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

CHAPTER 3

Microtones: equal divisions of the tone

3.1 Introduction

The term microtone refers to any division of a tone which is smaller than a semitone. Equal divisions of a semitone result in quartertones, eighth-tones, and so on. The distance between two semitones is 100 cents, which means that the distance between two quartertones is 50 cents and the distance between two eighth-tones is 25 cents.

In the literature both protagonist and antagonist views can be found regarding the bass clarinet's microtonal suitability. In his *Harmonielehre* Schönberg wrote: "Jedenfalls erscheinen Versuche, in Viertel- oder Dritteltöne zu komponieren, wie sie hie und da unternommen werden, mindestens solange zwecklos, als es zu wenig Instrumente gibt, die sie spielen könnten" (1922, p.26).[29] Both Bartolozzi (1982, p.26) and Sparnaay (2011, p.123) use this quote in their writing about quartertones, but for different reasons. Sparnaay to discourage players and composers from using microtonality on the bass clarinet,[30] Bartolozzi, however, to unveil "possibilities woodwind instruments offer in producing organized successions of sounds which are closer together than the semitone" (1982, p.26). Bartolozzi not only acknowledges the microtonal possibilities of woodwind instruments, he also encourages players and composers to do research into these possibilities.

> Seeing that woodwind can emit sounds which are less than a semitone apart, these developments must be examined, and it is evident from the outset that their possibilities are considerable, since woodwind can play intervals as small as one-eighth of a tone and one-sixth of a tone as well as the third- and quarter-tones already mentioned. (1982, p.27)

Bartolozzi published the first edition of his book in 1967 and, since this point in time, the bass clarinet has benefitted from a number of technical improvements. It is my aim in this chapter to exploit the microtonal possibilities of the current

---

[29] "Anyway, attempts to compose in quartertones or third-tones, as are being undertaken here and there, seem pointless, at least as long as there are too few instruments which would be able to play these" (Schönberg, 1922, p.26).

[30] "The contemporary bass clarinet has not been adapted in this way and I think this is fortunate and for me, Schönberg's statement is still completely valid for the bass clarinet" (Sparnaay, 2011, p.123).

bass clarinet further, and to try to find fingering patterns which enable the performer to play quartertones and eighth-tones.

3.2 Quartertones

A quartertone is "the distance between two tones which are one-half of a semitone (half step) apart" (Cope, 1973, p.124). The bass clarinet has been constructed with keywork that allows the production of semitonal steps. The keywork of the instrument does not always allow for microtones, but despite this it is possible to play many successions of quartertones on modern bass clarinet models.

According to American (bass) clarinettist E. Michael Richards "the quarter-tone is a logical rather than acoustic extension of the chromatic scale" and "in the practice and theory of a variety of Asian musics, for example, where microtonal intervals are employed, exact quarter-tones do not exist" (1995, p.30). However, in 'Das System der Aliquottöne und das temperierte System der Viertel-, Sechstel- und Zwölfteltöne' Hába explains the working of the harmonic series (2007, pp.92-102).[31] He shows that, very high up, the distances between the succeeding overtones get narrower and narrower, resulting in third-tones (25:26), fourth-tones [quartertones, HB] (34:35), sixth-tones (51:52), eighth-tones (68:69), and twelfth-tones (103:104).[32] Hába therefore demonstrates that extremely small microtonal intervals are contained in the natural acoustics of instruments. This form of microtonality, which is inherent to the bass clarinet, opens up additional possibilities for microtonal playing by using root-overtone fingering patterns, the subject of Chapter 5. In this chapter, however, my aim is to show that by using corrupted fingering patterns both quartertone and eighth-tone scales are possible. In the next sections existing fingering patterns for quartertone playing will be critically scrutinized for their accuracy, with the aim of establishing my definitive quartertone fingering pattern chart at the end of the process.

[31] 'The overtone system and the tempered quartertone, sixth-tone and twelfth-tone system' (Hába, 2007, pp.92-102).
[32] The numbers in parentheses are the ratios.

3.2.1 Existing literature

3.2.1.1 Notation

One of the recurring issues for both performers and composers is how to notate, read, and understand microtonal pitches. When the number of symbols needed for notation increases, so does the complexity of notational systems, often leading to confusion. In the case of quartertones, notation could still be relatively simple, as essentially only one additional symbol is needed between two semitones. However, as shown in Figure 34, many notational varieties can be found in existing sources. As can be deduced from the data, not only the graphics of the symbols vary quite a lot, but also the number of symbols used: from just two in the case of Richards, Sparnaay, and Villa Rojo,[33] to six in the case of Rehfeldt.

[33] Jesús Villa Rojo is a Spanish clarinettist, composer and scholar.

Source	¼ sharp	¾ sharp	¼ flat	¾ flat
Alder (2013)	𝄲	♯	𝄳	𝄳♭
Bartolozzi (1982)	𝄲	♯	♭	
Bok (2011)	𝄮	𝄰	𝄯	𝄭
Hába (2007)	♭	♯	𝄳	
Rehfeldt (2003)	𝄬 𝄮 𝄰		𝄭 𝄯 𝄱	
Richards (1995)	𝄲	♯		
Sparnaay (2011)	𝄮	𝄰		
Villa Rojo (2003)	𝄲		♭	

Figure 34: Symbols used for quartertones in eight sources

An additional source, British clarinettist Sarah Watts (2015), uses a form of notation which is near identical to Rehfeldt's notation. However, Watts' use of arrows is not to indicate exact quartertone pitches: "dissecting notes into notated quarter and eighth tones may result in inaccuracies and further confusion" (2015, p.32). Therefore, in Watts' notation system "an arrow pointing downwards indicates that the note is sounding below pitch and an arrow pointing upwards indicates that the note is sounding above pitch" (2015, p.32).

Source	Below pitch	Above pitch
Watts	♭↓	♭↑
	♮↓	♮↑
	♯↓	♯↑

Figure 35: Symbols used by Watts (2015)

Watts is not the only person who uses a notation with arrows to indicate ‘slightly higher’ or ‘slightly lower’: quite a number of composers also use this kind of notation to indicate more approximate microtonal pitch variations.[34] As the aim of this study is to enable the playing of precise microtonal pitches, this system of arrows will not be studied further.

3.2.1.2 Fingering patterns

Whilst Figure 34 shows examples of the way the reviewed sources notate microtonal pitches, a second aspect of notation involves the way in which the new fingering patterns are denoted. As these are dependent upon the type (for example, German or Boehm system), make (for example, Selmer Paris or Buffet Crampon), or even model (for example, old versus new Selmer Paris), it is of the utmost importance to include this information. This essential information is, though, missing from several of the sources studied here. For example, Rehfeldt (2003) does not present a clear fingering diagram for the bass clarinet, therefore we have to guess at the specific key nomenclature. Neither is there any information on the type and make of bass clarinet used to verify the fingering patterns. What can be deduced from Rehfeldt’s writing is that most likely a French bass clarinet make has been used, taking into account the keys indicated in the fingering patterns, which are missing on German bass clarinet models. Like Rehfeldt, Richards (1995) does not include a diagram of his key nomenclature system: the diagrams in the tables found in the book have to be filled in by the reader, trying to make sense of a system which uses squares, lines, numbers, and letters.

[34] A further complication of this system is that arrows are also sometimes used to indicate the ‘highest’ or ‘lowest’ note of the instrument as detailed in Villa Rojo (2003, p.112).

A comparison of the different key nomenclature systems used by the existing sources, shows that almost the only thing they all have in common is the seven circles which indicate the left hand thumb, and the index, middle, and ring finger of both hands. The only exception is Richards, who uses squares instead of circles.

The notation of the remaining keys can be roughly divided into three categories: one which uses letters and/or numbers (Sparnaay, Figure 36), one which uses a diagram of the keys (Alder, Figure 37), and one which uses a hybrid of these two (Watts, Figure 38, see also Figure 44). Both Rehfeldt and Richards also use the hybrid system.

