"Repertoire for a Swedish bassoon virtuoso: Approaching early nineteenth-century works composed for Frans Preumayr with an original Grenser & Wiesner bassoon"

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Chapter 5 Technical concerns and pedagogical examples

Performing Preumayr's early nineteenth-century Swedish repertoire confronts the period instrument player with the task of developing a high level of instrumental virtuosity as well as delivering a compelling and dramatic musical text. This chapter deals with some of the practical matters concerning material and technique required to approach these works.

One of the most striking characteristics found in Preumayr's repertoire that can be affected by both these means is the range from B♭– e♭^{2}.[226] I was curious if solutions to the problem of producing the top notes could be found by making replicas of the six original C.J.F. reeds described in chapter 3, for example. Part 1 of this chapter describes my discoveries about how reed dimensions influenced range, along with the consequences of using different reed-finishing styles. The quality of our contemporary material used for reed making, *Arundo donax,* was another important factor that had to be considered. In part 2, reports are given in the form of pedagogical examples about crook set-ups, reflection on some significant physical factors influencing tone production, such as posture, jaw position and air pressure, experimentation with various fingering combinations, as well as observations of mental attitudes hindering or enhancing performance of the high register.

[226]A range of ca. three octaves was common for nineteenth-century bassoonists. The extra half-octave presents no extraordinary difficulties for modern bassoonists however, as additional keys have been added to twentieth century models, enabling the production of these notes with relative ease.

Part 1: Technical issues concerning reeds

5.1 Cane layers and various reed styles

Reed cane, or *Arundo donax,* can be described as having three layers, usually identifiable by color: the hard and shiny golden outer layer of bark, the yellowish middle layer, and the softer, whiter pith. Most examples of eighteenth- or nineteenth-century reeds show evidence that makers preferred to leave some bark on the blade area; this style is often referred to as the "historical scrape", or is said to have an "inner-gouge" [see fig. 5.1]. In the process of internal gouging, some cane from the softer layer of pith is removed from the inside, leaving some of the outside bark on the blades, thus ensuring that the hardest layer of cane is used.[227] The "modern scrape", or "outer-profiled" style [fig 5.2] removes all of the bark in the blade area, and uses only the softer inner layers.

Today, a large variety of shapes and sizes of reeds are used by historical bassoonists. Aside from variations in dimensions of length and width, a major difference is whether the older or later style is used. The discussion inner-gouge vs. modern scrape has not been, nor will ever be conclusively resolved; these are matters of individual preferences and tastes in tone color and response, just as they were in earlier centuries. In an article published in the *Galpin Society Journal* about early reeds from 2001, Rainer Weber describes two main reed-making styles commonly found in the eighteenth and nineteenth centuries, "Paris-London" and "Saxon-Berlin"; he also refers to third style, found in Copenhagen and Stockholm and built on a metal staple, but wisely acknowledges:

[227] White (1984), 70–71. A detailed description of inner-gouging and the technique used to produce it are outlined here.

> There was no absolute standardization of external shape! There existed a far-reaching and individual range of possibilities, each according to the tonal conception of the player, as well as to the peculiarities of the instrument and the material.[228]

An example of the third type of reed style, a variation based on inner-gouging mentioned by Weber, is located in the Nydahl Collection in Stockholm and seen in figure 5.3.[229] The metal staple is only visible at the bottom end, and is otherwise covered by a waxed, string binding. It is not possible to determine if any wires are present on the staple.

Figure 5.1. Inner-gouged reeds, courtesy of G. Graziadio

Figure 5.2. Modern scrape reeds by author

The predominance of the darker bark in the blade area can be clearly seen in the inner-gouged examples [fig. 5.1], with only a little small part of the white pith revealed in the middle of the blade. Reeds made with a modern scrape have all of the bark removed in the blade area, leaving only the layer of white pith [fig. 5.2].

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[228] Weber (2001), 238–39. Weber explains that "Saxon-Berlin" style reeds were narrower and thinner than those of the "Paris-London" style. The third type, straight in blade shape, was apparently not very common. [See chapter 3.]

[229] An example of a reed on a staple was located at the Stiftelsen Musikkulturens Främjande (Nydahl Collection in Stockholm), website: http://www.nydahlcoll.se; practical reasons [entailing the making of metal staples] did not allow me to include experiments with this variation in my current study. Weber also includes a photo of a similar example found in Copenhagen: Weber (2001), 236.

Figure 5.3. Reed on a staple,
courtesy of the Nydahl Collection, Stockholm

5.2 Use of variable *Arundo donax* with old and new preferences

Recent research concerning climate change and cane density confirms that *Arundo donax* for woodwind reeds may vary considerably even from one year to the next, due to changing environmental conditions and the development of agricultural cultivation techniques, fertilization, and irrigation, all of which have had an impact upon the quality of cane throughout the last centuries.[230] In his article on the subject of cane selection and reeds, bassoonist David Rachor proposes that cane used to make reeds in previous centuries was considerably softer and/or less dense than that which we use today.[231]

Rachor suggests that replicas of internally-gouged reeds made with cane currently available may not react or sound as the original models did, and logically recommends using particularly soft material in combination with this finishing style. It is interesting to consider what the

[230] Kirsten M. Boldt-Neurohr, 'The Proof Is in the Playing: The Affects of Climate During Cultivation on Arundo donax - Part V', Double Reed, 34/4 (2011), 89–97.
[231] David J. Rachor, 'The Importance of Cane Selection in Historical Bassoon Reed-Making', GSJ, 57 (May 2004), 146.

