tone fingering patterns was done with the Scala tuning programme. Because of the organ we had to tune our instruments

at A=441 Hz. Working with Scala, we found that the area from D2 up to F4 (31-tone notation, bass clarinet octavation) was a good range for both the tenor saxophone and the bass clarinet. The range of the bass clarinet could be extended a bit further and I was able to come up with fingering patterns up to G4 (31-tone notation).

Finding 31 pitches per octave proved quite a challenge, but pushed by our interest in developing a new pitch language, our efforts were rewarded: at the end of our research we only missed about 5% of the pitches in our chosen range. In the case of the bass clarinet, of the 71 pitches available between D2 and F4, suitable fingering patterns could not be found for just two pitches, D𝄳3 and G♯3. In the case of the tenor saxophone only four fingering patterns were missing.

The next step was to confirm our fingering patterns with the actual organ. When working with the organ, during the first rehearsal, there were a few clashes between our carefully preselected pitches and those of the organ. Organ player Ere Lievonen pointed out that some notes on the organ did not match the Scala tuning programme exactly. Therefore, we had to adapt our findings and fingering patterns to match the organ.

In order to find suitable fingering patterns the same flexibility regarding the use of each digit was applied as in my quartertone and eighth-tone research. For example, in Figure 67, key 12 is played using the right hand thumb.

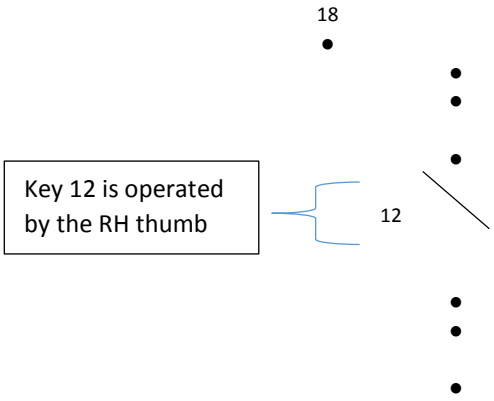

Figure 67: Fingering pattern for D♯3 used for the Huygens-Fokker concert

Due to the difference in construction of the keywork, the bass clarinet and tenor saxophone have different areas that allow more or fewer possibilities in terms of microtones. Because of the different range, the two instruments have different low notes that are unchangeable microtonally. The fact that the tenor saxophone overblows at the octave and the bass clarinet at the twelfth means that microtonally unchangeable pitches often do not coincide. The area from C3 to E3, complicated for the bass clarinet, does not pose particular problems for the tenor saxophone, whereas G3 to G♯3, for which the tenor saxophone only has extremely limited microtonal options, is microtonally viable for the bass clarinet. The results of my work with the Fokker organ can be found in Appendix D and Video 13.

Video 13: 31-tone scale version 1 (Appendix D)

4.1.1.2 Notation

As Evans writes:

> We were unable to find any suggestions for how transposing instruments should be treated when playing in 31-tone. Having studied the existing 31-tone methods of notation for the organ, we decided that given the limited rehearsal time, the simplest notation for both Bok and myself was one that was in some way familiar to us from our previous microtonal work. (2016, p.150)

After ample discussion, my duo partner elaborated a notation system which is a combination of the sharp and flat signs with the well-known symbols for quarter-sharp and quarter-flat, making it easier to get familiar with as performers, because we would recognise the symbols from semitone and quartertone music.

Laid out in one octave, for example from D2 to D3, this would be the result in writing:

D2 – D𝄲2 – D♯2 – E♭2 – E𝄳2 – E2 – E𝄲2 – F𝄳2 – F2 – F𝄲2 – F♯2 – G♭2 – G𝄳2 – G2 – G𝄲2 – G♯2 – A♭2 – A𝄳2 – A2 – A𝄲2 – A♯2 – B♭2 – B𝄳2 – B2 – B𝄲2 – C𝄳2 – C3 – C𝄲3 – C♯3 – D♭3 – D𝄳3 – D3

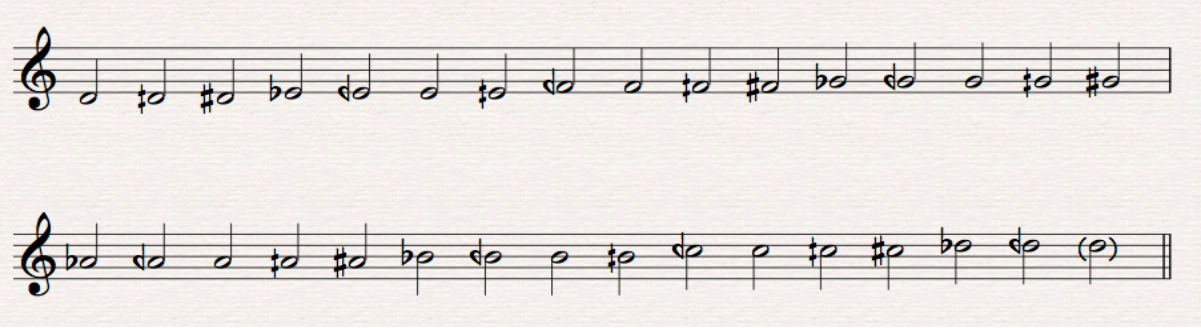

Figure 68: D2 to D3 notated in 31-tone pitches

4.1.1.3 Uijlenhoet: *Radio Istria*

In the May 2014 concert duo Hevans premiered six pieces, written for duo, trio (duo with organ or duo with live electronics) or quartet (with organ and live electronics).[55] The composers made use of several different tuning systems. Dutch electronic music composer René Uijlenhoet, for example, wrote an extensive new work in 31-tone tuning for the Fokker organ, tenor saxophone, bass clarinet, and live electronics (played by the composer), entitled *Radio Istria*.

During the preparation and rehearsal processes the same issues regarding the unavailability or the incompatibility of fingering patterns arose as has been spoken about in relationship with quartertone and eighth-tone playing on the bass clarinet. As my duo partner remarks:

> In the process of working through the score we discovered that whilst individual notes were possible, some of the changes between notes were not practicable. Working together with Uijlenhoet we addressed these areas of the piece, and found that mostly, by simply swapping the bass clarinet and tenor saxophone parts we were able to resolve these issues. (Evans, 2016, p.150)

This problem can be illustrated by studying bars 56-59. In the original version, the composer prescribed the sequence C♮3-F♮3 for the bass clarinet four times (Figure 69).

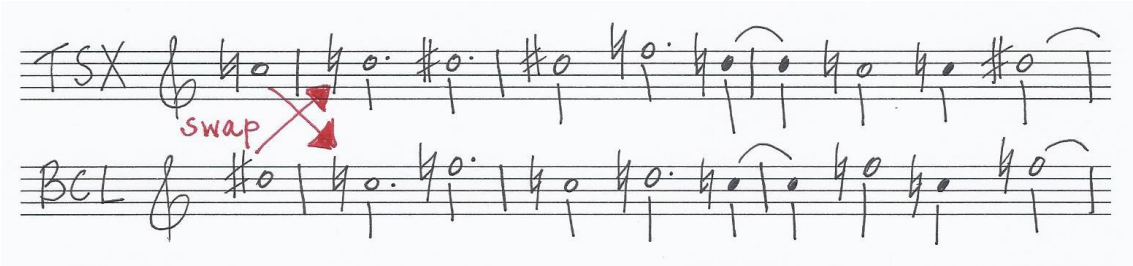

Figure 69: The tenor saxophone and bass clarinet parts for *Radio Istria*, bars 56-59

[55] In programme order, the other composers involved in the concert were: Diana Soh, Rose Dodd and Monty Adkins, Christopher Fox, and Scott Mc Laughlin. My piece *Multi-Micro I* was also premiered in this concert.

However, the C♮3 fingering pattern requires side keys 12 and 13 to be opened by the right hand thumb, whilst the F♮3 fingering pattern needs the same digit to depress key 1 on the lower joint. This creates a complicated sequence (Figure 70).

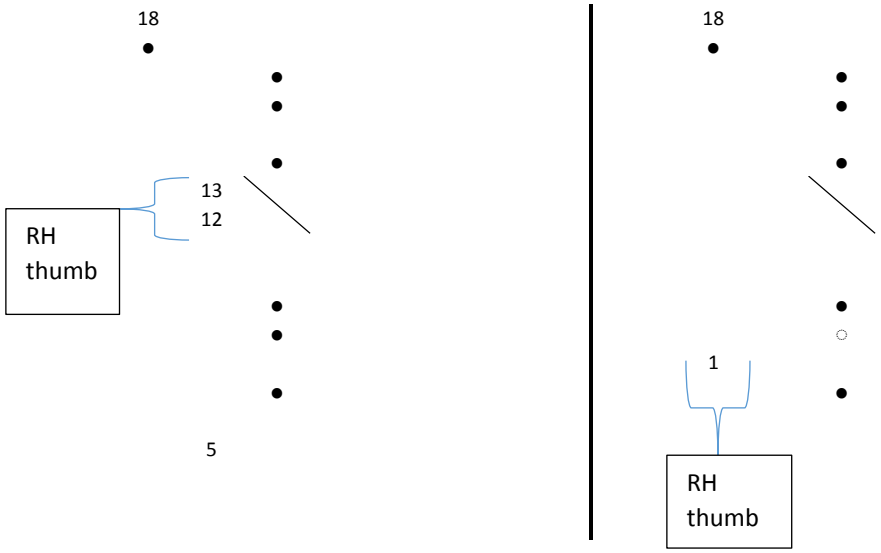

Figure 70: The fingering patterns for C♮3 and F♮3 (Appendix D)

The tenor saxophone does not have any particular problem playing the concerned notes in a row, so we suggested to the composer that the parts were swapped for these bars. Uijlenhoet accepted our suggestion, partly because the tenor saxophone and the bass clarinet can blend quite well, so that the sonic outcome was still the way he wanted.

Another example of problem solving can be found in Figure 71. In the original version of the score, the bass clarinet played together with the organ, and the tenor saxophone had three bars of rest. In bar 40, the bass clarinet has to move from C♯5 (second note) to D♭3 (third note). This succession of notes proved to be tricky at the desired tempo due to the movement from key 12 to key 13. The tenor saxophone therefore came to the rescue and played the D♭3.

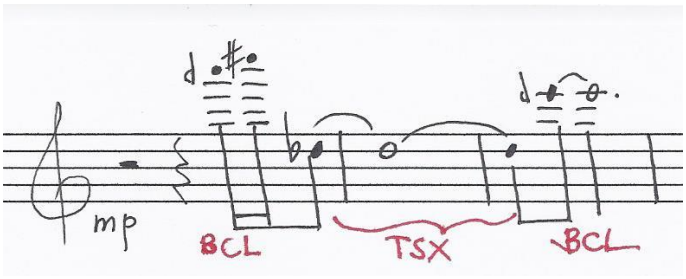

Figure 71: Uijlenhoet, *Radio Istria, part* 2C, bars 40-42

The solutions found by swapping between the two single reed parts proved to be very effective in solving any issues arising with the 31-tone fingering patterns used with the Fokker organ.