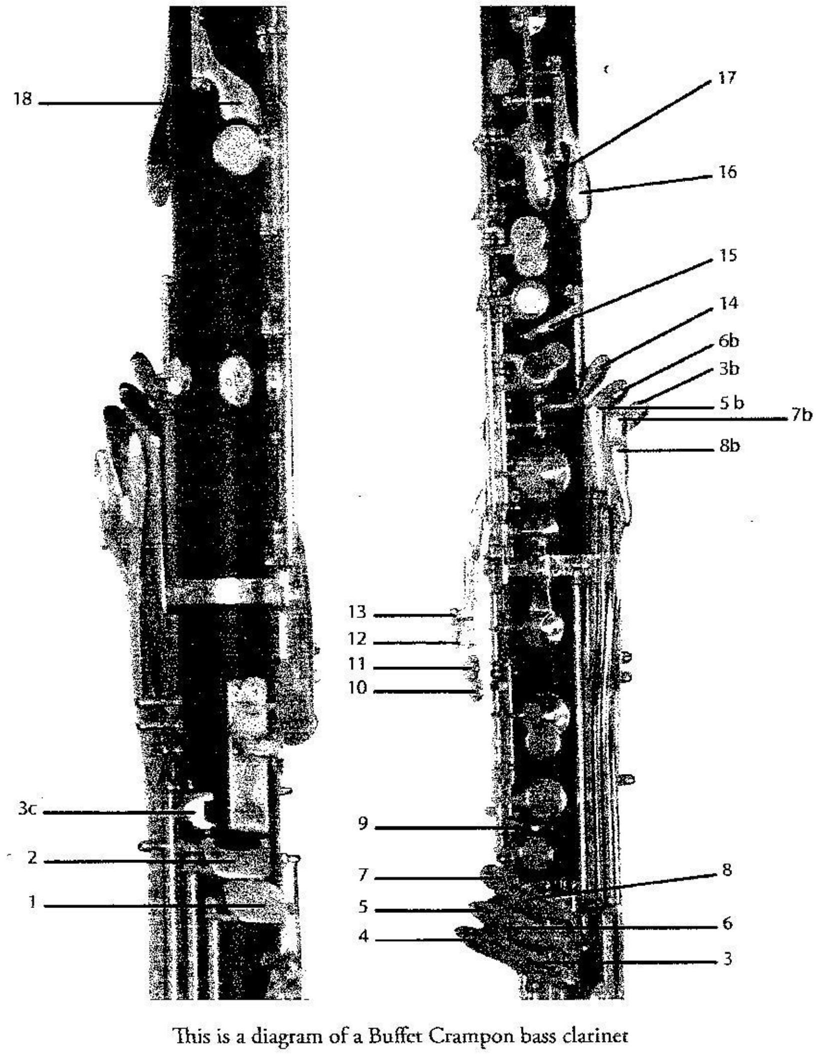

Figure 36: Sparnaay (2011, p.39), key notation system

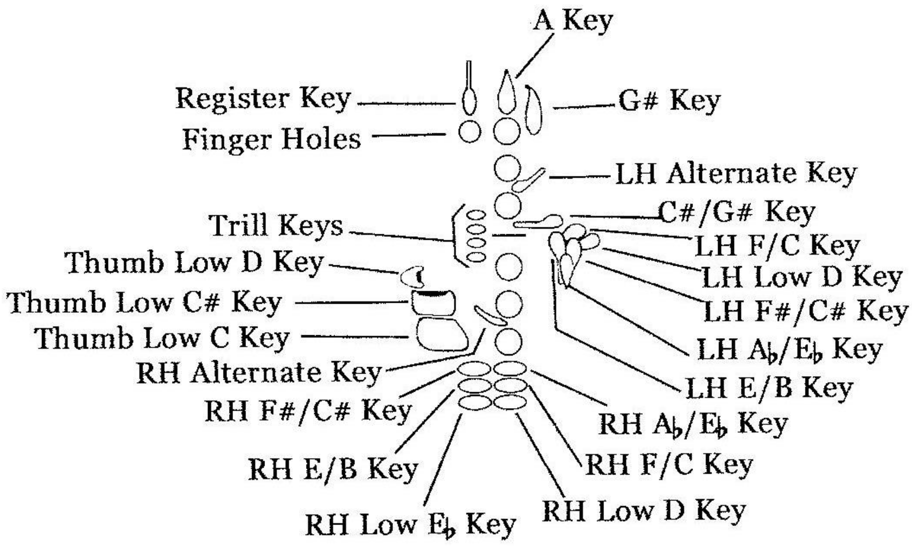

Figure 37: Alder (2013, p.iii), key notation system

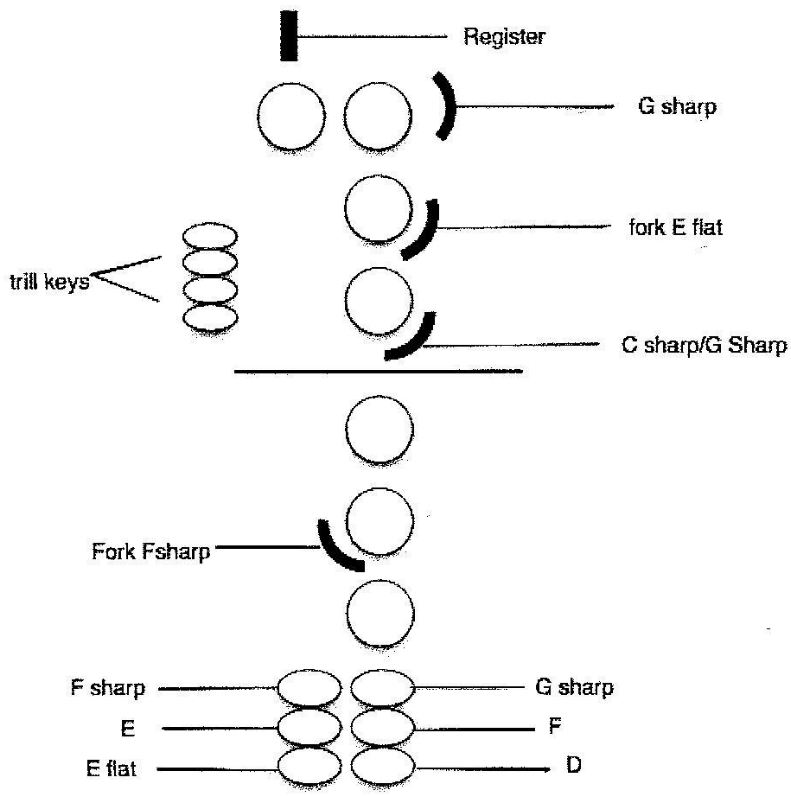

Figure 38: Watts (2015, p.83), key notation system

In Rehfeldt's hybrid system he uses pitch names to indicate keys. This has several disadvantages. Firstly, as the instrument overblows at the twelfth, the same keys are used to play different notes: for example, the F key (F1) is also the C key (C3). Secondly, the choice for sharps or flats, as enharmonic variants, seems rather aleatory. Whereas Rehfeldt calls key 16 'G♯', Richards calls key 16 'A♭' and calls key 8 'G♯' (Figures 39, 40, and 41).

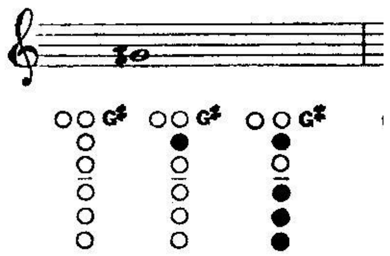

Figure 39: Rehfeldt (2003, p.34), fingering pattern for G♯2

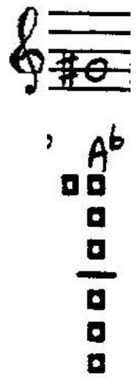

Figure 40: Richards (1995, p.32), fingering pattern for G♯2

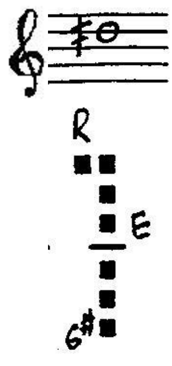

Figure 41: Richards (1995, p.32), fingering pattern for D♯3

An additional problem occurs, as some pitch names are used to label more than one key. For example, Rehfeldt uses the pitch name B♮ twice in his fingering diagram. He tries to differentiate between the two B♮ keys by adding 'tr' (trill) to the pitch name for just one of them (key 13 in my key nomenclature system). Nonetheless, it can be rather confusing to see the two 'B' keys pictured very close to each other and on the same side of the instrument.[35]

The only key for which Rehfeldt does not use the pitch name is the twelfth key or register key. He calls this key 'R', referring to 'register key'. Richards, whose system combines both numbers and pitch names to label the keys calls the same key, key '12', referring to the 'twelfth key'. In both Sparnaay's and my own key nomenclature system key '12' is one of the upper joint side keys. Richards, by contrast, refers to the four side keys at the right hand side of the upper joint as keys 1, 2, 3, and 4. I was, at first, confused when studying Richards' fingering pattern for F♯2 (Figure 42). This was partly due to the disparity of key naming systems and partly due to Richards' lack of explanation of his own key naming system. I initially read key '12', but subsequently realised that he was referring to two separate keys: key 1 and key 2 [key 10 and key 11, HB].

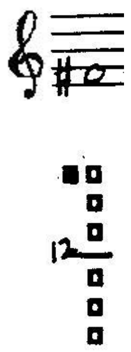

Figure 42: Richards' (1995, p.32), fingering pattern for F♯2

When I wrote *New Techniques for the Bass Clarinet*, the notation system I decided to use was a combination of the (seven) circles, commonly used in clarinet methods, and numbers. I assigned numbers to the keys according to the pitch they produce, rather than the position they have on the instrument. I decided to start with the lowest root fingering, C1, to which I assigned the

[35] For keys 9 and 15 Richards uses oblique lines, without adding any note names. This is very hard to read, especially when the key above is coloured black.

number '1', going up along the pitches and the placement of the keys, ending with the register key to which the number 18 was assigned (see my key nomenclature system).[36] In *Metodo per Clarinetto* Italian clarinettist Giuseppe Garbarino employs a similar notation system for clarinet, using circles and numbers. However, he starts numbering at the top and assigns the number '1' to the register key, then descends towards the lowest note on the instrument which is called number '18' (Garbarino, 1979, p.3). To me, it seemed and still seems, much more logical to start numbering at the bottom end of the instrument, as that is where the roots are. This also corresponds with Adolphe Sax's key numbering system (Dullat, 2001, p.88).

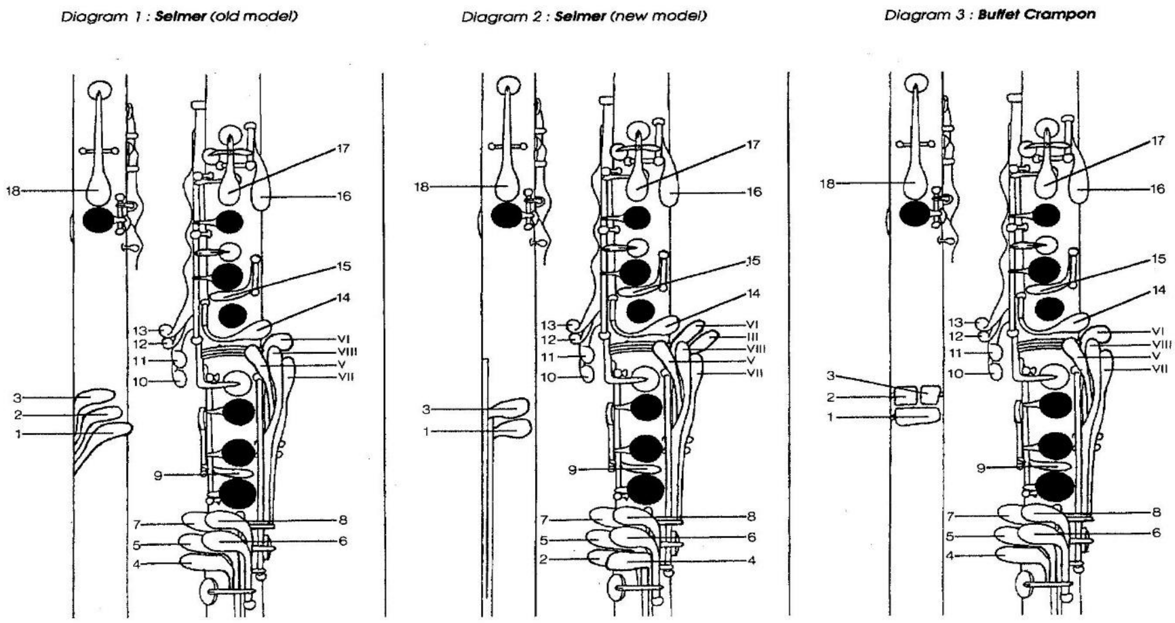

Figure 43: Bok's key notation system in *New Techniques for the Bass Clarinet* (2011, p.4)

For the pads which can be operated by either a left or a right hand key I used (corresponding) Roman numerals to label the left hand set of keys (Figure 43). For example, to play E1 either key 5 (right hand) or key V (left hand) could be used. I have since slightly adapted my system, by replacing the Roman numerals with an added 'a' to the Arabic numeral. For example, instead of 'V', I now use '5a'. Sparnaay adopted this system in his book (2011, p.39) with only

[36] Therefore, a 'short' bass clarinet going down to E♭1 starts with key 4.

two changes: he used ‘3b’-‘8b’ instead of Roman numerals to indicate the ‘doubling’ left hand keys, and ‘3c’ to denote the third D1 key, which the Buffet Crampon model that Sparnaay played possesses.[37] Since many composers already used the notation system I had introduced in my book, it is highly relevant that Sparnaay contributed to more uniformity in the key nomenclature of the instrument. As pitch and key number are connected in this system, all fingering patterns can be applied to any makes and models, therefore misreadings are reduced to the minimum. Whilst certain keys might be located in various positions on different bass clarinets, or might be missing altogether, the numbers which refer to different pitches remain the same.

Another advantage of this system is the relative ease with which a fingering pattern can be written down—in shorthand—in parts, scores, and etudes. Let us take E♭4 as an example. In certain musical contexts the preferred fingering pattern would be the ‘open’ fingering, which requires only key 16 to be depressed. In the systems used by Rehfeldt, Richards, Watts, and American clarinettist Jason Alder, whole diagrams would have to be copied into the score. As Rehfeldt and Richards have two G♯/A♭ indications, one at the bottom, one at the top, the player would still have to include the whole diagram in order to locate which one to use. With the circles and numbers system you can simply put ‘16’ in the score and it is unambiguously clear.

Whilst Alder and Watts both use drawings to represent the keys, and the names they assign the different keys are near identical (see Figure 37 and Figure 38), there are some differences, the most essential of which is the missing key in Watts’ fingering system: the ‘A’ key [key 17, HB] (2015, p.83).[38] Furthermore, the representation of keys 1, 2, 3, and 5a-8a is handled differently by the two sources. Whenever a fingering pattern uses key 1 or key 2 Watts puts the letters (C or C♯) in boxes to the left-hand side of the diagram, and whenever a left hand little finger key is prescribed, Watts puts the letter of the note written on the right hand side of the diagram. Alder relies solely on the drawing of the keywork system.