German bassoonist Carl Almenräder, author of the nineteenth century bassoon tutor, *Vollständige theoretisch praktische Fagottschule,* advises about cane selection in his chapter about reed construction. It is clear that he preferred soft cane to construct reeds using the inner-gouging method; hard cane gave him a poor result:

> Die einzige Probe, welche mir bis dahin bestanden hat, ist, . . . wenn man mit dem Nagel des Daumens über den äussern Theil des Rohrholzes, der Rundung nach fährt, daran am sichersten seine Elastizität erkennen kann. Bleibt bei einem mässigen Nageldruck keine Spur davon auf dem Holz zurück, so kann man überzeugt sein, dass es zu hart ist. Wenn auch manche dagegen Folgendes einwenden mögen, "das härteste, festeste Rohrholz ist am geeignetsten, taugliche Fagottröhren daraus zu fertigen", so muss ich hierauf entgegnen, dass man dann hiernach zu folgern, noch aus viel härteren und festeren Gegenständen, Fagottröhren anfertigen könnte, welche dann alle besser sein müssten, als die aus Rohrholz gefertigen, obschon ich mich getraue, eher ein taugliches Fagottrohr aus Kieferholz als ein solches aus zu festern Schilfrohr zu wege zu bringen.[232]

Reed makers will recognize that the test he recommends gives different results today; normal pressure will certainly not leave an impression in the bark of hard contemporary cane. Further, Almenräder directs readers to where reed makers in Germany could obtain Spanish *Arundo donax* (which he preferred to French cane), used at that time primarily in the construction of looms for weaving factories.[233] It is likely that the material which factories cast away was not of the highest quality.

I therefore contend that simply copying the appearance of an original reed or drawing cannot be sufficient; today's harder material may require a different scraping style in order to produce an ideally functioning reed. Contrary to certain reed-making schools that advocate using the older style, the more appropriate choice for reeds for historical instruments would use the less dense layer of harder contemporary cane, and not the harder outer bark.

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[232] Almenräder (1843), 123. "The only successful test I know, is, . . . run the thumbnail over the bark of the cane following its curvature to most certainly test its elasticity, and observe whether with normal pressure, any mark is impressed upon the cane. If none is left, you can be sure that the wood is too hard. While some on the other hand, might argue 'the hardest, most solid cane is the most suitable for making bassoon reeds', I have to reply to this that you could then conclude that making bassoon reeds out of much harder and firmer material would be better than from reed cane, although I trust myself to make a better reed out of pine than one made of too hard cane."

[233] Ibid., 123.

An ensuing question concerns why reed makers eventually stopped using the earlier technique. Why change something that works? The technological developments of gouging machines that contributed to revolutionizing the reed-making business in the nineteenth century have been noted by oboist and scholar Geoffrey Burgess, and it would be inaccurate not to consider the evolution of instrument making, changing tastes and musical demands in a discussion of reed construction and history.[234] It can be logically assumed that reed-making techniques were also adapted to accommodate the changing characteristics of the material and, most importantly, to ensure that reeds would function well. These developments are of particular significance to historical woodwind players; taking into account the quality of the material and using a combination of both historical and modern methods may offer the best results.

5.3 An experiment: comparing relative density and hardness

By taking a sampling of cane drawn from three different cane producers and measuring relative density and hardness, my aim was to determine if a large degree of variation existed amongst the groups, and then to compare data about the qualities of reeds afterwards, noting the consequences of material used. Taking ten tubes of cane from three suppliers, the results of up to approximately 90 reeds could, theoretically, be documented and compared.[235] Test criteria of the finished reeds would include range, response, aspects of tone color, and dynamic capabilities. Although variations in the natural material dictate that no reed can ever be truly duplicated, general tendencies could be identified and reported; these methods are usual and consistent with what has been described in bassoon reed-making treatises. Relative density and hardness measurements could not be compared with those from nineteenth-century *Arundo*

[234] Geoffrey Burgess and Bruce Haynes, *The Oboe* (New Haven, CT: Yale University Press, 2004), 157–61. Additionally in conversations about the development of oboe reed making techniques with oboists Geoffrey Burgess and Frank de Bruine in The Hague, January 16, 2012.
[235] The sample cane was drawn from two French suppliers MARCA and Madame Ghys and one Spanish supplier, Medir.

donax, but this data could possibly provide more insight into my reed-making process and hopefully aid in my search for the top register.

Cane preparation and measuring

Each piece of tube cane [fig. 5.4] was split into three pieces [fig. 5.5]; relative density was measured and noted for each piece, using a scale with sensitivity to 100th of a gram [fig. 5.6], using a method devised by researcher in musical instruments and related sciences Jean-Marie Heinrich.[236] Relative density is a ratio-comparing mass which is calculated by weighing the piece of cane *(M)* on a rack *(M1),* then in water under the rack (*M2);* the equation is: *RD = M / M1-M2*.