Audio example 9: Uijlenhoet, *Radio Istria, part* 2C, bars 40-42

4.1.2 Towards a definitive 31-tone fingering pattern chart

Whilst swapping parts in Uijlenhoet's *Radio Istria* was a simple manner in which to resolve any problems encountered in different successions of 31-tone fingering patterns, I have since felt that further investigation into the 31-tone microtonal possibilities of the bass clarinet could help erase certain incompatibility problems.

Although I would potentially have to revert to the fingering patterns developed for use with the Fokker organ, for any future projects with this instrument, I felt that my initial research on the 31-tone tuning system could be further developed. This expansion of my research had two aims: firstly, to go back to the fingering patterns I had already found, re-measure them and correct them where necessary, and secondly to try to extend the 31-tone possibilities into the altissimo regions of my instrument.

When working towards a second version of the 31-tone fingering patterns I tuned at A=442 Hz. As was found with the quartertones and the eighth-tones, measurements in the fifth octave became more and more difficult. However, I have managed to extend the fingering pattern chart for the 31-tone scale from the highest note in use in the Huygens-Fokker concert (G4) to D5, a full three octaves. This brought the total amount of pitches to 94, of which I was not able

to find a suitable solution for only two.[56] The results of this research can be found in Appendix E.

A comparison of the fingering patterns in Appendix D with those in Appendix E shows that quite a few changes have been made. Due to the margins of error used in this research, incidental overlaps could occur between different microtonal tuning systems: a fingering pattern could fall within the margins of error for more than one system. However, great effort has been taken to ensure that the pitches are as exact as possible and therefore these overlaps, where the same fingering pattern is used in more than one microtonal scale, have been kept to an absolute minimum. Of the 76 fingering patterns in Appendix D 32 have been changed in Appendix E, including nine standard fingering patterns.

Video 14: 31-tone scale version 2 (Appendix E)

Checking the measurements of Appendix E again, I was able to further refine several fingering patterns. The few, still existing overlaps with the eighth-tone fingering pattern chart could be repaired (a total of 10 fingering patterns) and between the 94 fingering patterns found in both Appendix E and F, 30 fingering patterns have been altered. This resulted in the third version of my 31-tone fingering pattern chart, my definitive version, which can be found in Appendix F and Video 15.

Video 15: 31-tone scale definitive version (Appendix F)

4.1.3 Preferred notation

Since the concert with the Fokker organ many more composers have shown an interest in writing for the bass clarinet in 31-tone tuning. When a composer writes a microtonal piece in which all the microtonal pitches belong exclusively to the 31-tone scale, the notation proposed in section 4.1.1.2 is adequate, as long as one is aware of the fact that in this notation enharmonic pairs do not

[56] The same missing pitches as in Appendix D.

exist. For example, between a D♯2 and an E♭2 there is a pitch difference of 38.7 cents.

Although the notation system discussed in section 4.1.1.2 worked well for the concert with the Fokker organ, Téhéricsen, Laufer, and Redgate, have chosen to write pieces in which 31-tone tuning is combined with other tuning systems. When different microtonal subdivisions are used alongside each other, though, the system is not acceptable, as, for example, the symbols ♯ and 𝅘𝅥 are used in both quartertone notation and 31-tone notation, and the symbols ♯ and ♭ are shared between semitone and 31-tone notation, but the four symbols indicate different pitches in the disparate systems. Notation might therefore become ambiguous, if the composer does not find another solution for making the different tuning systems apparent. Different composers have solved the problem of changing between tuning systems in a variety of ways. For example, in his solo piece, *verse & refrain*, Laufer has used colour to indicate the difference. He writes in the score: "black note heads: traditional intonation,[57] red note heads: 31-tone microtonal intonation" (Laufer, 2016, p.1).[58]

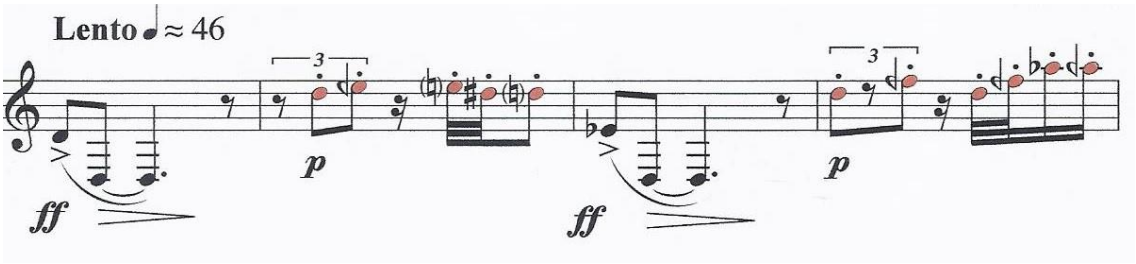

Figure 72: Laufer, *verse & refrain*, bars 1-4

Roger Redgate has combined 31-tone tuning and quartertone intervals in his bass clarinet solo piece. His way of distinguishing between the two tuning systems is simple, but quite efficient: he uses two staves. In his score, the upper stave is reserved for 31-tone writing and the lower stave for quartertone writing (Figure 73).

[57] Laufer refers to semitone writing as "traditional intonation" (2016, p.1).
[58] Laufer also uses red x-shaped note heads to indicate key clicks. Although these key clicks are red and could be presumed to form part of the 31-tone sections, the composer has indicated that the key clicks are not pitch-specific (N. Laufer, personal communication, June 1, 2017).

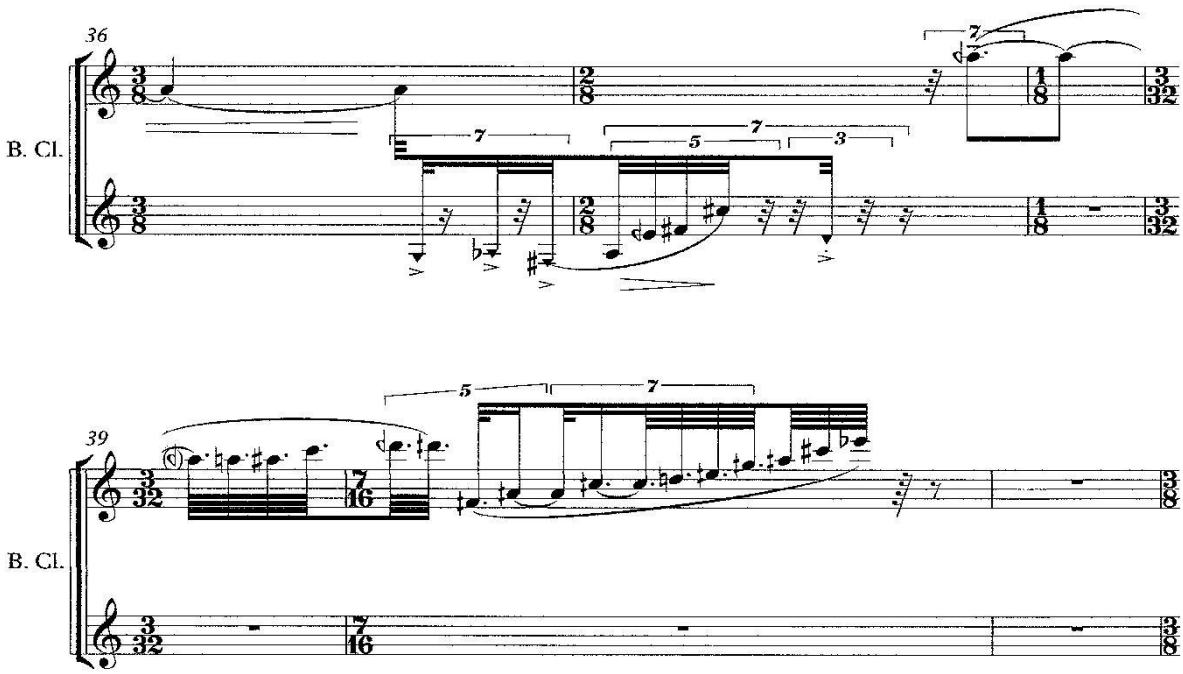

Figure 73: Redgate, *new work*, bars 36-41

In my own compositions the system I have so far used to indicate the difference between quartertone sequences and 31-tone sequences is marking either (1/4T) or (31T) under the first bar of a section (Figure 74).

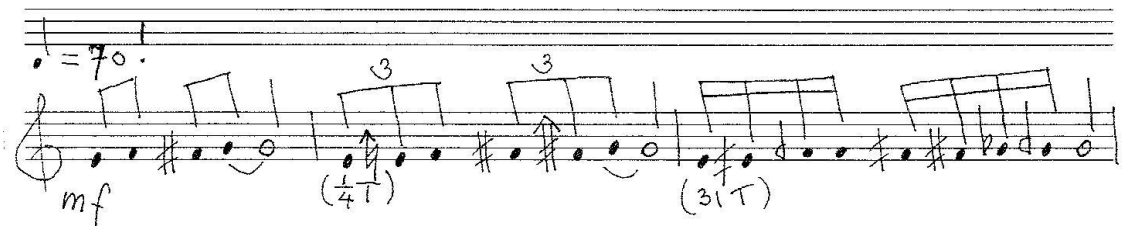

Figure 74: Bok, *Homage*, bars 6-8

Comparing the different solutions discussed above, I will, however, adopt Roger Redgate's notation system from now on, for reasons of clarity and readability.[59] Solutions are context sensitive, though. Whilst colours work well in the score (as can be seen in Laufer's *verse & refrain*), one only has to imagine a situation on tour, when the composer sends the last pages of the score by fax or email and there is no colour printer available, for this option to be rendered unusable.[60] The option to use two staves could complicate reading and performing were a composer to switch systems every few notes or inside the same bar, as the visual aspect of the writing could turn into a patchwork. Although I would like to adopt Redgate's notation system for longer pieces which use two kinds of microtonal subdivisions, I would not change my notation in *Homage* (Figure 74), as the piece is short and linear.

4.2 Applications

Three composers, Téhéricsen, Laufer, and Roger Redgate (in chronological order of receiving the scores) have contributed to my research by committing themselves to engage in collaborative 31-tone projects.

I knew Laufer and Téhéricsen from earlier projects. I had never worked with Roger Redgate before, but wanted to try and convince him to write his first solo work for the bass clarinet.[61] As the first 31-tone compositions in which I was involved were all ensemble pieces, written for the duo Hevans concert with the Fokker organ, I expressed my preference for solo compositions.

Laufer presented the initial version of *verse & refrain* on August 13, 2016, followed by Téhéricsen who sent me the score of *Progression Bureaucratique* on September 9, 2016.[62] At the final stage of this study (Summer 2018), Redgate is still working on his solo piece, but the collaborative process relating to the project has been both intense and highly effective.