Various inconsistencies in her work detract from Watts’ system. As Figure 44 shows, in SW48 (2015, p.175)[39] Watts writes ‘e’ to indicate key 5a, whilst in

[37] This key, which is located at the back of the lower joint, has been changed to an alternative E♭1 on the new Tosca model.
[38] Whilst my research here does not specifically cover multiphonics, my investigations of microtonality on the bass clarinet have shown that multiphonics using the ‘A’ key [key 17, HB] do exist. Therefore, Watts’ negligence to include this key, limits the viability of her study.
[39] SW48 refers to Watts’ numbering system of multiphonics: Sarah Watts multiphonic number 48.

both SW52 and SW94—fingering patterns which include key 5a—the notation has been changed to an ‘E’ (2015, p.176, p.183). This is despite the use of capital letters in her key naming system being associated with the right hand thumb keys (1, 2, 4a).

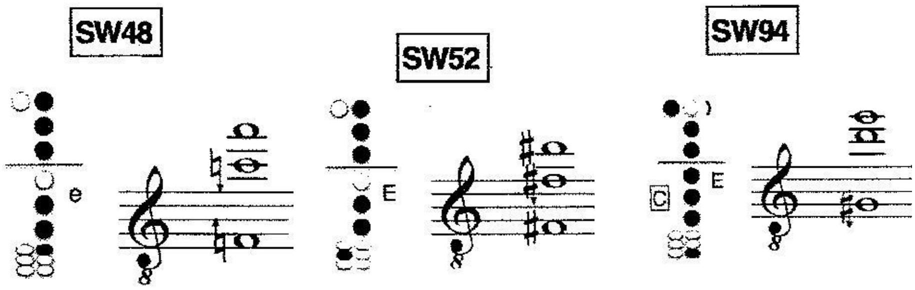

Figure 44: Watts (2015, p.175, p.176, p.183), fingering patterns SW48, SW52, and SW94

There also appears to be some confusion around the use of alternative keys in Watts’ system. For example, the fingering pattern for SW52 (Figure 44) shows that both key 5 and key 5a have to be depressed, but since both keys operate the same pad, this is totally unnecessary. Equally confusing is the fingering pattern SW94 (Figure 44), which prescribes that key E [key 5a, HB], key D [key 3, HB], and key C [key 1, HB] should all be operated. However, depressing key 1 automatically shuts the other two keys, therefore Watts’ notation seems unnecessarily complicated.

Alder’s key nomenclature system is more consistent as it only uses graphical representations of the keys, but reading those graphics can be difficult. This especially applies to the set of keys representing keys 3a, 5a, 6a, 7a, and 8a. Without Alder’s ‘Guide to the Fingering Chart’ at hand it can be a challenge to distinguish between the tiny ‘flower petals’ that he uses to represent these keys (Figure 45).

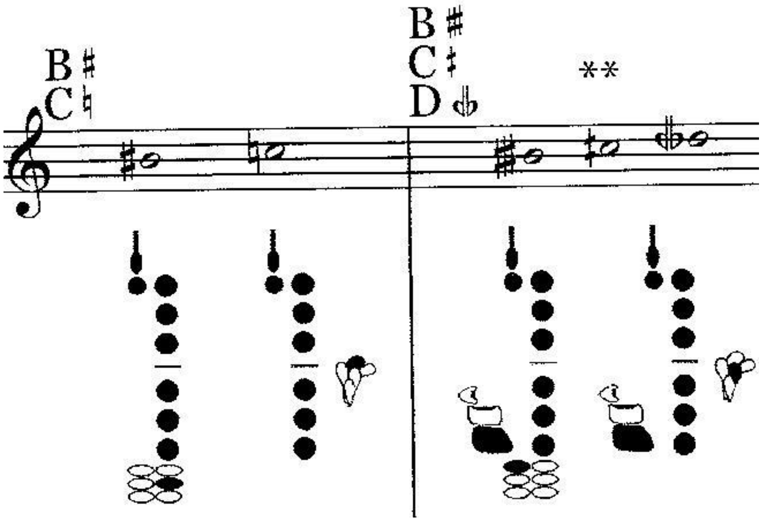

Figure 45: Alder (2013, p.4), two key notation examples showing the difficulty in reading the graphics representing keys 3a and 5a-8a

A general problem with interpreting the visual representation of keys, a problem shared by the notation systems of Alder and Watts, is that keys are not always used to sound the same notes on the different makes and models.

A comparison of the keywork on two different models highlights the issues of visual representation (Figures 46 and 47). For example, the key highlighted in red in Figure 46 [key 4, HB], which Alder calls the “RH Low E♭ Key”, used to have a different function. On one of the Selmer Paris models I used during the research for my book in 1989 (called the ‘new’ model at the time), the key in that position used to be key 2, Alder’s “Low C♯ Key”. On the same model, the key highlighted in green was used for E♭1 [key 4, HB], but is now used to play D1 [key 3, HB]. Finally, on the same model, the key highlighted in blue, on the back of the instrument, was used for D1 [key 3, HB], but is now used to play C♯1 [key 2, HB]. When you own such an instrument (and there are still plenty around), the visual representation in Watts’ and Alder’s notation systems could easily lead to misunderstandings, even with the explanations given by Alder in his ‘Guide to the Fingering Chart’.

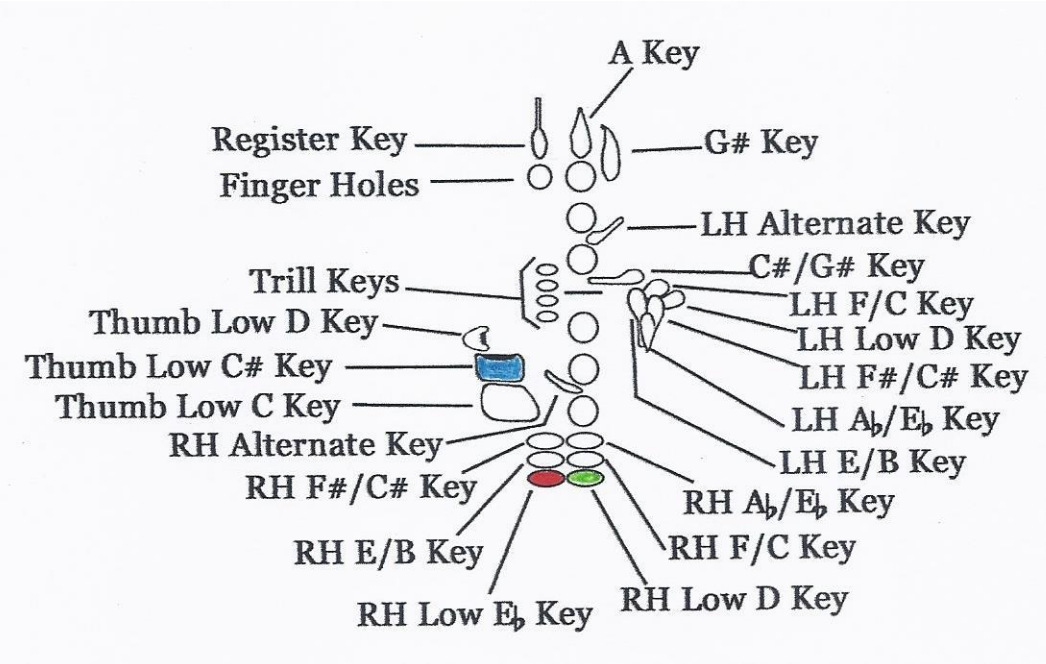

Figure 46: Alder (2013, p.iii), 'Guide to the Fingering Chart'

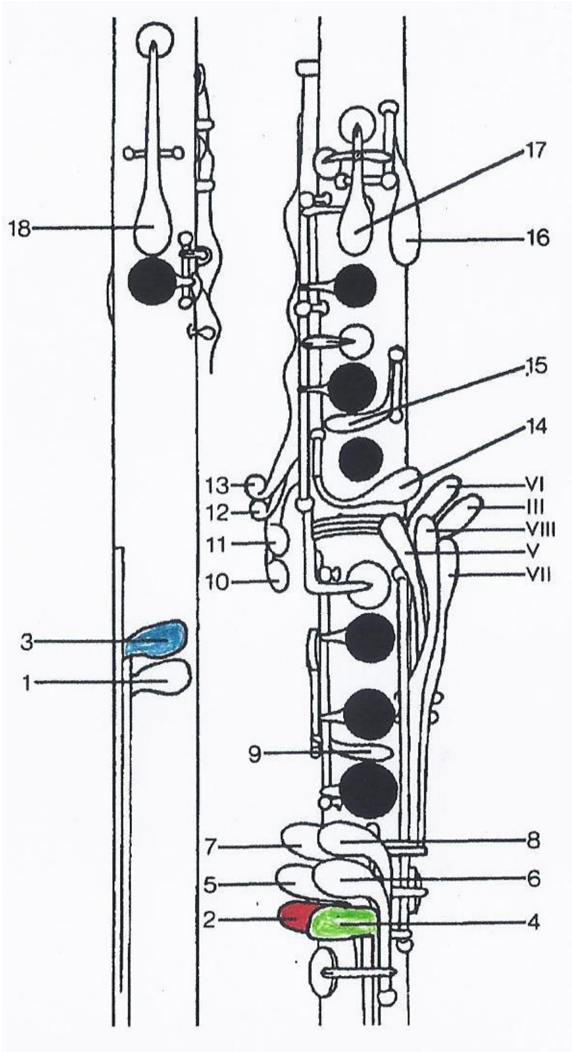

Figure 47: Bok (2011, p.4), diagram of Selmer Paris (new model)

The interpretation of Alder's key notation system also poses problems for current model instruments, as he uses drawings to represent the right hand thumb keys. On Alder's Buffet Crampon instrument, the upper key in this section of the diagram is the "Thumb Low D Key" (Figure 46), which is used to play a D1, but due to the different keywork on Selmer Paris instruments, Selmer players would see it and read it as an E♭1 [key 4a, HB] (see my [key nomenclature system]).[40] Although these fingering pattern charts are meant primarily for (French) Boehm system and not for German system bass clarinets, one could imagine that certain fingerings would also work on these instruments. However, many German models have four keys at the back and fewer keys at the front for the lowest notes. Of course, from the 'Guide to the Fingering Chart'

[40] On Selmer Paris instruments E♭1 can be played using either key 4 or key 4a.

the corresponding keys can be deduced, but it would not make any sense, visually speaking. The use of numbers aids in the elimination of these issues.

The key depressed by the left hand index finger [LHK1, HB] can be half closed, that is, depressing the key but not covering the vent hole in the middle of the key. For standard semitone fingerings on the instrument the half-closing of this key is usual for notes D4 and higher. Half-closing this key also generates more multiphonic and microtonal possibilities. Both Sparnaay and I use an ‘x’ to indicate half-closed, a form of notation which is, again, easy to write in shorthand. The notation for half-closing, common to Alder, Rehfeldt, and Watts, is a half-coloured circle (top half white, bottom half black).[41] Watts’ use of the half-closing of the left hand index finger key is only sporadic, in 18 of her 257 fingering patterns, whilst in Richards’ fingering patterns the half-closing option for this key is totally absent. His failure to include this additional option has meant that many of his fingering patterns are inexact.

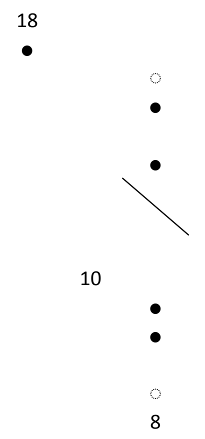

Figure 48: Richards (1995, p.33), fingering pattern for A𝄳4

When tested for this research, the pitch produced using Richards’ fingering pattern for A𝄳4 was actually A♭4 +14 cents, not even close to the quartertone pitch.