I shared the same 31-tone data with all three composers: the fingering patterns documented in Appendix D, accompanied by additional information about

[59] This system suits solo and small chamber music works, but has drawbacks in the case of pieces for larger ensembles.
[60] This problem does not exist, of course, when the score is read on an electronic device such as an iPad.
[61] Redgate is renowned for his complex music, involving microtonality as one of its core elements.
[62] I premiered Téhéricsen's piece in January 2017 during the Festival Musica nas Montanhas, in Poços de Caldas, Brazil.

combinability, reliability, dynamics, and sound quality, as well as information regarding the acoustics of the bass clarinet.

4.2.1 Téhéricsen: *Progression Bureaucratique*

Téhéricsen started working on his piece in May 2016. As indicated earlier the initial range of my 31-tone fingering patterns was from D2 to G4. In an email the composer asked me to continue exploring the high notes, as he wanted to push the limits of instrumental playing, especially regarding the top of the altissimo (F. Téhéricsen, personal communication, May 24, 2016). This request was subsequently withdrawn, as Téhéricsen realised that what I gave him was sufficient for him to start writing his piece. The title of the piece is intriguing, but also a bit mysterious. The composer's explanation makes it clear: "[it] is because the bureaucratic system progress very small steps after very small steps" (F. Téhéricsen, personal communication, July 9, 2016).

On September 9, 2016 the composer sent me the first version of *Progression Bureaucratique*. After having studied this version of the score I came up with a list of 15 questions. Most of the questions concerned dynamics, accidentals, and the use of extended techniques such as glissandi and harmonic glissandi, singing and shouting. I also had concerns regarding the A♯5 and A5 the composer had written in bar 97 (Figure 75), pitches which are above the range in which I had found 31-tone fingering patterns, and also above the range I generally recommend to composers.

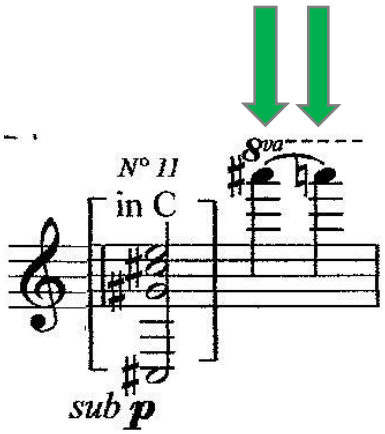

Figure 75: Téhéricsen, *Progression Bureaucratique*, original version, bar 97

I shared my doubts with Téhéricsen despite continuing my search for reliable fingering patterns, but eventually decided that the pitches A♯5 and A5 were unrealistic and asked him for a solution. Therefore, in the second version of the piece Téhéricsen decided to transpose the phrase down one octave, “because the phrase is going down slowly to the melody in bar 101, so no problem at all, one octave lower is ok” (F. Téhéricsen, personal communication, December 5, 2016).

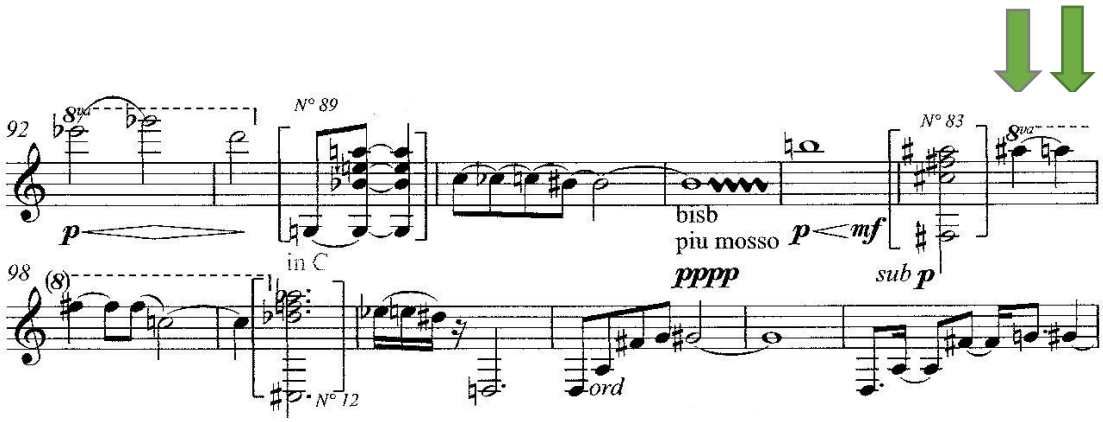

Figure 76: Téhéricsen, *Progression Bureaucratique*, version 2, bars 92-103

Téhéricsen’s music is very energetic, lively, and full of surprises. His use of the 31-tone microtonality illustrates these characteristics. The composer combines semitonal writing with 31-tone microtonal writing, which could sometimes evoke doubts or questions, as he does not use any system to differentiate between semitonal and microtonal writing. However, the context is leading and takes away the hesitations most of the time. The very beginning of the piece is a good example (Figure 77).

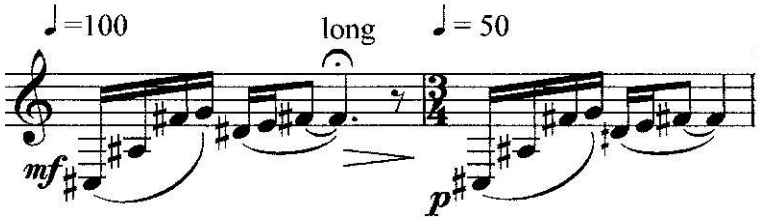

Figure 77: Téhéricsen, *Progression Bureaucratique*, bars 1-2

The pitches of the second bar are the same as in the first (semitonal) bar, except for one microtonal pitch, D♯2 (31-tone), making it really stand out.

Bars 8-10 also have repeated (semitonal) notes, D♯1, B♭1, and G2 in bars 8 and 9, D♯1 and B♭1 in bar 10, with microtonal 'aliens' E𝄲3, E3, and E♯3 (31-tone) as long notes, joined by a G♯2 (31-tone) in bar 10.

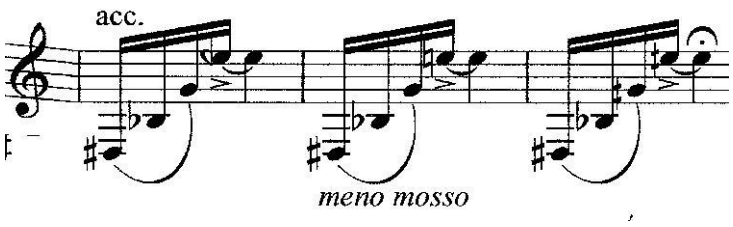

Figure 78: Téhéricsen, *Progression Bureaucratique*, bars 8-10

D♯1 and B♭1 do not have 31-tone fingering pattern options in the chart which I shared with the composer, thus can only be read as semitones. Therefore, this passage could be interpreted as a repeated melody with microtonally varied endings: a grouping of three (semitonal) and one (31-tone). However, the G2 changes to a G♯2 (31-tone) in bar 10, which could point at groupings of two (semitonal) and two (31-tone).

Another example of such a hybrid situation, again contextualised by a repeated motive, is the four note sequence found in bars 30 and 31. Like D♯1 and B♭1, I could not find a 31-tone fingering pattern option for E1, therefore this note can only be read as a semitone. In both bars the two last pitches of the four-note motive are altered: E3 and E4 (31-tone) become E♯3 and E♯4, moving up one step of the 31-tone scale (Figure 79).

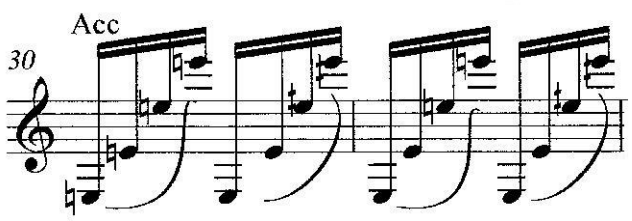

Figure 79: Téhéricsen, *Progression Bureaucratique*, bars 30-31

Still, these bars could be read in different ways, because the same choices of note groupings could be made as in bars 8-10: two plus two or one plus three. Due to the uncertainty of which interpretation to adopt, I had to contact Téhéricsen and ask him to express his wishes: a subdivision of two semitonal pitches followed by two 31-tone pitches in each bar (Audio example 10).

Audio example 10: Téhéricsen, *Progression Bureaucratique*, bars 30-31

On a final note, regarding the choices between semitonal or 31-tone readings in this composition, I used the following system as a rule of thumb (acknowledged by the composer):

- As Téhéricsen's information for 31-tone fingering patterns came from my Huygens-Fokker chart (Appendix D), all notes lower than D2 do not have 31-tone options and should be interpreted as semitones.
- If no microtones appear within a bar, the notes should be read as semitones.
- If the majority of pitches within a bar are microtonal, all notes should be read as 31-tone pitches.

However, there were other occasions when further clarification was needed regarding the application of these rules. For example, the last three notes of bar 119 and the first three notes of bar 120 are seemingly the same. Be that as it may, they are in fact the juxtaposition of one microtonal bar and one semitonal bar. This means that for the last three notes in bar 119, F2, G2, and G♯2, 31-tone fingering patterns should be used and for the same three notes in bar 120 semitonal fingering patterns, as confirmed by the composer. Téhéricsen's writing here alternates between the two systems (Figure 80).

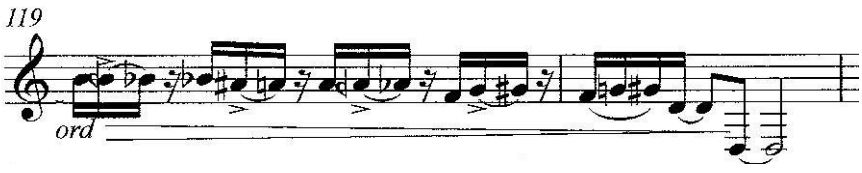

Figure 80: Téhéricsen, *Progression Bureaucratique*, bars 119-120, 31-tone reading and semitonal reading

To conclude, Téhéricsen's score is not self-explanatory, and although certain decisions are dictated by the (un)availability of fingering patterns, interpretational choices could be multiple due to the absence of an unambiguous notation system.

4.2.2 Laufer: *verse & refrain*

In *verse & refrain* Laufer combines 31-tone microtonality with semitonal writing and also with root-overtone microtonality (this aspect of the work will be discussed in Chapter 5). The subtitle of Laufer's composition is 'microtone study' and it is approximately five minutes long. The piece has a *lento* character (crotchet ≈ 46). As previously discussed, Laufer has used red note heads to indicate pitches in 31-tone tuning.

The initial information the composer received about the 31-tone possibilities of the bass clarinet was for the range D2 to G4 (31-tone pitches).[63] In *verse & refrain* Laufer has used this entire range. On two occasions he also expanded his 31-tone writing below D2. The two notes, D1 and G1, indicated in Figures 81 and 82, are in the lowest fifth of the instrument's range (see Chapter 1 for an explanation) and therefore I was not able to find suitable fingering patterns for either note.

[63] The fingering patterns can be found in Appendix D.