[41] Alder is the only one who explains the option of half-closing this key (2013, p.iv).

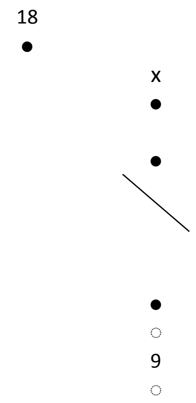

Figure 49: Bok, fingering pattern for A𝄳4 (Appendix B)

By utilizing the half-closing of the LHK1 (Figure 49) I was able to produce an A𝄳4 that fell within the margin of error set for this research (see section 3.2.2).[42]

3.2.1.3 Range, missing pitches, and accuracy

As was discussed in Chapter 1, the lowest fifth of the instrument is a problematic area for microtonality. The keywork in this region offers very limited possibilities for microtonal manipulation, meaning that the only options for microtonal playing in this range of the instrument is by embouchure manipulation or half-closing keys. One of the most salient differences between the quartertone fingering pattern charts found in other sources is where their quartertone scale begins.

Notwithstanding his reservations concerning the use of quartertones on the bass clarinet, Sparnaay still adds a list of fingerings “for those who want to experiment with these intervals” (2011, p.128). The first pitch Sparnaay includes in his chart is G𝄮1 [G𝄲1, HB], but he indicates that between this pitch and B𝄮1 [B𝄲1, HB] the microtonal pitch variants are smaller than quartertones and he describes them as ‘bisbigliando’, and “not even close to a quartertone”

[42] Another example is my fingering for E𝄳2 in my definitive 31-tone pattern chart, Appendix F: the fingering in Appendix D comprised thumb key, left hand index, middle and ring finger keys, plus keys 10 and 15. The measured pitch was a little flat. Half opening the index finger key brought the fingering pattern up to the right pitch.

(2011, p.128). Quartertone fingering patterns are given from B♮1 (Sparnaay, 2011, pp.128-129). Richards gives microtonal fingering patterns from A1: microtonal fingering patterns, that is, not quartertone fingerings. He marks his first two microtonal pitches as “**sl** (slightly low)” and “**sh** (slightly high)”, stating that “it was not possible to find equal-tempered quarter-tones for all intervals” (Richards, 1995, p.30). So, both Richards and Sparnaay actually start their *quartertone* scale with B♮1.

Rehfeldt and Alder differ from this consensus and they provide fingering patterns from E♭1[43] and C1 respectively. As Rehfeldt advocates the use of the same fingering patterns for the eighth-tones either side of each quartertone pitch for the notes from E♭1 to D𝄳2, the accuracy of his fingering patterns is questionable. Looking at Rehfeldt’s solutions for this area, the techniques used are: controlling key openings by the left calf, the right calf, the left knee and the right knee, lipping notes down, and half-shutting keys. Rehfeldt describes the impreciseness of these pitches as “fluid in nature” (2003, p.22), which contradicts his statement that “it should also be noted that the charts have been developed with pitch as a primary consideration rather than ease of finger movement” (2003, p.39). Alder’s solutions for quartertones in the lowest fifth are very similar to those advocated by Rehfeldt: the use of either “half-keying” or embouchure manipulation (2013, p.ii, p.1), although he specifies that “these notes can…be obtained through other manipulations of the mouth rather than the imprecision of half-keys” (2013, p.ii). It is obvious that the use of such hard to control techniques will give very aleatoric and imprecise results, a sharp contrast with “the well-defined order of fingerings” which Bartolozzi advocates (1982, p.27). My review of all four existing quartertone scales (Appendix A1) clearly indicates that no precise quartertones could be measured lower than B1.

The highest quartertone pitch for which Sparnaay supplies a fingering pattern is B♮4, giving his quartertone scale an ambitus of three octaves (2011, pp.128-129). Richards’ quartertone scale goes up to G♯5, covering almost four octaves (1995, pp.32-37). Rehfeldt’s highest quartertone pitch is F♮5, which makes his ambitus slightly more than four octaves (2003, pp.33-39). Alder’s ambitus for the quartertone fingering patterns is from C♮1 up to D𝄳6 (2013, pp.1-8). At slightly more than five octaves this is by far the largest range covered amongst the four sources. However, as Richards justly remarks:

[43] Although there is no information in the book regarding the bass clarinet model Rehfeldt has used for the verification of his fingering patterns, it is very likely that it was a low E♭ instrument. This notion is also supported by his multiphonics chart in which the lowest key used is the same E♭ (key 4).

> Another section of the quarter-tone scale that is weak consists of pitches above F-sharp 6 [F♯5, HB]. The altered air and embouchure pressure necessary to produce these pitches (often on different partials) [roots, HB], as well as awkward fingerings make them treacherous, especially if approached quickly by leap or attacked without preparation. (1995, p.30)

During the process of measuring microtonal pitches it has become clear that from F♯5/G5 and upward, measurements indeed become less precise and less reliable.

Ascending through the bass clarinet's ambitus, in general, fewer 'tricks' are needed, the exception being the pitches roughly between B2 and E3. As shown in Appendix A1, the quartertone fingering patterns in this range of the instrument often came out as imprecise, making the area B2-E3 the second problem zone for quartertones.

Whilst Rehfeldt supplies a distinct set of fingering patterns between A3 and F♯↓5 [F𝄲5, HB], for the pitches C𝄲3, D𝄳3, D𝄲3, E𝄳3, and F𝄲3, half-keying with the help of the calf, knee, and fingers have to come to the rescue again (2003, p.35). Alder brings half-keying and embouchure manipulation in again "for some of the clarion[44] register counterparts in the middle of the staff, where there are no other fingering options available for quarter-tones" (2013, p.iv). Sparnaay's fingering patterns for C𝄲3, D𝄲3, and E𝄳3 are marked "with the aid of the embouchure", and D𝄳3 is marked "only possible with embouchure" (2011, p.129). Richards does not include a fingering pattern for two of these pitches (C𝄲3 and D𝄳3), remarking: "From C4 [C3, HB] to D4 [D3, HB] there are no practical fingerings for quarter-tones, since virtually the entire length of the instrument is employed. Cross fingerings cannot be utilized" (1995, p.30).

[44] As opposed to the 'chalumeau' register (which is basically the root section of the clarinet, including the lowest fifth), the term 'clarion' refers to the overtone sections of the clarinet, notably the altissimo.

3.2.1.4 Hand position and keywork

Richards states that: “Adjacent notes in a microtonal scale” have been chosen “not only according to pitch, but according to several basic guidelines” which include “minimum motion” and the “avoidance of contrary motion, where possible” (1995, pp.3-4). These guidelines, and his avoidance of cross-fingerings, limit his microtonal success.

Other sources do not adhere to the same guidelines or ideals as Richards, but it is interesting to note that, alongside Richards, neither Alder nor Rehfeldt choose to examine the options provided by operating keys with different fingers. Both Sparnaay and Watts do explore this, and use the right hand thumb to operate additional keys to those it normally is used for (keys 1, 2, and 4a). In his quartertone chart Sparnaay only uses this technique once, for B𝄲2, but he clearly explains to the reader that “key 13 must be played with the right hand thumb (away from under the thumb support)” (2011, p.129). Although Watts fails to explain this phenomenon, one only has to look at her diagram labelled “Figure 4.9” (2015, p.89), an example of a type 2 multiphonic, to discern that the only way keys 12 and 13 can be depressed is by using the right hand thumb. That the other sources—Alder, Rehfeldt, and Richards—do not include this technique in their fingering patterns, means that fingering pattern opportunities have been left unexplored. Other, or more exact fingering patterns, could possibly have been found, if they had used the right hand thumb as an additional digit.

As remarked earlier, Rehfeldt provides no information about the type and make of bass clarinet he used to establish the fingering pattern chart in his book, whilst it is known that Alder, Richards, and Sparnaay all used Buffet Crampon instruments for their research. This information is important, as the two main French brands, Selmer Paris and Buffet Crampon, do not offer the same microtonal possibilities. This is due to a combination of the different layout of the lower joint keys and a different functioning of upper joint side key 14, which is used for C♯2 and G♯3. It is opened by the left hand little finger. In the fingering patterns for C𝄲2 proposed by Alder, Richards, and Sparnaay (Appendix A1) the player has to close keys (RHK1, RHK2, or RHK3) on the lower joint with combinations of the right hand index, middle, and ring fingers. On a Selmer Paris instrument closing RHK1 and RHK2 will automatically close key 14. As the pad operated by key 14 must be open in order to sound the quartertone, their fingering patterns for C𝄲2 therefore do not work on the Selmer Paris instrument.[45]

Richards presents fingering patterns, such as the one for C𝄲2, involving the use of key 14 and closing holes of the right hand, but does not acknowledge this represents a difficulty for Selmer players. Both Sparnaay and Alder indicate this issue very clearly. Alder comments:

> One particular difference to note is with instruments with articulated C♯/G♯ keys, such as those from Selmer. With these instruments, closing any holes of the right hand will also close the C♯/G♯ [key 14, HB] if it's open.[46] An alternate will need to be found for any notes requiring this hole to open with right hand holes closed. (2013, p.iii)

As the bass clarinet I used for this study is a Selmer Paris instrument, it meant that I could not review and measure the fingering patterns belonging to this category and that I had to come up with alternative fingering patterns for my instrument.

The change in ergonomics of the current bass clarinet makes and models have, on the one hand, made certain fingering patterns which would have had to be discounted in the past, currently possible. On the other hand, some fingering patterns accounted for in the past can no longer be used. For example, as Sparnaay remarks, "with the older models a low E [E1, HB] or E flat [E♭1, HB] could be played and the low C key could be closed separately"[47] (2011, p.124).

<u>3.2.1.5 Additional information</u>

Richards includes indications for timbre (dark, slightly dark and slightly bright) and for pitch deviations (sh=slightly high and sl=slightly low) in his quartertone scale table. He also adds DAT for notes which are "difficult to attack strongly" (Richards, 1995, p.30). Timbre indications and the term 'strongly' are of course prone to subjectivity. Sparnaay also supplies additional information, writing about;

---

[45] This construction was made by Selmer Paris to facilitate trills between lower joint notes and the C♯2/G♯3.

[46] However, depressing key RHK3 does not close key 14.

[47] In *New Techniques for the Bass Clarinet* these fingering patterns have been marked with 's.a.' (Selmer Paris ancien/old model).

- the sound (“very poor tone quality”)
- the embouchure (“with the aid of the embouchure” and “only possible with embouchure”)
- make/model limitations (“not possible on the Selmer bass clarinet”)
- additional/special techniques (“key 9 played with the 4th finger of the right hand” and “key 13 must be played with the right hand thumb, away from under the thumb support”) (2011, p.129).

Alder adds that it “may require extra manipulation with embouchure and/or tongue to lower [the] pitch” (2013, p.1) of fingering patterns involving half-keying, and Rehfeldt gives additional information whenever ‘manipulation’ is needed. For instance, “control the ‘c♯’ opening by obtaining leverage against the left calf” or “control ‘e’ opening by pressing against right knee, or with R.H. [right hand, HB] third finger” (Rehfeldt, 2003, p.35).

3.2.2 Towards a definitive quartertone chart

In order to be able to determine whether it is possible to play quartertones on the bass clarinet the first step taken was to check and determine the precise pitch of each fingering pattern in the quartertone scales by Alder, Rehfeldt, Richards, and Sparnaay. The measurements, which have been documented in Appendix A1, often show substantial deviation from the desired pitch. Pitch measurements in the fifth octave became more and more difficult, reaching an unacceptable grade of instability above G5. Therefore, notes above G5 have not been included in this research. Also, manipulations using knee, calf, or leg have not been taken into consideration. In the four sources there are no fingering patterns for D𝄳3 and G𝄲3, leaving 39 quartertone pitches between D2 and G5, for which there was a total of 219 measurable fingering patterns.

In order to analyse the results I nominally established categories of ten cents pitch deviation. Appendix A2 gives an overview of pitch deviations per note and makes the comparison between measurement results of a given pitch easier. It is notable that for some quartertones, fingering patterns have been documented which produce a wide range of pitch deviations (from small to extreme). For example, analysing the results for E𝄳4, seven fingering patterns have a pitch deviation of 1-10 cents and three have a pitch deviation of 11-20 cents. However, one fingering pattern has an extreme pitch deviation of more than 51 cents. By contrast, the fingering patterns for E𝄳2 all have a pitch deviation of

1-10 cents. Studying the fingering patterns for C𝄲4 and D𝄳4 reveals a huge disparity in pitch deviation. Each of these two pitches has one fingering pattern which has a pitch deviation of 21-30 cents flatter and one which has a pitch deviation of more than 51 cents sharper. The span between these two results is roughly 80 cents.

Appendix A3 shows the total measurement results in percentages. The majority (67%) of the fingering patterns were found to produce notes with a pitch deviation that was larger than ten cents from the actual quartertone. Huge pitch deviations were measured in the category of 51< cents (7%). Two fingering patterns produced notes with pitch deviations of more than a semitone. The category of 41-50 cents pitch deviation (3%) includes fingering patterns which are a quartertone away from the desired pitch. Similarly, sixth-tones (33.3 cents) and 31-tones (38.7 cents) fall within the category of 31-40 cents (11%) pitch deviation and eighth-tones (25 cents) in the category of 21-30 cents (17%). Only 33% of the fingering patterns produced notes with a pitch deviation of 1-10 cents.

In choosing my quartertone fingering patterns, I therefore wanted to increase the preciseness and reduce the pitch deviation. Adopting a pitch deviation of 1-10 cents either side of the exact quartertone as my margin of error, it was my goal to apply this 20% margin to all of my quartertone fingering patterns. This meant that fingering patterns which did not meet these strict criteria were not accepted.[48]

The next step in the process was to review the data found in two sections of my earlier book. In *New Techniques for the Bass Clarinet* Table 4 documented timbral changes and Table 5, which was aimed at a wider spectrum of microtonal variants, including quartertones, eighth-tones, third-tones, and sixth-tones, was titled ‘Microtones/micro-intervals’ (Bok, 2011, pp.25-39). I decided to check and measure all proposed fingering patterns on my current bass clarinet and set-up, and following my new approach to timbral change, which considers it as microtonal variants, these fingering patterns were also retested.

The decision that precision and reliability should be the main goals for the research meant that options for microtonal fingering patterns involving half-keying, lipping-down, and the use of the legs, ankles, knees, or thighs to close keys, as suggested by Rehfeldt and by Alder, had to be disregarded. As

[48] These are marked in the fingering pattern charts as ‘no fingering pattern fulfilled the research criteria’.

previously stated, these imprecise and unreliable options occur mainly in the lowest fifth and in the first corresponding overtone area (B2-E3), problematic zones for microtonality.

Despite not considering lipping-down as a primary means of adjusting the pitch in order to play a microtone, it is important to state that special fingering patterns alone are not sufficient for the creation of microtonal pitches. They need to be combined with correct embouchure and lower lip positions. It is for this reason that extensive video and audio material has been included in this study.

Sparnaay has called the notes given by the fingering patterns he includes for notes lower than B1, 'bisbigliando' (2011, p.128). Whilst I believe that there are some possibilities for microtonal manipulation using special fingering patterns between F♯1 and B1, the results are not close to quartertones. In *New Techniques for the Bass Clarinet* I had therefore categorized these as 'variations in timbre' or 'colour fingerings' rather than quartertones. My categorization of these small microtonal variants has since changed, and I now would choose to consider them as smaller microtonal entities.

3.2.3 Technical aspects

As explained in section 3.2.2, a margin of error of 10 cents either side of the precise quartertone pitch was allowed when documenting suitable fingering patterns. Only fingering patterns which produced pitches within this area would be considered as quartertones.

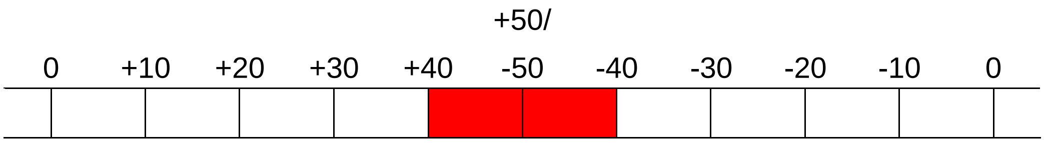

Figure 50: A diagram showing the margin of error allowed for the quartertone pitches between each semitone pitch (The 0's represent any two chromatic semitones. The area in red represents the allowed margin of error)

Measurements were done tuned to A=442 Hz, using the same instrumental set-up throughout, including the reed. The use of the same reed to check and document the microtonal pitches was of particular importance. The reed is a significant variable when doing tests, as the shape, balance, strength, and flexibility vary a lot, therefore using different reeds could have made the results less reliable.

Often fingers had to be re-located and used to depress keys other than the ones they are traditionally used for, in order to find quartertone fingering patterns which met the parameters of this research. The most frequent occurrence of this phenomenon was the use of the right hand thumb (which traditionally operates the keys at the back of the lower joint: keys 1, 2, and 4a) to depress side keys 10, 11, 12, or 13 on the upper joint. These are keys which are traditionally operated by the right hand index finger. The left hand middle finger and the right hand middle finger, ring finger and little finger have had to be re-located occasionally, in order to make quartertone fingering patterns possible.

The choice of logical subsequent quartertone fingering patterns to be used in a scale format may prove to be problematic in other quartertone contexts. Players and composers should be especially careful with combinations of quartertones in which the role of the right hand thumb in subsequent fingering patterns changes from depressing a key at the back of the lower joint (for which this digit is traditionally used) to depressing side keys on the upper joint (keys 10, 11, 12, and 13), since sufficient time must be allowed for the thumb to change position.

Sometimes the relocation of fingers is only needed in certain pitch sequences and not needed in other microtonal contexts. This is included as additional information in the fingering patterns chart.

3.2.4 Preferred notation

I believe that quartertones should be easy to read and easy to write: consistent and unambiguous. Combining these parameters would favour the use of the smallest possible number of symbols. Since there are only two added pitches within a whole tone, the symbols for quartertones can be reduced to two. Although Richards, Sparnaay, and Villa Rojo have each opted for different graphics, they all use only two symbols. In the first edition of his *Bass Clarinet Quarter-Tone Fingering Chart* Alder also had only two symbols, 𝄲 and 𝄳, but in his second edition he added “enharmonic spellings for three-quarters sharp (#) and three-quarters flat (𝄳♭)” (2013, p.ii). He comments: “I intentionally omitted them the first time because, frankly, I don’t like them. I would prefer to read quarter-tones in relation to the closest full tone than as three-quarters tones, such as A𝄲 instead of B𝄳♭” (Alder, 2013, p.ii). Not everyone will agree, composers might want to use three-quarters sharp or three-quarters flat symbols for “reasons of desired voice leading” (Richards, 1995, p.30), but from a performer’s point of view, “adherence to either sharps or flats within a work will make visual and technical recognition easier” (Richards, 1995, p.30).

However, performers might also prefer to use the symbols # and 𝄳♭ in certain instances dependent upon the fingering pattern required to play the microtonal pitch.

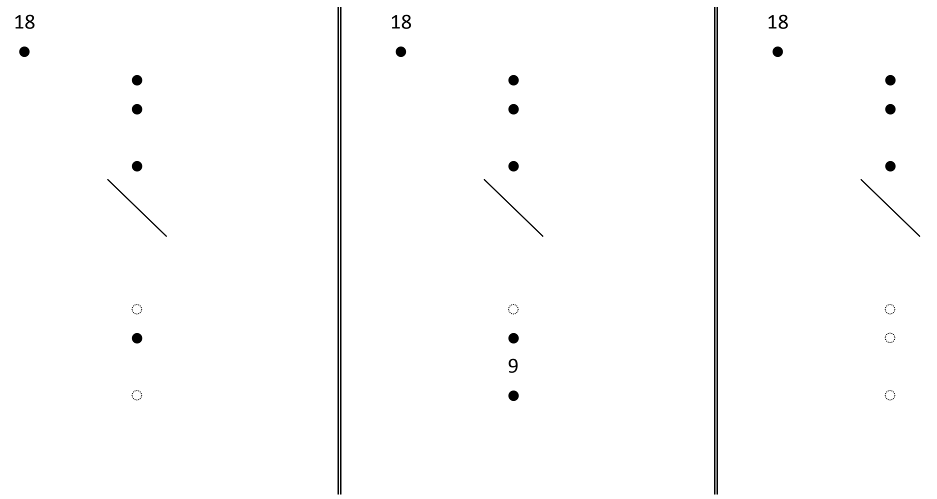

Figure 51: Fingering patterns for F♯3, G𝄳3, and G3 (Appendix B)

In Figure 51 a sequence of three fingering patterns is shown for the notes F♯3, G𝄳3, and G3. As can be seen, the fingering pattern for G𝄳3 bears a closer resemblance to that for F♯3, than that for G3. Key 9 and RHK3 are added to the fingering pattern for F♯3. Key 9 *raises* the pitch of the fingering pattern for F♯3 and for this reason many performers might prefer to read an F♯3 in the notation rather than a G𝄳3.

Alder decided to include the three-quarters symbols in his revised edition, "since notation for three-quarters tones exists and is used" (2013, p.ii), but the result is that for one quartertone pitch he has two, or sometimes even three alternative notation patterns (for example, B𝄰, C𝄲 and D𝄳♭), which for me complicates matters more. Taking into account all the arguments discussed above, I would, however, like to propose as my preferred notation, for reasons of simplicity and uniformity, a system of two graphics, which consistently indicate a quartertone up or down from the indicated pitch:

𝄲 quartertone higher

𝄳 quartertone lower[49]

[49] Heather Roche, one of the most recent sources on contemporary (bass) clarinet techniques, also uses this notation (www.heatherroche.net).

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

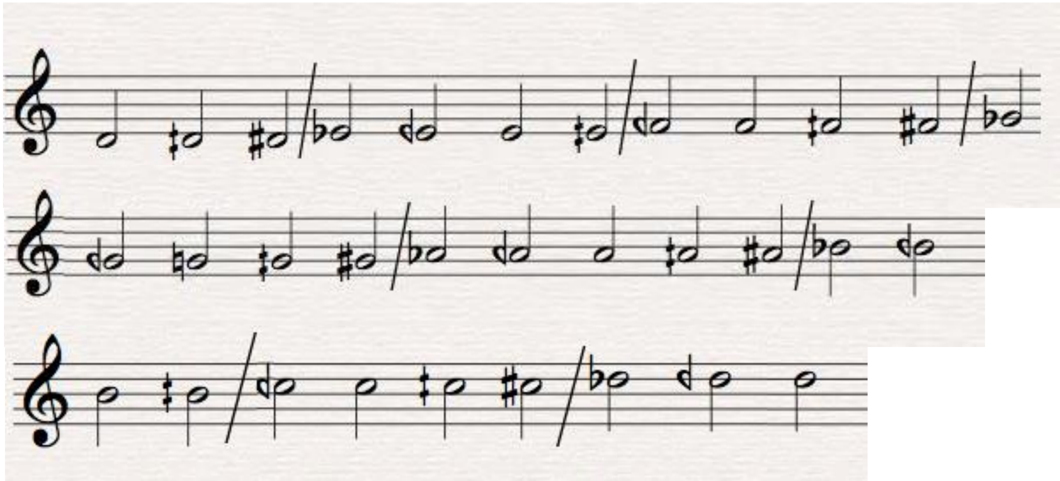

Figure 52: D2 to D3 notated in quartertones

3.2.5 Results

Due to the difficulties encountered in the lowest range of the instrument and as the first quartertone pitch which fulfilled the research criteria was actually D‡2, I chose to start my quartertone scale on D2. This means that the lowest ninth of the instrument is not suitable for quartertone playing. Because of the difficulties with pitch measurements above G5, I have decided that this will be the highest note included in my scale.