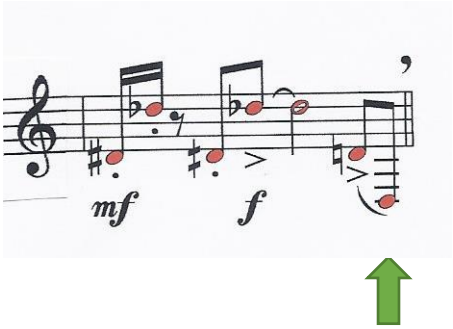

Figure 81: Laufer, *verse & refrain*, version 1, bar 15

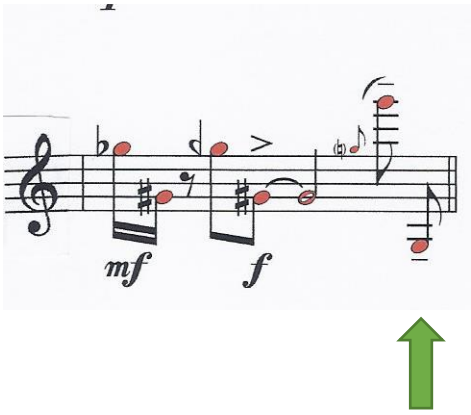

Figure 82: Laufer, *verse & refrain*, version 1, bar 43

I discussed this issue with the composer and suggested putting the notes in semitonal writing. Laufer adopted my suggestion for these two 'out of range' pitches and changed them to "traditional intonation" (N. Laufer, personal communication, June 6, 2017).

Upon studying the piece further, I found that it was difficult to play D♯3 (31-tone) staccato as the composer desired. This highlighted an issue which I had not previously had with my microtonal work: the influence of articulation upon the success of microtonal fingering patterns. The combination of notes in bar 2 (Figure 83) and bar 60 (Figure 84) emphasized this issue and I communicated these articulation issues with the composer:

> The D♯3 is very unstable, especially after a higher pitch. This is the case in bar 2 where this pitch follows the higher E. In bar 60 it is slightly less

of a problem, since the D is just before (as a reference point). To make the risk in bar 60 smaller, I would like to suggest to change the staccato to legato just for these two notes. (H. Bok, personal communication, June 4, 2017)

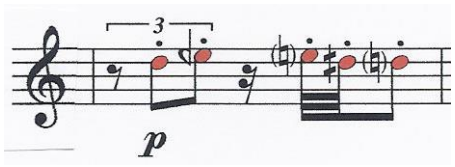

Figure 83: Laufer, *verse & refrain*, version 1, bar 2

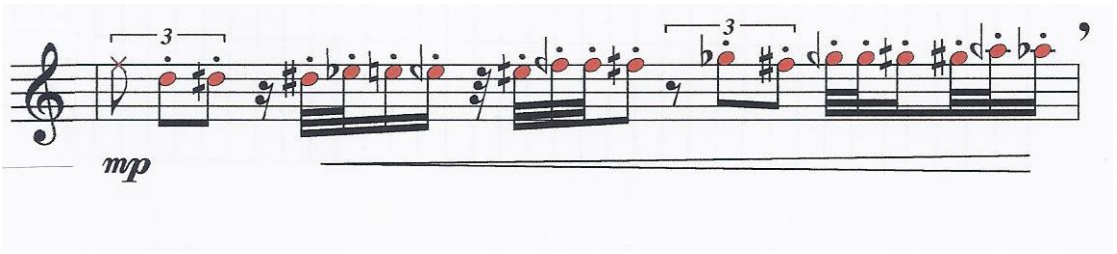

Figure 84: Laufer, *verse & refrain*, version 1, bar 60

Laufer chose to resolve the instability caused by the articulation in two ways: he replaced the note in bar 2, and, following my advice for bar 60, he changed the staccato articulation to legato.

Laufer had also included the pitches D𝄲3 and G♯3 (31-tone) in his composition on several occasions. These notes fell within the range (D2 to G4), but they were notes for which I had not been able to find suitable fingering patterns.

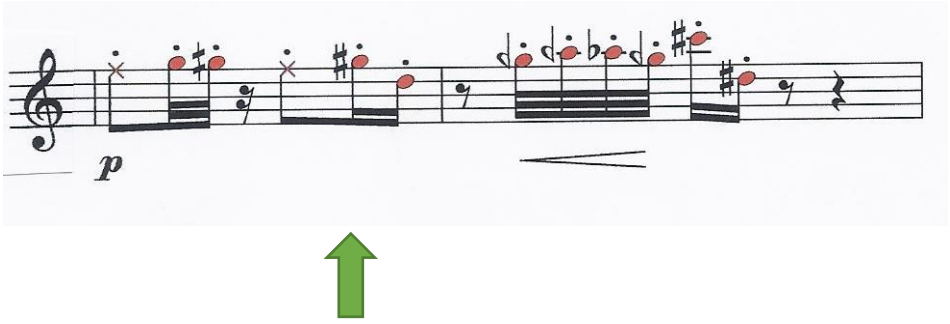

Figure 85: Laufer, *verse & refrain*, version 1, bar 6

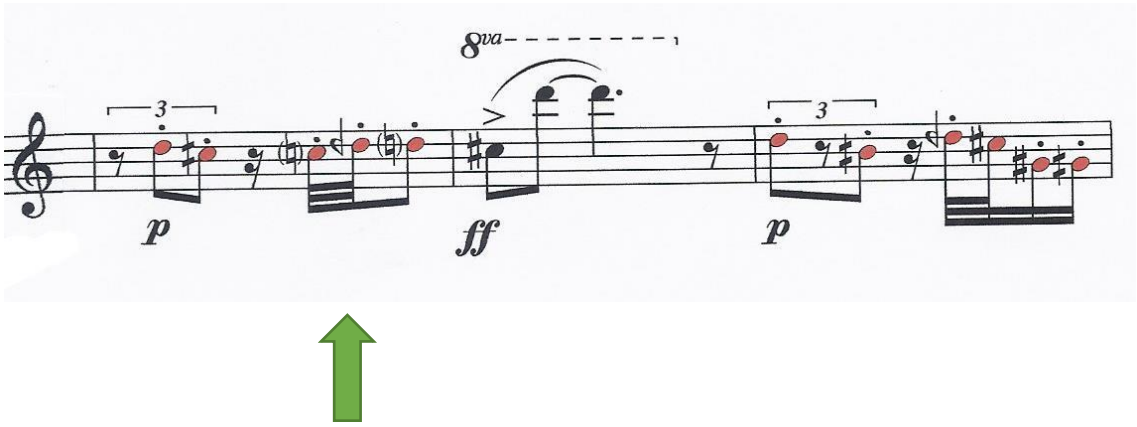

Figure 86: Laufer, *verse & refrain*, version 1, bars 9-11

I explained the lack of fingering patterns for these notes to Laufer, accompanied by some suggestions:

> In the chart I sent to you I had not found a fingering for two pitches: D𝄲3 (nr 31 of the first octave) and the G♯3 (nr 16 of the second octave). In the chart I had put a big X. Sorry, if that was unclear. Although I have tried to find a fingering pattern, even today, nothing can be found at the moment. Here are the bars relating to this problem: 6, 9, 11, 34, 39, 42, 58, and 60. (H. Bok, personal communication, June 4, 2017)

Although Laufer subsequently replaced the D𝄲3 and the G♯3 with other pitches, the solution he came up with for bars 9 and 11, created incompatibility problems.

> Another problem occurs when two fingering patterns are to be used for the 31-tone pitches which separately would work, but not in a sequence. There are two 'culprits': in the complicated fingering patterns for this extreme microtonality the right hand thumb has to be used as an active digit fairly often to motion side keys of the upper joint, normally played by the right hand index finger. The right hand thumb is traditionally needed for key 1 (C1 key) and key 2 (C♯1 key) at the back of the lower joint. Whenever in a sequence of two notes the thumb is used firstly for either key 1 or key 2, and secondly for an upper joint side key (10, 11, 12, 13, or 10/11 and 12/13 as sets), the combination becomes impossible. The opposite is also true: starting on a side key and having to use the thumb for key 1 or 2 is not feasible. The second 'culprit' is the combination of

side keys 12 and 13, either used separately or as a set: it is very hard/impossible to move from 12 to 13 (or vice versa) or to go from one key to two keys. As an example, if the first fingering pattern includes key 12 and the second 12+13, there is a problem. Here are the bars where certain combinations pose problems: bar 4 (combination of third and fourth note), bar 14 (combination of fourth, fifth, and sixth note), bar 15 (combination of first and second note), bar 35 (combination of the first four notes), bar 41 (combination of the first two notes, directly after the key click), bar 42 (combination of third and fourth note), bar 60 (combination between note 3 and 4 after the key click). (H. Bok, personal communication, June 4, 2017)

In the second version of *verse & refrain* Laufer had solved the compatibility problems in bars 14, 15, 41, and 42,[64] but bars 4, 35, and 60 still needed solutions. Due to the revisions made in bars 9 and 11, changing the D𝄲3 (31-tone) to D♭3 (31-tone), these bars now also had issues.

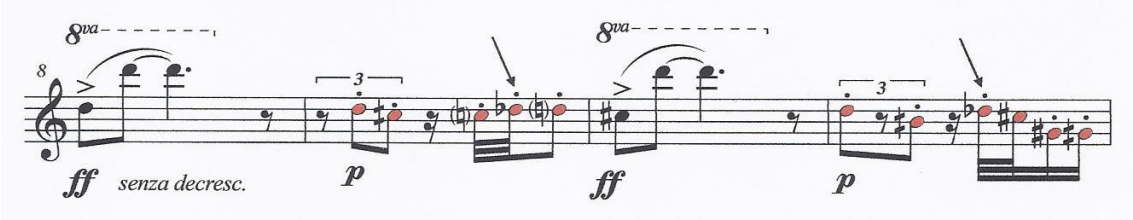

Figure 87: Laufer, *verse & refrain*, version 2, bars 8-11

I communicated these incompatibilities with Laufer and explained to him that the problem of impossible or complicated sequences was caused by the 'double role' of the right hand thumb, which would have to jump from lower joint keys (key 1 or key 2) to upper joint keys (key 12, key 13 or keys 12/13 combined). This situation occurred in bars 4, 9, 11, 35, and 60 (H. Bok, personal communication, June 6, 2017).

Laufer then sent me a third version of the score, with the following comment: "This time I tried to stick to the logic of my row: when I changed bar 4, I felt that I also had to change 11, 32, and 39. I really hope that this works" (N. Laufer,

[64] That is when the Huygens-Fokker fingerings (Appendix D) are used in bars 41 and 42 rather than the newly found fingerings.

personal communication, June 6, 2017). Unfortunately, the changed pitches in bar 4 and in bar 11 still did not combine. The process neared its completion, but a number of issues remained: in bars 4, 9, 11, 58, and 60 the right hand thumb still had to execute impossible jumps (H. Bok, personal communication, June 7, 2017).