During my endeavours to find an exact quartertone scale I encountered the same problems as other players had for some of the notes in the range B2 to E3. The only potential fingering pattern which I found for C‡3 was the same as that of both Alder and Sparnaay. Upon testing the fingering pattern, the result was C♯3 -19 cents, meaning it was much too high. In his chart Alder states that the fingering pattern “may require extra manipulation with embouchure and/or tongue to lower pitch” (2013, p.4). Albeit the only fingering pattern option, I had to disregard it in the final version of my chart (Appendix B), as it did not meet the set parameters.

I have not been able to find fingering patterns for D𝄳3 or D𝄲3 which fulfil the strict research criteria. D3 is a very problematic note for any microtonal change, since depressing the keys available for changing the pitch—keys 1, 2, 3, 4, 5, 6, 7, and 8—all change the pitch by a semitone or more, as do keys 10, 11, 15, 16 and 17.[50] Neither do the side keys of the upper joint prove to be of much use as far as microtonal changes of D3 are concerned. Key 12 raises the pitch just ever so slightly—not even an eighth-tone—and key 13 does not change the pitch at all. On Selmer Paris instruments key 14 does not operate any pad, when the right hand keys are closed. Due to these technical restrictions of the instrument it is not surprising that no solutions have been found for the microtonal manipulation of D3 (D𝄳3 and D𝄲3).[51]

The range between D2 and G5 includes 41 quartertone pitches. I have been successful in finding fingering patterns that meet the research criteria for 38 of these pitches. Additionally, wherever more than one suitable fingering pattern was found, it has been included as an alternative. In the discovery of this quartertone scale every effort has been made to take into consideration the most convenient and logical sequence of fingering patterns. I continued to refine my quartertone fingering patterns during the process of finding suitable eighth-tone fingering patterns. My definitive quartertone fingering pattern chart can be found in Appendix B and in Video 10.

Video 10: Quartertone scale

[50] Opening key 10 (or 15 which is interchangeable with 10) results in a C4; opening keys 10 and 11—a common combination—results in G♯4 when underblown, and in a D𝄳4, with normal embouchure (a combination of both types of embouchure creates a dual sound); opening key 16 results in a A𝄳2 when underblown and in a D♮↑4 with normal embouchure; opening key 17 results in an A𝄲2.

[51] In her blog, Heather Roche too signals this problem: “You’ll notice that there is no series starting from the D quarter flat on the fourth line. That’s because there is no viable fingering for this pitch and it should be avoided in all cases!” (www.heatherroche.net).

3.3 Eighth-tones

Whilst trying to find fingering patterns which allow quartertones to be played on the bass clarinet I discovered that many of the existing sources of quartertone charts included fingering patterns which actually produced pitches closer to eighth-tones. I made the same discovery when studying my own previous work, *New Techniques for the Bass Clarinet* (2011).

Of the sources consulted, only Rehfeldt presents eighth-tone fingering patterns (2003, pp.33-39), but for many pitches the same fingering pattern is given for three subsequent microtonal pitches. For example, Rehfeldt uses the same fingering pattern for C𝄲2 and for the eighth-tones either side of it. He marks these fingering patterns with an asterisk to indicate that “the pitches are fluid in nature, that is, they do not ‘lock in’ at a definitely prescribed point” (Rehfeldt, 2003, p.22). He also uses less accurate, and less controllable techniques in order to play his eighth-tones: frequently half-closing keys using various body parts.

Such techniques are hard to control exactly, especially in a short amount of time. When playing standing, which is becoming standard procedure when playing solos or duos, the use of parts of the legs to change the pitch can quite literally turn into a balancing act. Left with little information to be found in existing sources, I was challenged to come up with new data and put together an eighth-tone scale.

3.3.1 Towards a definitive eighth-tone chart

The research for eighth-tones was undertaken by applying the same basic principles as the quartertones: measurements were done tuning to A=442 Hz, and using the same instrumental set-up throughout, including the reed. For reasons of preciseness and reliability only specific fingering patterns were considered and lipping-down, half-keying and the use of the legs, ankles, knees, or thighs to close keys were disregarded.

I decided to apply the same margin of error of 20% as I had for my quartertone measurements. So, when measuring eighth-tones, a margin of error of 5 cents either way was allowed. This meant that all quartertone fingering patterns had to be scrutinized once more, under these stricter criteria.

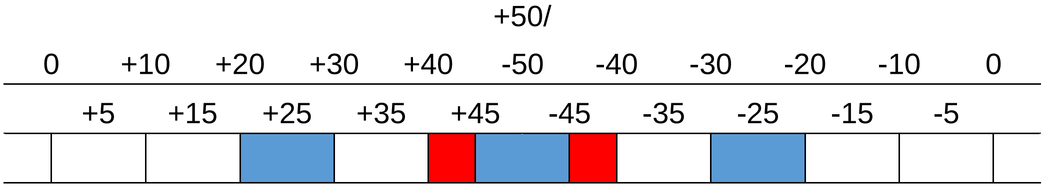

Figure 53: A diagram showing the margin of error allowed for the eighth-tone pitches between each semitone pitch (The 0's represent any two chromatic semitones. The areas in blue show the margin of error allowed for each eighth-tone pitch. The area in red represents the original margin of error allowed for quartertone pitches)

Work documenting the precise pitch showed that whilst microtonal variants are possible around F♯1 and for the range from G♯1 to D2, measurements showed deviations of only 2-13 cents. It appeared that from C1 up to D2 no eighth-tones could be found which met my criteria. Aiming at finding sequences of eighth-tones rather than odd, isolated ones, I took D2 as my starting point and tried to establish a list of eighth-tone fingerings on my instrument covering three octaves and a fourth: from D2 up to G5.

3.3.2 Notation and preferred notation

As with quartertone notation, many notational varieties for eighth-tones are found in the literature. Rehfeldt uses a '+' sign and a '-' sign to notate eighth-tones (2003, pp.33-39). Interestingly, Hába used the same '+' sign to indicate a sixth-tone in his *Suita* op.96 (1964, for example, second movement, bar 16). Although Sparnaay does not include fingering patterns for eighth-tones, he does include a list of symbols for quartertones and eighth-tones used by composer Gérard Grisey (2011, p.126). Grisey notates an eighth-tone sharp with an arrow up ↑ and an eighth-tone flat with an arrow down ↓. Villa Rojo has a whole inventory of notational options for quartertones, but only three symbols for eighth-tones: (eighth-tone higher) and and (eighth-tone lower) (2003, p.14).

For reasons of readability and consistency the symbols I will use to notate eighth-tone pitches are a combination of the traditional ♮ ♯ and ♭ signs and arrows going up or going down.

Eighth-tone higher: ♮↑ ♯↑ ♭↑
Eighth-tone lower: ♮↓ ♯↓ ♭↓

These symbols are very largely the same as those Rehfeldt uses to notate quartertones. Laid out in one octave, for example from D2 to D3, this would be the result in writing:

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

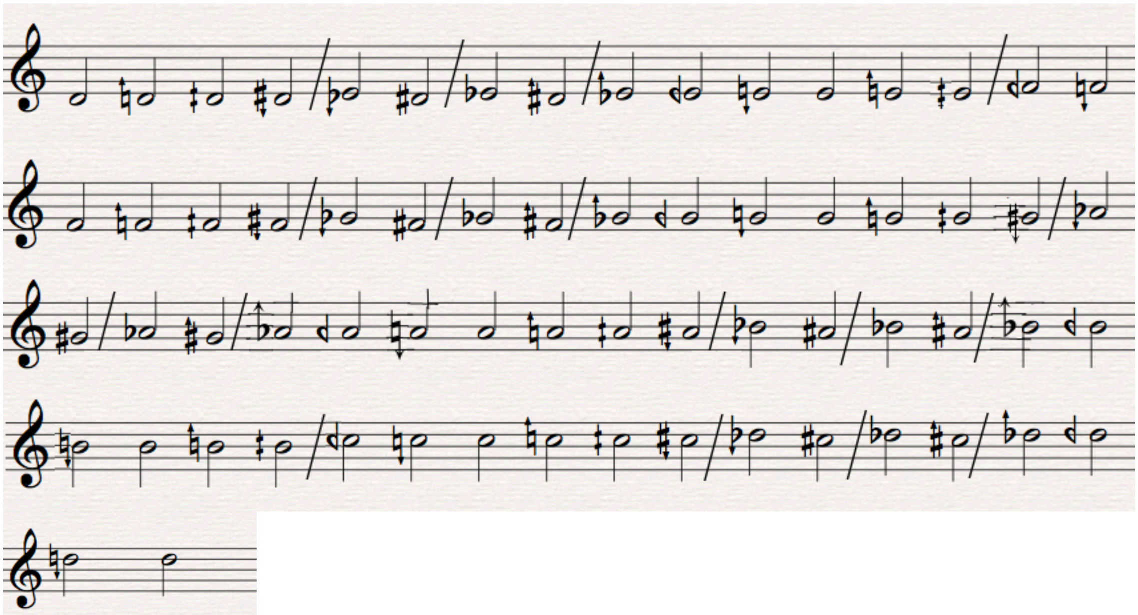

Figure 54: D2 to D3 notated in eighth-tones

3.3.3 Results

Of the 82 eighth-tone pitches accounted for, I could not find fingering patterns for 16: 12 in the first octave (D2-D3) and four in the second octave (D3-D4). The first octave, D2-D3, largely consists of roots (fundamentals), which explains why 12 of the 16 notes for which no fingering options were available, are found in this octave. From D4 up to G5, one octave and a fourth, not a single fingering pattern is missing, which could be expected because of the abundance of root-overtone fingering options.

Looking at the bigger microtonal picture the same area, B2-E3, again has to be signalled as very problematic. Of the eight eighth-tones between C3 and E3, fingering patterns have only been found for three of them.

Wherever more than one fingering pattern was found, it is mentioned as an alternative. Also, in the case of the eighth-tone chart an effort has been made to take into consideration the most convenient and logical sequence of fingering patterns. My definitive eighth-tone fingering pattern chart can be found in Appendix C and in Video 11.

Video 11: Eighth-tone scale

3.4 Applications

In this section I want to look at the way I have applied the newly found data regarding quartertones and eighth-tones to my artistic activities as a performer and as a composer, by interpreting solo works involving microtonality written for this project by other composers, by collaborating on microtonal pieces with other performers, and by performing my own microtonal compositions.

Several composers responded positively when I asked them if they would like to be part of my microtonal artistic journey and wrote new solo pieces for me: Spanish composer Francisco Domínguez, German composer Norbert Laufer, British composer Roger Redgate and French composer Fabien Téhéricsen. Three of these four composers combined several types of microtonality. Domínguez was the sole composer who decided to base his writing largely around quartertones, therefore, his composition will be the only one studied in the next section.

3.4.1 Domínguez: *Cuerpo Negro*

Domínguez started to write his solo work *Cuerpo Negro* in May 2016. I discussed the handwritten sketches of the piece with Domínguez on several occasions, and in March 2017 the composer sent me the first full version of the score. On May 27, 2017 Domínguez sent me a revised version of *Cuerpo Negro* to which he added the text of *Cuerpo Negro*, the poem by Spanish-Cuban author Alfonso Hernández Catá, the source of inspiration for Domínguez to write his composition. As he wanted to use more of the text than the first two lines he used for the solo piece, he subsequently added a second part to the work, for soprano voice and bass clarinet.

Domínguez' writing is quite bass clarinet specific and the sound world he intends to create suits the instrument well. His use of the bass clarinet's resources is very skilled and knowledgeable. However, there were challenges regarding the microtonality in the piece, as Domínguez included a number of quartertone pitches for which I had not found fingering patterns. Through intensive email communication I started a collaborative process with the composer, pointing out the problems and suggesting possible solutions.

I explained to Domínguez that, when I started working on my quartertone fingering pattern chart, I was hoping to establish a measured sequence from D1 up to G5, although I realized that certain areas, C3-E3 in particular, would pose problems. Upon completion of my research I was left with the following problematic quartertone pitches: five fingering patterns were missing (C𝄲2, D𝄳2, C𝄲3, D𝄳3, and D𝄲3). We then started to discuss the bars in the piece which contained these 'drop-out' notes.

- D𝄳2 occurred once in the piece, the last pitch of bar 27 (Figure 55). Domínguez first asked me to "play D♮2 instead of the impossible D𝄳2 at the end of bar 27" (F. Domínguez, personal communication, May 28, 2017), but when he sent me the final version of the score, he had changed all three pitches of the final sequence of bar 27 (Figure 56), in my view a logical continuation of the previous sequence.

- Bars 51-55 contained several C𝄲3 pitches. As Domínguez writes chromatically in quartertones, I assumed that he wanted to have exact outcomes. My suggestion was to bring the whole passage up one octave, as all quartertone pitches are available and sound very easily from C4 upward. Domínguez seemed very happy with this suggestion and decided to transpose the passage (Figure 57).

- There was one last problematic section in the piece, bars 88-90, which contained the 'missing' pitches C𝄲3, D𝄳3, and D𝄲3 (Figure 58). In the course of my research I had found approximate fingering patterns which did not meet my margin of error and I decided to mention this to Domínguez. After discussion and deliberation he decided to "accept the C𝄲3 and the D𝄲3 as not exact and to change D𝄳3 in bar 88 to C♯3, and in bar 89 to C♮3" (F. Domínguez, personal communication, May 30, 2017). Figure 59 shows the final version of bars 88-90.

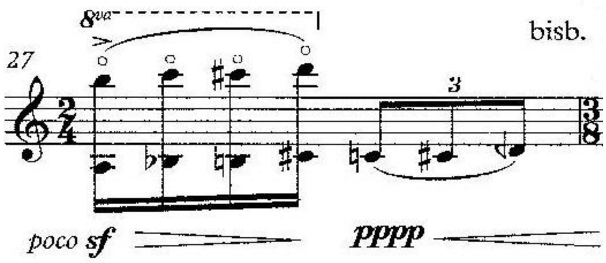

Figure 55: Domínguez, *Cuerpo Negro* part 1, bar 27, original version

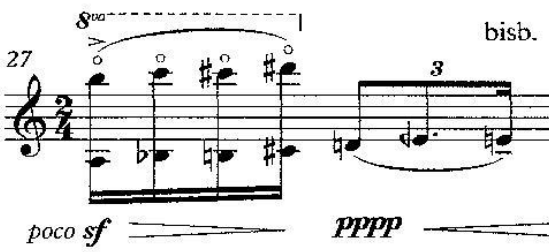

Figure 56: Domínguez, *Cuerpo Negro* part 1, bar 27, final version

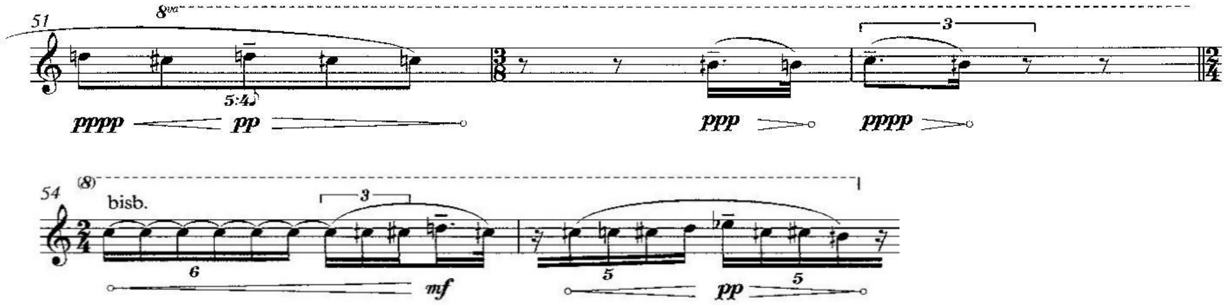

Figure 57: Domínguez, *Cuerpo Negro* part 1, bars 51-55, final version

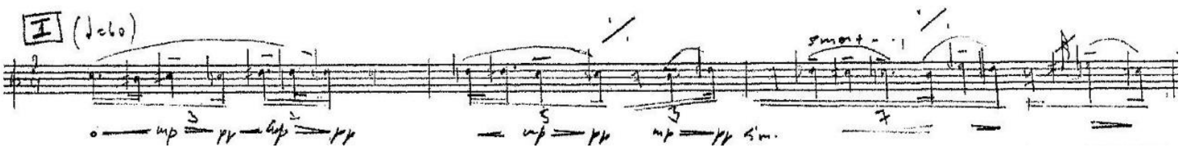

Figure 58: Domínguez, *Cuerpo* Negro part 1, bars 88-90, original version

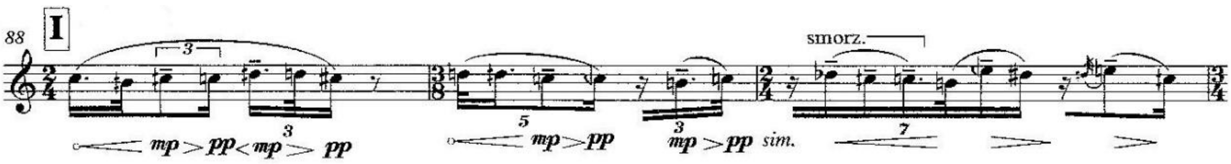

Figure 59: Domínguez, *Cuerpo Negro* part 1, bars 88-90, final version

Audio example 1: Domínguez, *Cuerpo Negro* part 1, bars 88-90, final version

A few of the issues discussed above also appear in the second part of *Cuerpo Negro*. In bar 17 there is another D𝄳3 for which no fingering pattern is available, and in section C (bars 50-63) the problematic pitches C𝄲3 and D𝄲3 occur frequently. However, they are found here in a context of greater pitch fluidity (use of lip glissandi up and down, microtonal trills in the bass clarinet part, and irregular vibrato in the soprano part) therefore the lack of precision of the C𝄲3/D𝄲3 pitches might be acceptable to the composer and I suggested the approximate fingering patterns to him. Having shared this information with Domínguez he has come up with the following solutions: “In bar 17 the D𝄳3 is resulting of a lip gliss. [glissando, HB] with the same fingering as the D♮ [D♮3, HB] (this is the rule for all the notes between brackets after a lip gliss)”. Domínguez writes: “In this part we leave it as it is”, agreeing with my remarks above regarding bars 50-63 (F. Domínguez, personal communication, June 2, 2017).

The exchange of information and feedback during the collaborative process between performer and composer led to a final result which dealt with the microtonal issues to the satisfaction of both parties. The solutions the performer and the composer came up with make the piece a more complete and resourceful work for bass clarinet in a microtonal context.

3.4.2 Own compositions

In my catalogue of works the compositions for solo bass clarinet are the highest in number. I have always included extended playing techniques in my pieces, and my opus one, *Vinho do Porto Brasileiro* (1997), written to be used as an encore, contains a great number of extended playing techniques, albeit without specific microtonal elements.[52] The first solo piece I wrote making extensive use of microtonality was *There is a place for multiphonics* (2012).[53] All the solo pieces written since have an extensive microtonal content.

The compositions written for duo Hevans are the second highest in number in my catalogue of works. Duo Hevans was founded in 2006 and consists of tenor saxophonist Evans and myself. Although pieces for alto saxophone and bass clarinet (for example, by Christian Lauba) and for baritone saxophone and bass clarinet (for example, by Lee Hyla) existed when the ensemble was founded, we were not aware of any existing repertoire for tenor saxophone and bass clarinet. We were attracted by this instrumental combination, since these two single reed instruments are able to merge together perfectly but are capable of huge contrasts as well. Many composers proved to be interested in this unusual chamber ensemble and now, 12 years after the start of duo Hevans, the repertoire has grown explosively.

---

[52] However, the root-overtone manipulations are used for their microtonal impact.
[53] This piece will be discussed in Chapter 5, as it uses many root-overtone microtonal variants.

Since around 2010 Evans and I have become increasingly interested in microtonality, partly because we met composers for whom microtonality is a regular component of their work, and partly because we started researching the microtonal capabilities of our wind instruments.

There has always been crossover between my roles as performer and composer and the duo gave me a lot of ideas and inspiration for new pieces. As performers, Evans and I like to push boundaries and to set the bar high, which is a great challenge for me as a composer. Such an ensemble offers a unique chance to try things out, an ideal workshop or ‘laboratoire’ for a composer.

In 2012 I wrote my first two microtonal pieces for the duo, *Fluctuations I* and *ANNalogy*, followed in 2014 by *Multi-Micro I*, and in 2016 by *small change*. The latter work was premiered in Dublin at the Doctors in Performance conference (September 8-9, 2016). The two 2012 works use mainly quartertones, whilst the two more recent works contain different subdivisions of the tone.

3.4.2.1 Bok: *Fluctuations I*

In *Fluctuations I*, and to a lesser extent also in *ANNalogy*, microtonal sequences appear in unison. During the workshop stage of the writing process I had to change pitches a couple of times, as writing crept into areas of one or the other instrument where no fingering patterns were found which were able to produce precise quartertones.

A characteristic example of the unison quartertone duo playing can be found in bars 5-6 of *Fluctuations I* (Figure 60). After playing in unison (heterophonically) at the beginning of bar 6 the two instruments play polyphonically from the third beat on, ending the bar playing a minor second.

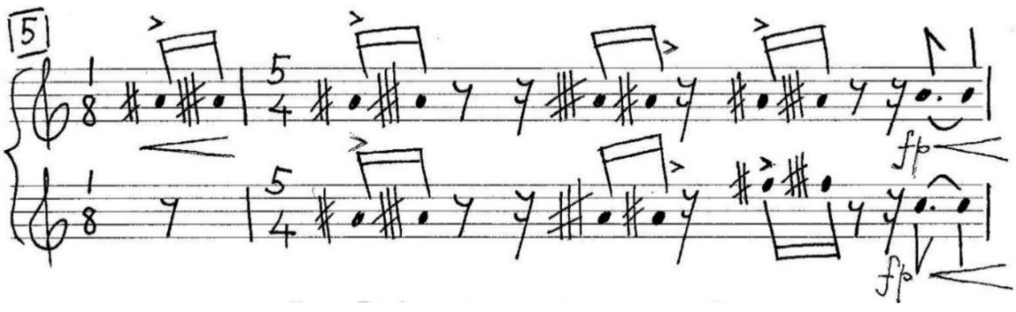

Figure 60: Bok, *Fluctuations I*, bars 5-6

When working on finding suitable quartertone fingering patterns, we allowed 10 cents either way of the exact quartertone pitch for each instrument. Despite this, during initial rehearsals, we discovered that an even greater precision of intonation was required for successful ensemble quartertone playing. For example, if the fingering pattern for the tenor saxophone had a discrepancy of ten cents above the precise quartertone pitch, and the bass clarinet fingering pattern had a discrepancy of ten cents below the exact quartertone pitch, the pitch deviation between the two instruments would be almost 20 cents, or in other terms close to an eighth-tone. In early rehearsals such pitch deviation was deemed unacceptable by both players, as it could cause beating between the two instruments (Audio example 2). Working further on reducing the margins of error we were able to come up with a different solution (Audio example 3).