Shortly after, Laufer sent version 4 of the score with the following comment:

> Now I see a possible solution (from the point of view of the composition) in repeating two notes that came right before the problematic two notes. As I have to change bar 4 and 11, I also want to change 32 and 39. Bar 9 seems to be a special problem; so far I do not want to change the parallel phrases. Last page: for me it is important to have the passages which are one octave higher or lower, just as the 'original' one: so you asked me to change 58 – I want to change bar 62 (one octave higher), the same is with bar 60 and 56 (one octave lower). If this does not work, please make suggestions which fit into the microtonal-chromatic lines". (N. Laufer, personal communication, June 7, 2017)

I did not have to make any suggestions, as all changes proposed by the composer in the fourth version of *verse & refrain* were feasible. Therefore, this version of the work became the final version.

The collaborative process for *verse & refrain* was time-consuming and labour-intensive. The reason for this is largely due to the complexity of the 31-tone fingering patterns which inhibits certain combinations or sequences. Composers have to be made aware of certain incompatibilities caused by the complexity of the fingering patterns and by the additional tasks given to digits, which are unorthodox when compared to playing non-microtonal music. Such incompatibilities are difficult to communicate through fingering pattern charts, as they generally communicate the keys needed rather than the fingers used to operate them. As such I have since added extra information regarding the use of alternative digits to all of my fingering pattern charts. The ability to see the hand and finger positions in the videos which accompany my fingering pattern charts (Videos 10, 11, and 13-15) may serve to aid composers who wish to use microtones in musical sequences.

4.2.3 Redgate: new work

At the point of writing, the collaborative process which I hope will lead to Redgate's first solo bass clarinet work is still taking place. After Redgate received my 31-tone fingering pattern chart (Appendix D), he came back to me with a series of scales he had prepared, and he asked me to record these as a reference for him.

In his series of scales the composer had included D𝄳3 and G♯3 (31-tone), notes for which I have yet to find suitable fingering patterns. Redgate appeared unphased by the missing pitches and said that: "it doesn't matter about the missing pitches, as I can also use transpositions to avoid them if need be" (R. Redgate, personal communication, December 14, 2016). I therefore recorded the scales (leaving out the unavailable pitches).

Redgate said the recordings were "extremely useful, as it was just important for me to hear how they sound" (R. Redgate, personal communication, December 14, 2016). His comments once again made me realise the relevance of including recordings of my newly found microtonal fingering patterns. In the future, as a direct result of this research, composers will have access to extensive audio and video information to aid their compositional process.

Work on the piece continued and on April 10, 2017 Redgate wrote:

> Work is going well on the piece, but I just wanted to start checking a few things with you. I've attached a page from the score and I wanted to see how feasible this kind of passage is, before I go any further. (R. Redgate, personal communication)

Redgate indicated that "the tempo at this point is pretty much as fast as possible" (R. Redgate, personal communication, April 10, 2017), but the complexity of the 31-tone fingering patterns largely dictates which tempi are feasible. Therefore, I decided to annotate the score (Figure 88) with rough indications of the tempo at which different combinations of fingering patterns were possible.

- VS - very slow
- S - slow
- M - medium
- F - fast
- VF - very fast

I also included two additional markings:

- '- leg.' to indicate that legato playing is not possible
- 'imp.' to indicate that certain pitch sequences are not possible

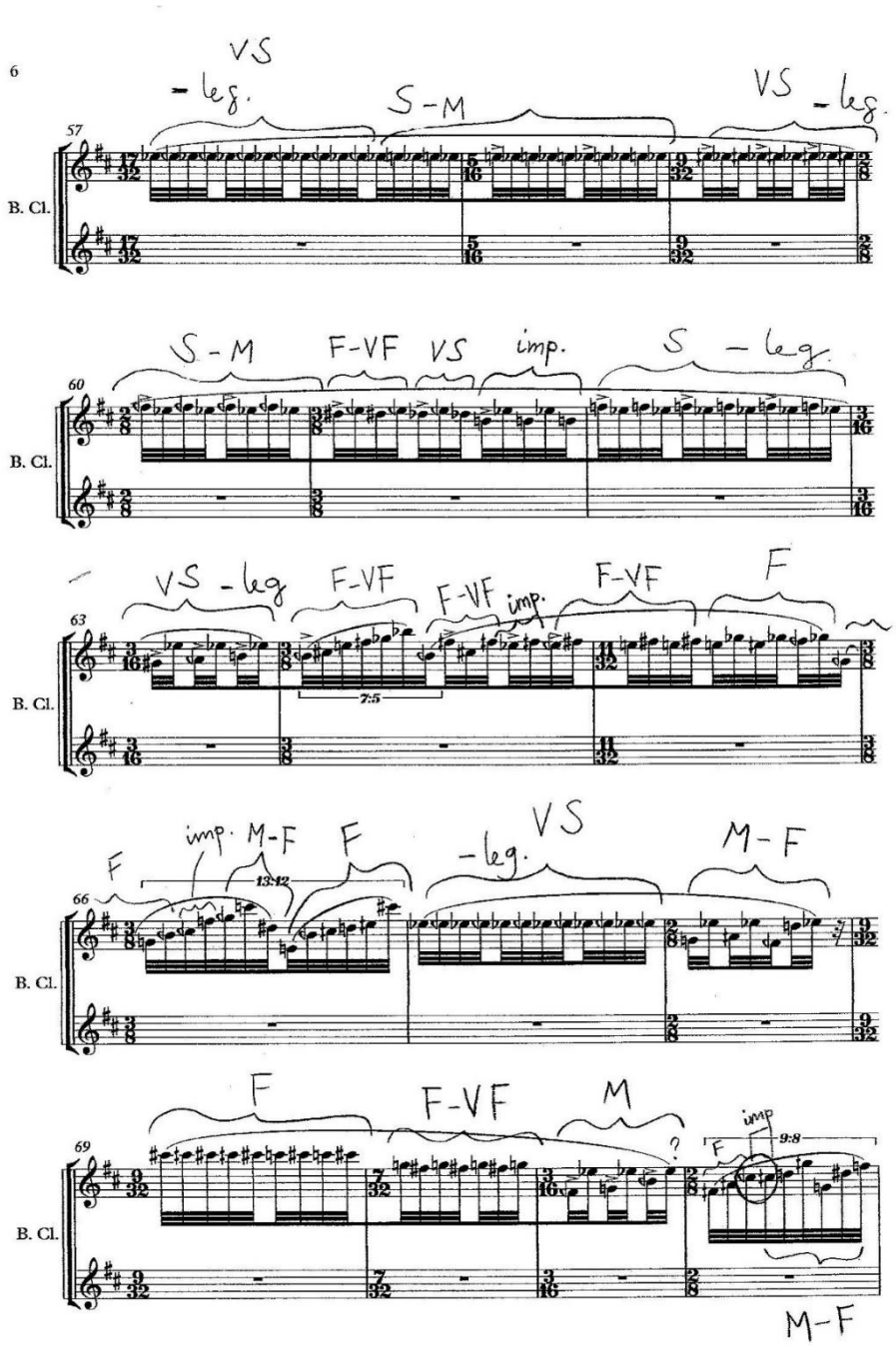

Figure 88: Redgate, bars 57-72 from the score for bass clarinet solo with my annotations

I elaborated that the ‘culprit’ of many problems regarding both the speed at which any given passage (Figure 88) could be played and whether it could be played legato, is E♭3 (31-tone).

> To go from the E♭3 in bar 57 to the second note I have to bring my right hand thumb back from the upper joint (key 13) to the lower joint in order to press key 2. This makes legato impossible and slows down the tempo dramatically, which is not what you want. (H. Bok, personal communication, April 14, 2017)

As E♭3 was quite a central pitch I explained about the double role of the right hand thumb in my microtonal fingering patterns: operating the three keys at the back of the instrument’s lower joint (keys, 1, 2, and 4a), and as an additional digit to operate the upper joint side keys (keys, 10, 11, 12, and 13). The limitations of how quickly the right hand thumb can make this ‘jump’ between lower and upper joint is similar to the issue that Laufer and I had to work through during the collaborative process for *verse & refrain*.

On April 15, 2017 Redgate sent me a second sample page from the score in progress, this time a page combining 31-tone intonation with quartertone writing (Figure 89).[65] I again annotated the score before replying to him.

[65] In Redgate’s score the upper stave is reserved for 31-tone writing and the lower stave for quartertone writing.

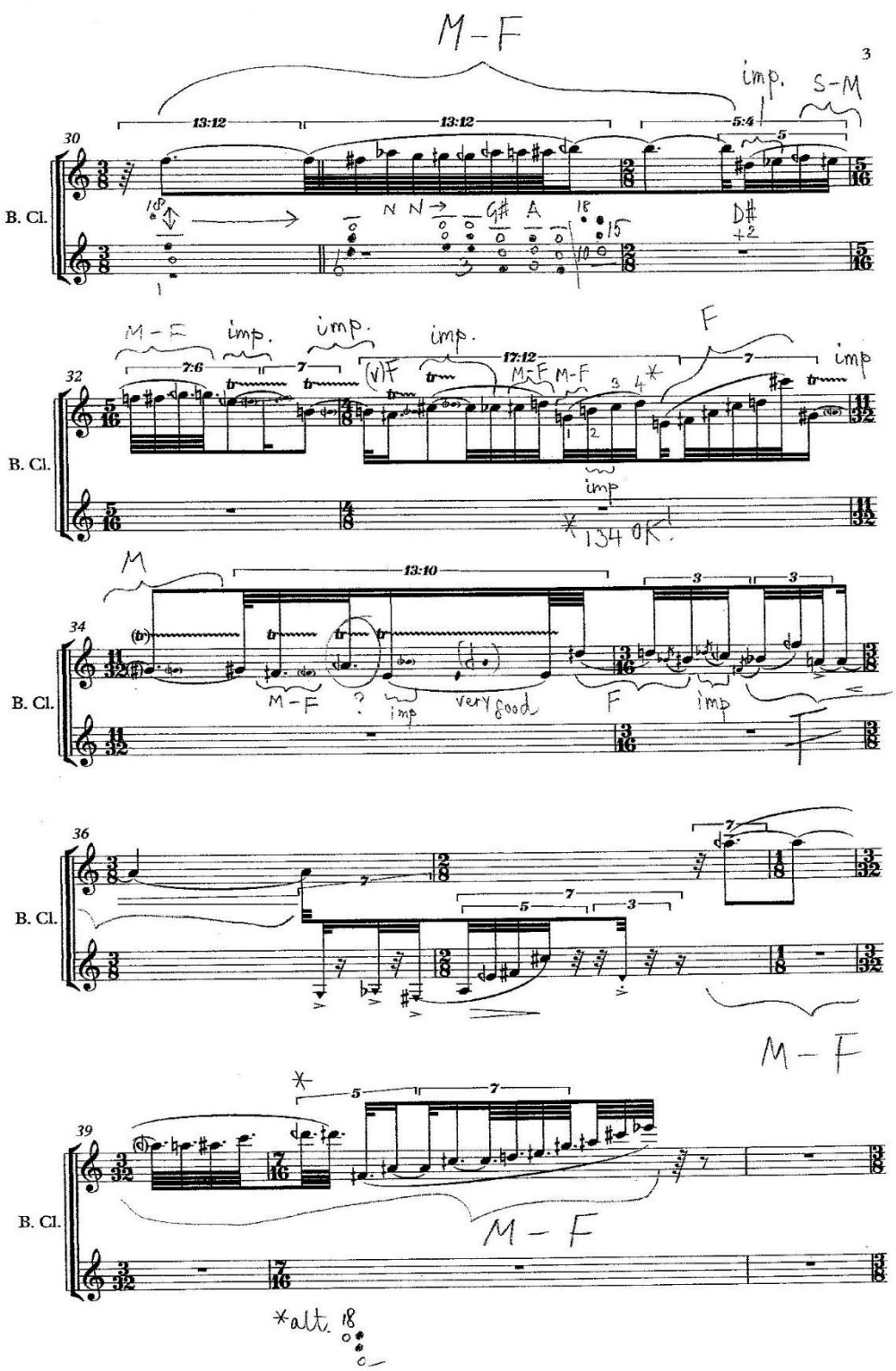

Figure 89: Redgate, bars 30-41 from the score for bass clarinet solo with my annotations

Challenged by the composer's wishes, and not wanting to give in without trying all the alternatives I could think of, I even discovered an additional fingering for the first pitch in bar 40, so that I would be able to play the sequence legato.[66]

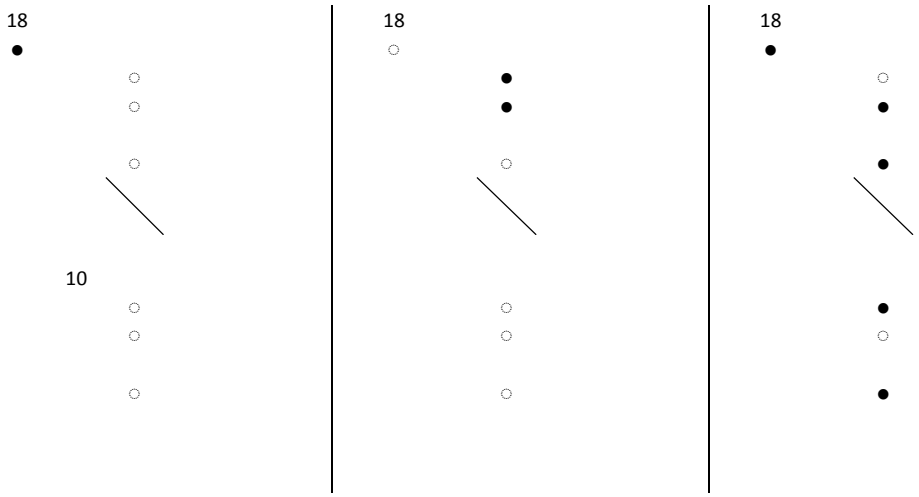

Figure 90: Fingering pattern sequence for C4, D𝄲4, and D𝄳4 (31-tone) in Redgate, bars 39-40

Informed by my feedback, Redgate used transposition to change the problematic E♭3 (31-tone) pitch on sample page 6: "I'm happy to change pitches, as it's not so prescriptive, but based around combinations of various scales" (R. Redgate, personal communication, April 15, 2017). Following this, the composer sent me revised versions of both sample pages which showed that I had managed to sufficiently communicate the difficulties specific to microtonal bass clarinet playing, making him comment: "I don't mind the technical stuff – it helps me understand the practicalities of the fingerings" (R. Redgate, personal communication, April 25, 2017).

Redgate's words led me to an important conclusion: coming up with fingering patterns which fit in the set parameters (of this research) does not necessarily mean that they can be used at the composers' free will. The practicalities of the fingerings also have to be understood. Explaining the instrument's keywork and

[66] The newly discovered fingering pattern is written in on the annotated version of the sample page.

the (extended) use of the digits for microtonal playing to all three composers led to a better understanding of the combinability of fingering patterns for 31-tone intonation and resulted in fewer problems in the scores. Whilst it is difficult to indicate the consequences of combining every single fingering pattern, especially when different microtonal tuning systems are merged in one piece, it is hoped that the additional information regarding unusual finger and thumb positions, which has been included in the fingering pattern charts (Appendices B-F) and can be seen and heard in Videos 10, 11, and 13-15, will aid composers in their microtonal writing for the bass clarinet.

4.2.4 The use and combinability of fingering patterns from Appendices D, E, and F

As mentioned before (see section 4.1.2), after establishing the Huygens-Fokker 31-tone fingering pattern chart (Appendix D) I have been able to further refine the data, in two steps; establishing a second version of my 31-tone scale (Appendix E) and finally coming up with a third version, my definitive 31-tone scale (Appendix F).

In any situation involving the Fokker organ only the fingering patterns found in Appendix D are valid. In other situations, especially in the case of solo pieces, the different sets of fingering patterns could become a (personal) dilemma, creating an almost ethical issue. When Téhéricsen, Laufer, and Redgate started writing their solo pieces for this research project, I shared the fingering patterns included in Appendix D with them, as it was the only information available at the time. Of the 76 pitches contained in Appendix D, 13 were standard fingering patterns, nine of which could be resolved and refined in Appendix E.

An issue which became very important during the collaborative process with the three composers was the combinability of sequences of fingering patterns. The lack or difficulty of fingering pattern combinations led to a substantial number of performance issues, as seen and discussed in sections 4.2.2 and 4.2.3. The importance of this matter led me to include additional information on the combinability of pitch sequences and the alternative use of digits, the right hand thumb in particular, in Appendices E and F.

However, the use of more refined 31-tone fingering patterns, such as those included in Appendices E and F, could present combinability issues which were not there in the original fingering pattern chart (Appendix D).

For example, with the 31-tone fingering patterns found in Appendix D, the transition between C𝄲3 and C3 could be played legato (Figure 91).

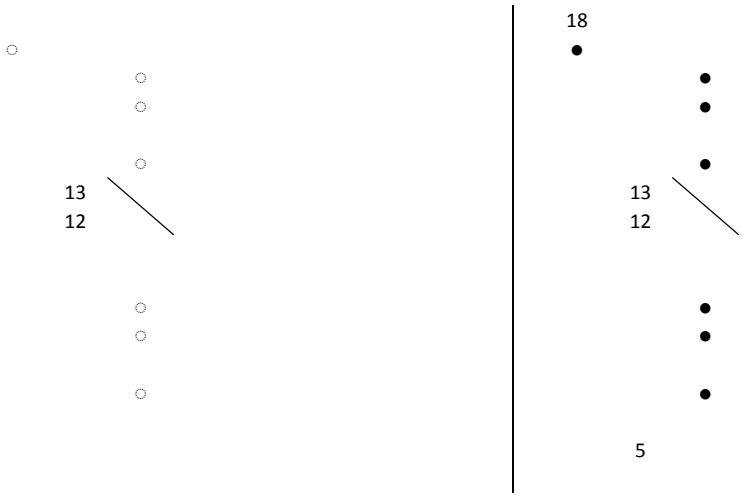

Figure 91: Fingering patterns for C𝄲3 and C3 in Appendix D

However, the same sequence played using the more precise fingering patterns found in Appendix E, would cause an articulation problem: a legato sequence is not possible due to keys 12 and 13 both being operated by the right hand index finger (Figure 92).

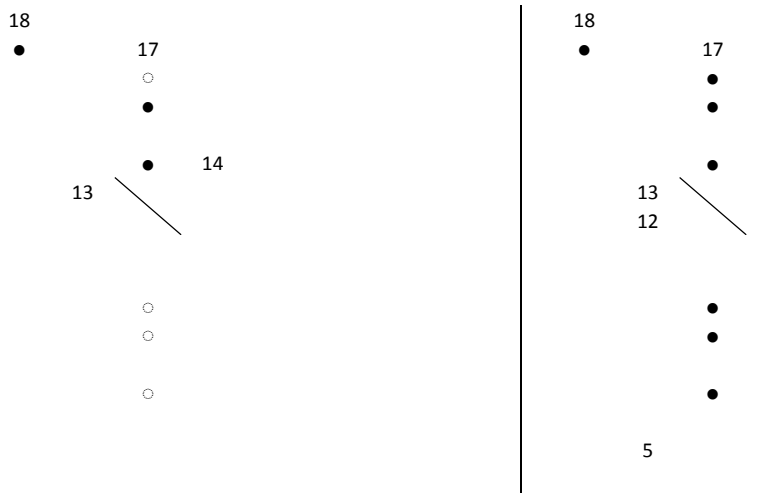

Figure 92: Fingering patterns for C♯3 and C3 in Appendix E

Informed performance choices have to be made, in this case between the more precise pitches or the legato possibility. Generally, adopting a pragmatic attitude regarding which fingering patterns should be used seems to be a good approach. This is, of course, somewhat easier in a solo work than in an ensemble setting.

However, pragmatic solutions are dictated by the options found by the knowledgeable performer and the concrete possibilities offered by the research data. Available options are more limited in the case of ensemble playing as different criteria have to be applied when making decisions.

The extensive video material which accompanies this chapter elucidates the information found in the fingering pattern charts, to aid players and composers in their use of fingering patterns from the different appendices.

4.2.5 Own compositions

4.2.5.1 Bok: *Homage*

Although I have included microtonal elements regularly in my solo bass clarinet works, I have only more recently started to use 31-tone intonation, inspired by the fingering patterns I was able to find and document for this research.

In *Homage*, written in May 2016, the first 31-tone section is placed right in the middle of the piece (bars 8 and 9) and the second section right at the end (bar 13), just before the final bar. Both 31-tone sequences are meant to be important 'ear catchers'. They effectively 'stretch' the distance between E2 and G2 by using even more notes within this range (E2-G2) than the quartertone series in the preceding bars (see also Figure 74).

Figure 93: Bok, *Homage*, bars 8-9

Audio example 11: Bok, *Homage*, bars 8-9

Following the discussion about the choice of fingering patterns (see section 4.2.4), two of the nine pitches in bar 8 only have one option (E2 and F♯2), as the fingering patterns are the same in Appendices D, E, and F. For the pitch F2 I have chosen to use the Appendix D fingering pattern, which coincides with the standard fingering pattern for F2, as the more precise option, found in Appendix E, makes the transition to F♯2 very complicated. However, for G♭2, G𝄲2, and G2 I opted for the more precise fingering patterns found in both Appendices E and F. This avoids using a fingering pattern which is the same in both Appendix B (G𝄲2, quartertone scale) and Appendix D (G𝄲2, 31-tone).

The next 31-tone section, in bar 13, repeats the sequence found in bar 8 exactly a twelfth higher which, due to the overblowing system of the bass clarinet, means it is a reiteration in overtones. Here I have chosen to stick with

my original (Appendix D) fingering patterns, for technical reasons. I composed the piece using Appendix D fingering patterns. When *Homage* is played using Appendix D fingering patterns, the sequence has a very logical development in finger placement, which makes it easier to memorize.