Audio example 2: Bok, *Fluctuations I*, bars 5-6, original version

Audio example 3: Bok, *Fluctuations I*, bars 5-6, final version

3.4.2.2 Bok: *ANNalogy*

In this piece I chose to tackle an area of the bass clarinet's range that is microtonally limited. The opening of *ANNalogy* illustrates a recurring problem: C‡3. This pitch, the second note of the piece, is to be played in unison, which could be problematic as the microtonal options differ greatly between the bass clarinet and the tenor saxophone, for which this particular area is very rich in microtonal possibilities.

Figure 61: Bok, *ANNalogy*, bars 1-4

I was initially satisfied with a less exact microtonal change to the central pitch C. In early rehearsals, Evans was able to find a fingering pattern which matched the pitch of my less than exact fingering pattern (Figure 62).

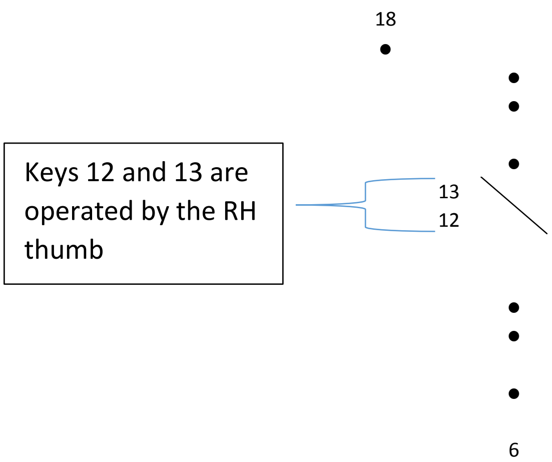

Figure 62: Fingering pattern initially used for the C‡3 in *ANNalogy*

My discovery of a better fingering pattern option (Figure 63), albeit still inexact, presented a new challenge for the duo: would we be able to match the intonation again?

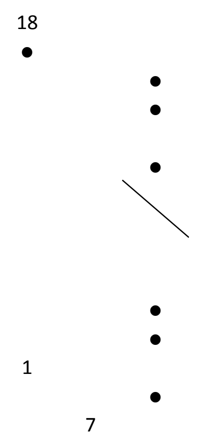

Figure 63: Fingering pattern now used for the C𝄲3 in *ANNalogy*

As this is a region of the bass clarinet that has few microtonal options, I was pleased with the discovery of the second fingering pattern. However, it meant that Evans had to find another fingering pattern which would combine well with my newly found, albeit still inexact, fingering pattern. She did discover an alternative fingering pattern and the old and the new versions can be heard on the two audio examples below.

Audio example 4: Bok, *ANNalogy*, bars 1-4, old version

Audio example 5: Bok, *ANNalogy*, bars 1-4, new version

In *ANNalogy* rehearsal letter D bar 5, the final section of the piece starts building, leading to a climactic outburst of sound in bar 14. To increase the musical tension in this section I mainly used a chromatic scale in quartertones, starting on A3 and ending on E𝄲4. The microtonal textures I used were playing a descending series of quartertones alternating between tenor saxophone and bass clarinet (bar 5), a descending series of quartertones played together in octaves (bars 8 and 9), and an alternating series of ascending quartertones between the two instruments from F♮3 up to C♮4, which is the start of a unison final section ending on E♮4 (bars 10-13).

Figure 64: Bok, *ANNalogy*, letter D, bars 5-13

Audio example 6: Bok, *ANNalogy*, letter D, bars 5-13

In the first version of the score I had written the three notes D4, D♮4, and D♯4 in both parts. However, these pitches turned out to be very unreliable for the tenor saxophone because of the quick tempo and the fingering patterns required to play the prescribed pitches. Therefore, I decided to change the first beat of bar 13 to a bass clarinet sequence only and keep the second beat for both instruments in unison (Figure 64).

My writing for the combination of tenor saxophone and bass clarinet largely benefitted from the microtonal opportunities each instrument offered. The differences between the richer and the weaker microtonal areas of the two single reed instruments complimented each other, enabling me, as a composer, to optimally realize my musical ideas.

3.4.2.3 Bok: *E-A-E*

I wrote *E-A-E* in 2015 for my recital programme at the ICA ClarinetFest in Madrid (July 2015). It is a rather introvert work in which I use eighth-tones and other smaller microtonal divisions as the main structural element for the first time. Additional techniques include air sounds, multisounds, key clicks, shadow overtone trills, bisbigliando overtone trills, playing plus singing, and underblowing.

The composition also explores the softer dynamics the bass clarinet is capable of. The ***ppp*** opening of the piece starts with the lowest E available on the instrument, E1, followed by an E4, played as softly as possible, using a standard fingering.

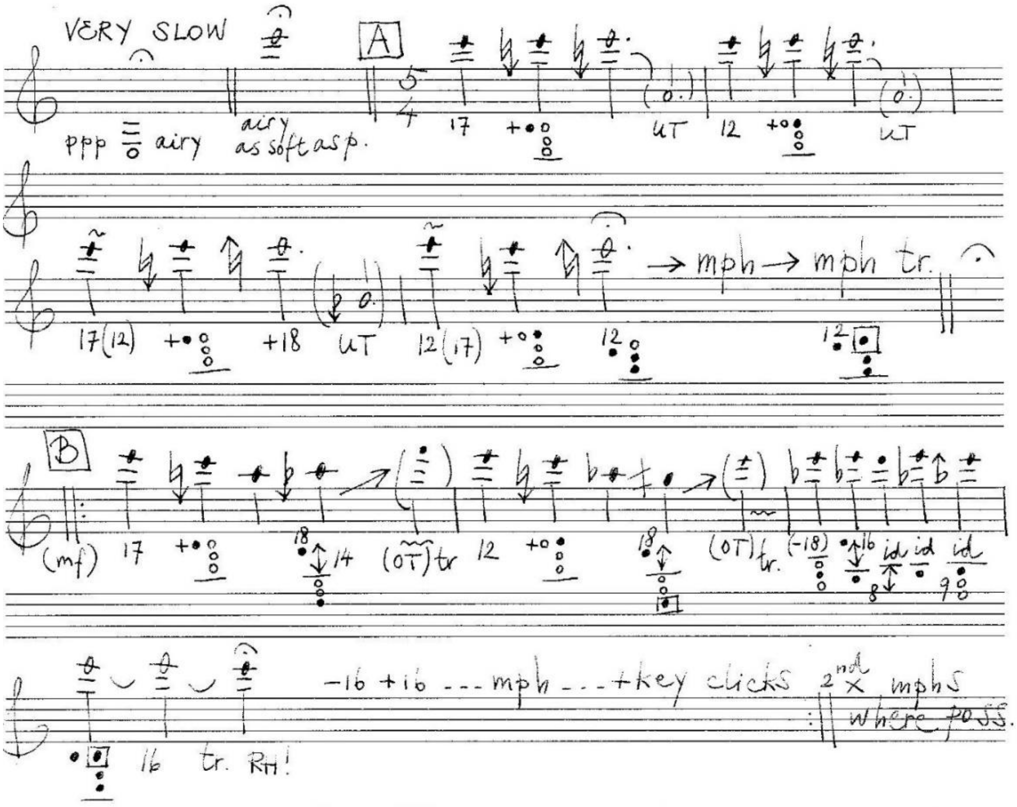

Figure 65: Bok, *E-A-E*, bars 1-10

All the dynamics are lower end dynamics, which means that the performer needs to deploy extreme technical control and to combine efficient finger movement, lower lip manoeuvring, and air management in order to sound the eighth-tone pitches. The influence of an extended dynamic range upon the playability of microtonal fingering patterns was something I first encountered with duo Hevans when working at the opposite end of the dynamic spectrum. The influence of extremely loud dynamics had a negative effect upon the microtonal results by flattening the pitch. By contrast, here I find the quiet dynamic levels in the piece aid the performance of the small microtonal changes, eighth-tones, which I have asked for, as lower end dynamics allow the microtonal pitches to sound more easily and permit greater embouchure manipulation.

Audio example 7: Bok, *E-A-E*, bars 1-10

3.4.2.4 Bok: *smaller change*

To conclude I would like to discuss a piece I have been working on during the process of writing this thesis. *smaller change* is a composition which has three formats: there is a version for bass clarinet solo, one for bass clarinet and tenor saxophone, and one for bass clarinet and piano.[54] For the bass clarinet part—which is the same in all three versions—I have chosen D4 as the central pitch, as it has lots of sonic variants. The version for bass clarinet and tenor saxophone features the instruments separated by one octave, the saxophone playing one octave lower than the bass clarinet. This is largely because of the diverse microtonal possibilities of each instrument. As previously stated, it is notable that this area, which has such limited microtonal possibilities on the bass clarinet, is a microtonally rich region within the tenor saxophone's range.

My idea when composing this piece was that it would represent all the microtonal variants I discuss in my written work and would function as a clear demonstration and illustration of the sonic outcomes. The excerpt shown in Figure 66 uses both quartertones and eighth-tones.

Figure 66: Bok, *smaller change*, quartertone and eighth-tone sections

Audio example 8: Bok, *smaller change*, quartertone and eighth-tone sections

[54] I gave the latter version a different title: it is called *Fifty shades of Dee*. 'Dee' is the Thai word for 'good', but refers, of course, also to the pitch D.

3.5 Summary and conclusions

With the technical improvement of the bass clarinet since Bartolozzi originally made his statement about the microtonal possibilities of woodwind instruments, the possibilities for playing microtones have grown considerably.

Most of the information found in the existing sources concerns the quartertone scale, and the only fingering pattern chart dealing with eighth-tones appears in Rehfeldt's book (2003, pp.22-23, pp.33-39). However, the reliability and the accuracy of all the existing fingering patterns is highly questionable. The (four) quartertone scale fingering pattern charts studied here all acknowledge certain issues with microtonal playing, which were dealt with by including approximate fingering patterns, suggesting half-keying and lip manipulation, or providing no solutions at all. The accuracy of existing fingering patterns has been studied and documented in Appendix A1.

Sparnaay has said that since "the instrument is not really designed for it…there are major difficulties to overcome when producing quarter tones" (2011, p.123). Indeed, there are major difficulties to overcome. New fingering patterns and new techniques have to be learnt, but such microtonal possibilities make the sound world of the bass clarinet much richer. The research presented here not only demonstrates that it is possible to play many quartertone pitches on the bass clarinet, but also to play steps smaller than a quartertone: the research has resulted in a measured scale of eighth-tones, covering more than three octaves. The results of my research into quartertone and eighth-tone playing has been documented and the fingering patterns can be found in Appendix B and Appendix C.

Video 12: Summary of the core elements of quartertone and eighth-tone playing

In the next chapter I want to take my research further and try to discover whether uneven subdivisions of the tone, such as 31-tone intonation, can be realised on the current bass clarinet through a set of measured fingering patterns.