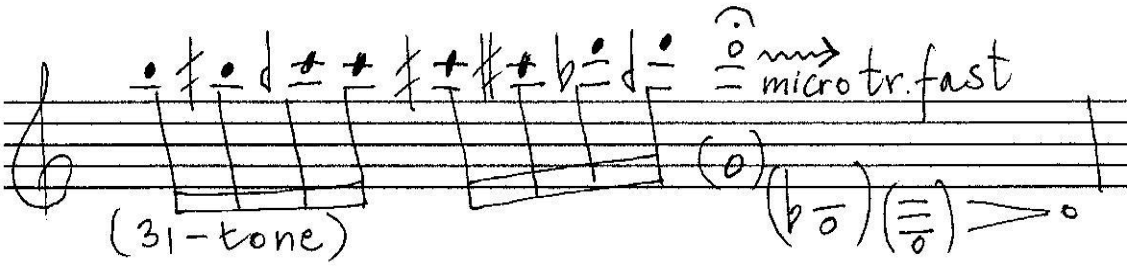

Figure 94: Bok, *Homage*, bar 13

Audio example 12: Bok, *Homage*, bar 13

4.2.5.2 Bok: *GIANT nano Steps*

In *GIANT nano Steps*, written two months after *Homage*, I pay tribute to two icons of music history, jazz saxophonist John Coltrane and American composer Elliott Carter. One of Coltrane's most famous compositions is called *Giant Steps*, and Carter wrote an important bass clarinet solo piece called *Steep Steps*.[67] The 'nano' element of the title refers to my microtonal take on Coltrane's and Carter's music, an initial 'step' in my 31-tone writing.

Bar 21 of my piece contains a short quote from *Steep Steps*, marked in orange on the score (Figure 95). I use this quote as a pivot note to start the opening lines of *Giant Steps* (marked in green on the score). However, I immediately repeat the melody of bars 22-28 in bars 29-32, but this time rubato and in 31-tone intonation, creating a moment of suspense and alienation. I believe that the 31-tone section in *GIANT nano Steps* is effective, as relating it to a well-known melody (from the jazz world), makes the perception of the microtonal variant much stronger.

[67] *Steep Steps* will be analysed in section 5.2.2.

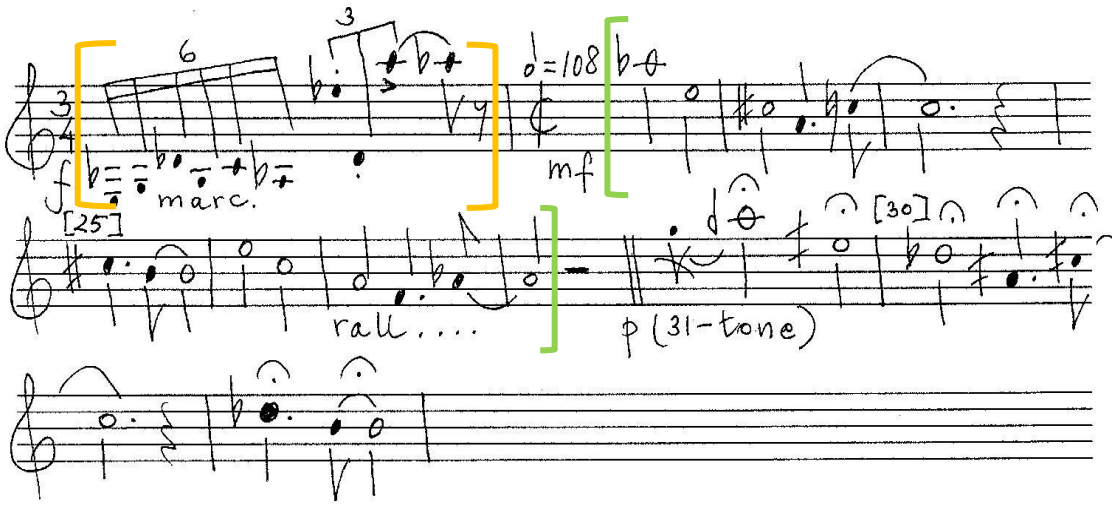

Figure 95: Bok, *GIANT nano Steps*, bars 21-32

Audio example 13: Bok, *GIANT nano Steps*, recording of bars 21-32

4.2.5.3 Bok: *Microclimate I*

Microclimate I for two bass clarinets was written at the end of 2015 and dedicated to my Duo Clarones partner Brazilian bass clarinettist Luis Afonso, generally known as 'Montanha'. The compositional content of the piece comprises quartertones, microtonal trills, multiphonics (type 1 and type 2), root-overtone microtonal variants, and key clicks. In 2017 I revised the score, changing several quartertone sections into 31-tone sections, as I felt the sonic outcome would benefit from that.

A challenging section, in which 'false fingerings' are used in octaves starts at rehearsal letter E. The 'false fingerings' (indicated in the score by square note heads), are in fact all 31-tone fingering patterns, and I wanted the octave pitches to match completely.

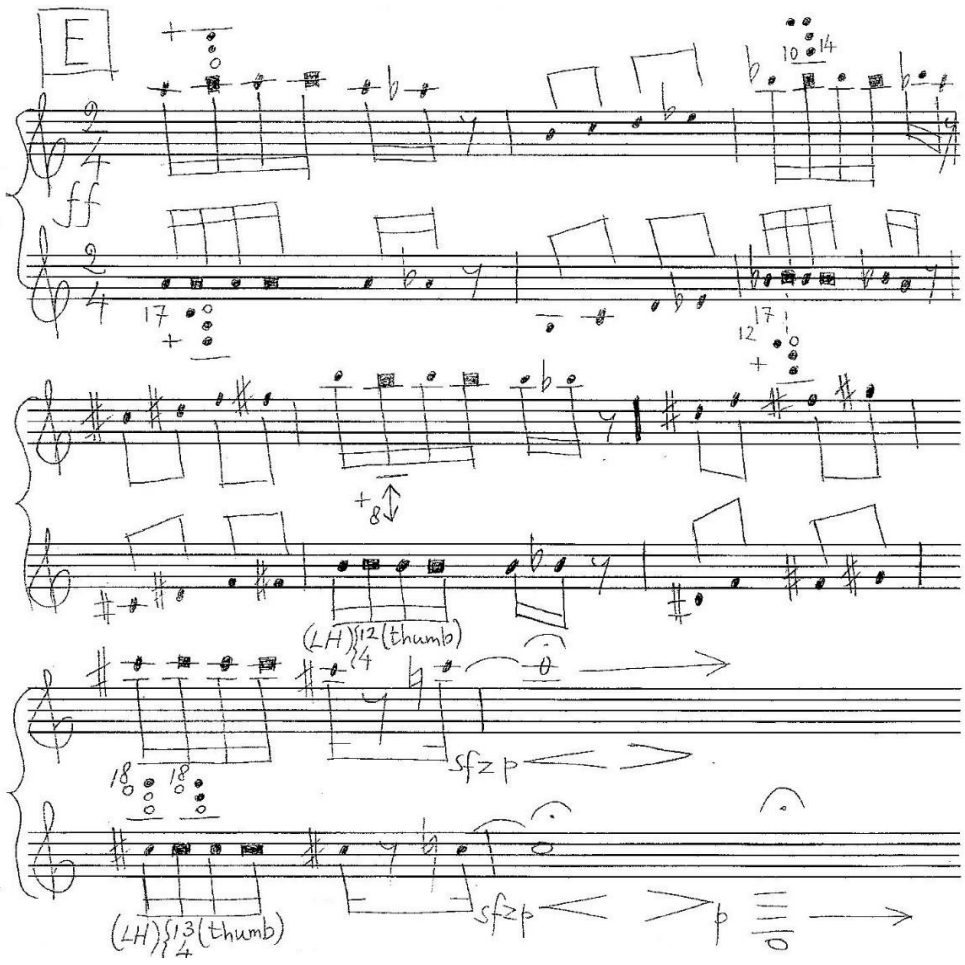

Figure 96: Bok, *Microclimate I* for two bass clarinets, E bars 1-8

Since my duo partner Montanha is not used to playing this kind of extreme microtonality, I included all the fingering patterns in the score, but during the preparation and rehearsal process with Montanha, I noticed that microtonal playing involves much more than learning some new fingering patterns. A player's mindset has to be different when learning whole series of unusual fingering patterns and getting the ear accustomed to different tuning systems.

As a result of my work with Montanha I decided that a video, in which I explain my own practice when playing 31-tone music, would potentially better enable other bass clarinettists to adopt this tuning system than fingering patterns alone (Video 16).

4.2.5.4 Bok: *smaller change*

My most recent piece, *smaller change* (2017), can be considered an artistic summary of my research into the microtonal possibilities of the bass clarinet so far.

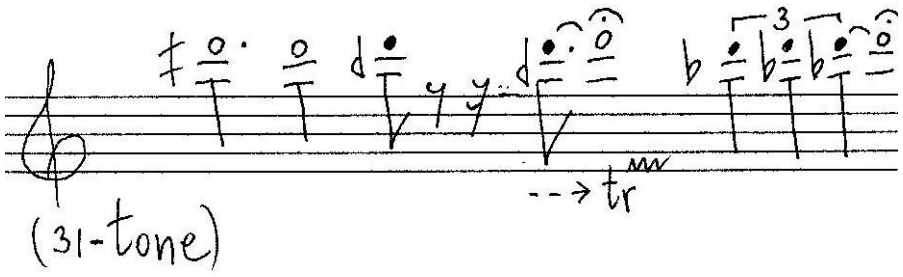

Figure 97: Bok, *smaller change* for solo bass clarinet, 31-tone section

The 31-tone section of *smaller change* uses the 31-tone fingering patterns from Appendices D, E, and F. The merits of mixing fingering patterns from Appendices D, E, and F were that I could create more '*shades of Dee*',[68] D4 being the binding factor of the composition. Having two sets of fingering patterns available for D𝄲4, D4, and D𝄳4 (from Appendices D and F respectively) gave me six fingering patterns to choose from. As I expanded the ambitus of my 31-tone fingering pattern chart to three full octaves (Appendices E and F), D𝄲5 and D5 also became available. Using these eight fingering patterns I was able to avoid combinability issues. An example of this is the third pitch in Figure 97, D𝄲4, for which I chose the original fingering pattern—found in Appendix D—because it could easily be changed into the trill I wanted. The more precise fingering pattern found in Appendices E and F could not be used to the same effect.

Audio example 14: Bok, *smaller change* for solo bass clarinet, recording of 31-tone section

[68] This is the title of the bass clarinet and piano version of *smaller change*.

4.2.5.5 Bok: *small change*

The predecessor to *smaller change*, *small change*, which represents my first ensemble piece containing structural 31-tone writing, was composed in 2016 for duo Hevans. My previous 31-tone work had been with Evans, a player equally at home in microtonal tuning systems and as preoccupied with pushing boundaries as myself. Therefore, I found duo Hevans an ideal ensemble to write for.

The piece opens with an eight bar phrase which is subdivided into three sections. The first section is a three bar exposition in semitonal writing. The bass clarinet part covers a diminished octave (commonly referred to as a major seventh)—from G♯1 to G2—which the tenor saxophone doubles one octave higher. It is followed by a three bar variation in quartertones,[69] and the eight bar phrase ends with a two bar extension based on the second bar of the exposition (Figure 98).

[69] Most of this section (marked in green) comprises heterophonic writing except for the last quintuplet, which is an example of polyphonic microtonal writing.

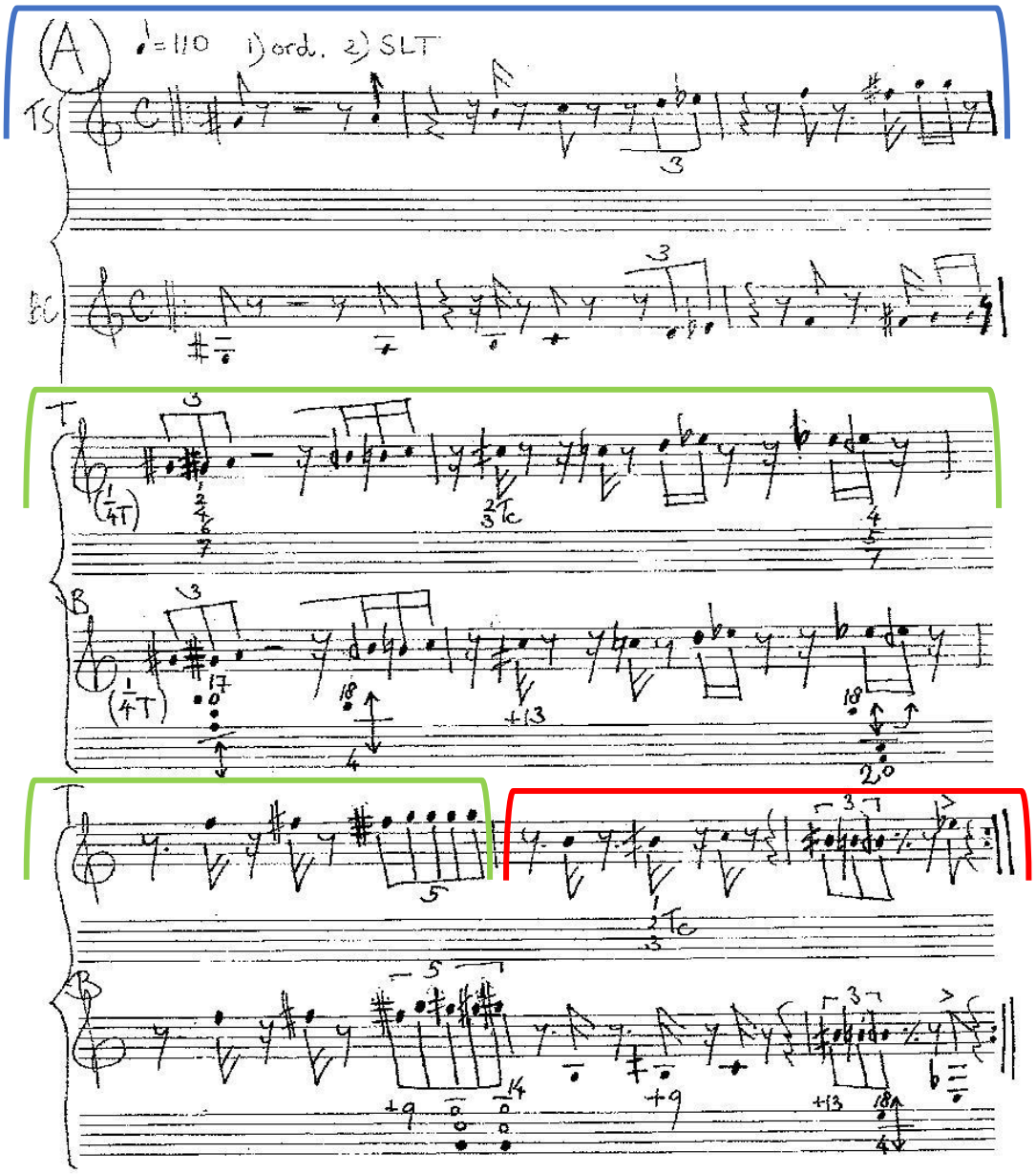

Figure 98: Bok, *small change* for tenor saxophone and bass clarinet, bars 1-8

The second eight bar section, section B, is an elaboration of the material presented in the first eight bars, this time in 31-tone intonation. The phrase starts in unison for the first four pitches (heterophony), after which the two instruments drift away from each other (polyphony), in the beginning only one

31-tone pitch apart but gradually growing wider apart before occasionally meeting in unison again.

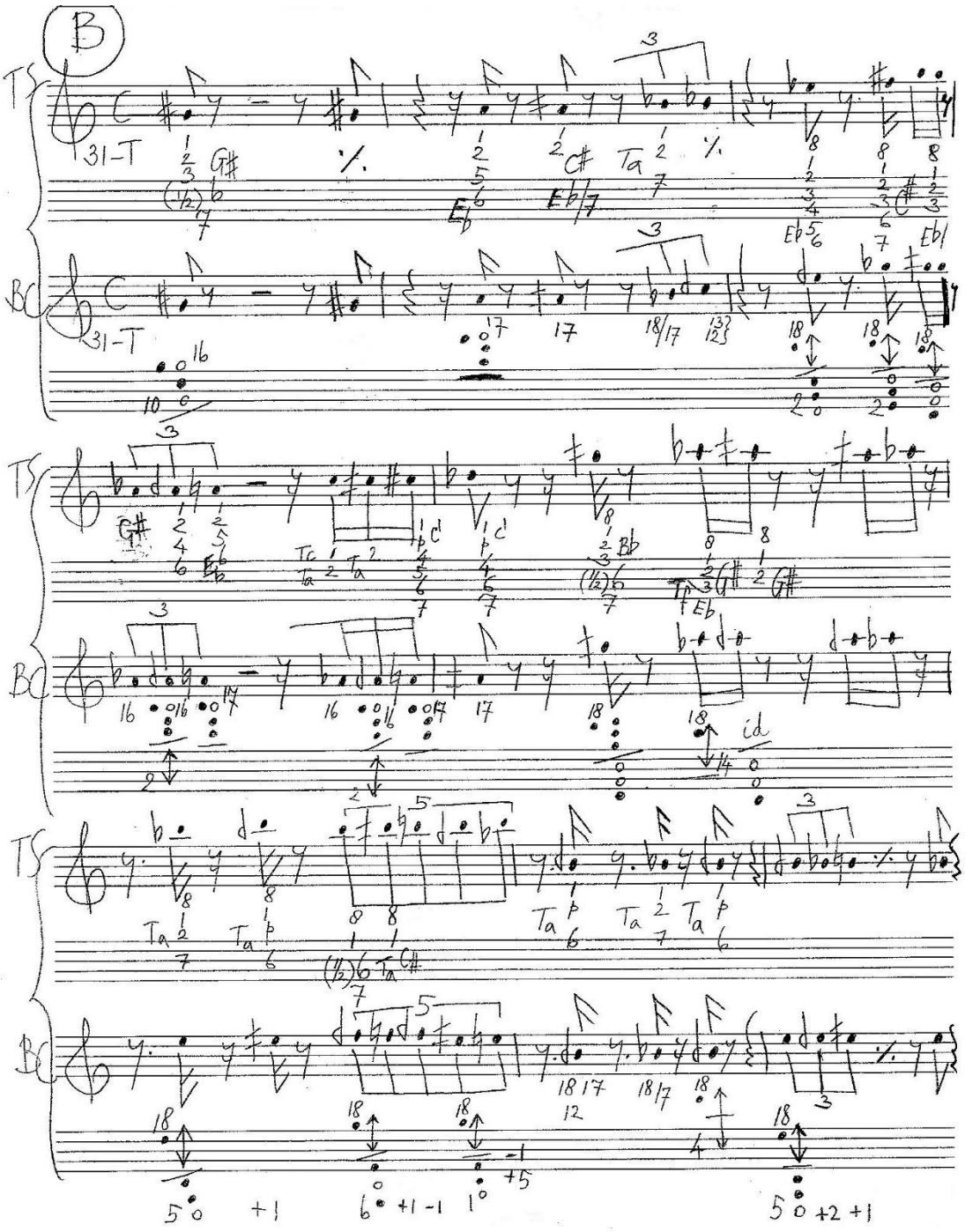

Figure 99: Bok, *small change* for tenor saxophone and bass clarinet, section B (bars 9-16)

As a bass clarinettist I am able to identify fingering pattern combinations which are hard to play and categorize them as either ‘difficult’ or ‘impossible’. Whilst I regularly include ‘difficult’ fingering pattern combinations in my own compositions, my knowledge of the instrument means that I am able to avoid the ‘impossible’ fingering pattern combinations. As a result, for me, the compositional process with such new, different fingering patterns has fewer pitfalls than for composers who do not have an intimate knowledge of the bass clarinet.

Taking into account the differences between the two single reed instruments with regard to intonation, response (attack), and dynamics, when playing microtonally, and looking at the preciseness of pitch control, these passages can only be successfully performed when the musical partners do not only know their own instrument well, but also the instrument of the other person. My knowledge of the saxophone, as a former player, supports my compositional choices for this combination of instruments. Despite this, I do not solely rely upon my own knowledge of the saxophone for such microtonal composition, but also upon the workshop style rehearsals of duo Hevans, where scores are not presented as final versions, but as material to be tried and discussed.

Audio example 15: Bok, *small change* for tenor saxophone and bass clarinet, recording of section B (bars 9-16)

4.3 Summary and conclusions

Initially inspired by the possibility of duo Hevans performing with the 31-tone Fokker organ, Evans and I were challenged to find 31-tone fingering patterns for our respective instruments. At the end of our research we were able to document more than two octaves of 31-tone fingering options (Appendix D). The next step in developing my fingering patterns was to try to expand the ambitus of the 31-tone area on my instrument, so that composers would have more possibilities to choose from when writing 31-tone music. As the data shows, I was able to extend the ambitus to three octaves, from D2-D5 (Appendices E and F). Apart from the extension of the range I aimed at greater accuracy: the goals I set myself for this development could be met, as two subsequent versions of my 31-tone fingering pattern chart, which each represent a step towards greater precision, could be established (Appendices E and F).

Having shared my newly found 31-tone data with several composers I discovered that the most frequently recurring issue, regarding the use of my fingering patterns by composers, was that of combinability. The 'culprit'—the finger responsible for many of the combinability issues—was the right hand thumb. This is due to its double role in many microtonal fingering patterns. To aid composers in their use and understanding of my microtonal fingering pattern charts I have therefore since added any necessary information about finger position in the Appendices. Videos of the scales have also been added, so that players and composers can hear the pitches, whilst seeing the corresponding fingering patterns (Videos 13, 14, and 15). Finally, to aid other performers, I have also included a short video about the core elements of 31-tone playing on the bass clarinet (Video 16).

Video 16: Summary of the core elements of 31-tone playing on the bass clarinet