Figure 5.4. Three cane tubes

Figure 5.5. One tube split into three

[236] David Rachor, http://www.uni.edu/~rachor/art_baroque_heinrichdensity.html [accessed April 9, 2012]. The method invented by Jean-Marie Heinrich for testing cane density and the equipment required for this procedure is described.

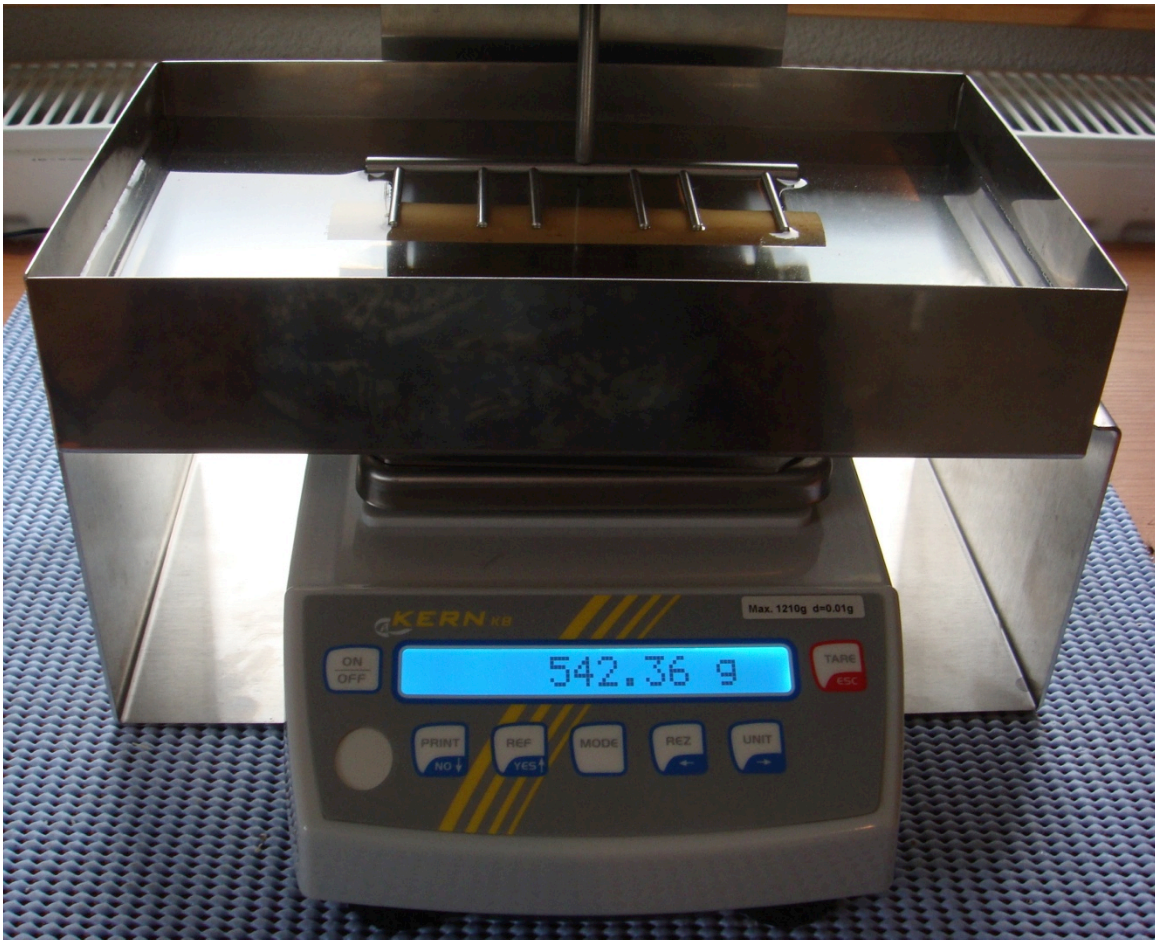

Figure 5.6. Weighing cane to calculate relative density

TABLE 5.1. RELATIVE DENSITY RANGE	
Scale: Low figure (= less dense) to high figure (= more dense)	
Cane sort	**Range**
Madame Ghys	0.39–0.48, Mean *RD* = 0.408
Medir	0.36–0.52, Mean *RD* = 0.441
Marca	0.39–0.58, Mean *RD* = 0.475

Pieces were then gouged on a machine to a thickness of 1.20 mm [fig. 5.7] and hardness was measured using a digital hardness tester [fig. 5.8]. [237]

[237] The machine-gouging process evenly removes material to a pre-determined thickness from the inside of the cane. The hardness tester presses a lever into the gouged cane and measures resistance against it. These values are expressed as a number; for example: "20" means that the hardness tester penetrates the cane by 20 thousandths of a mm (0.020 mm) at this point. Three measurements of hardness using a digital hardness tester from suppliers Reeds 'n Stuff were taken: one from each end and one in the middle; the average was then calculated to arrive at a mean value.

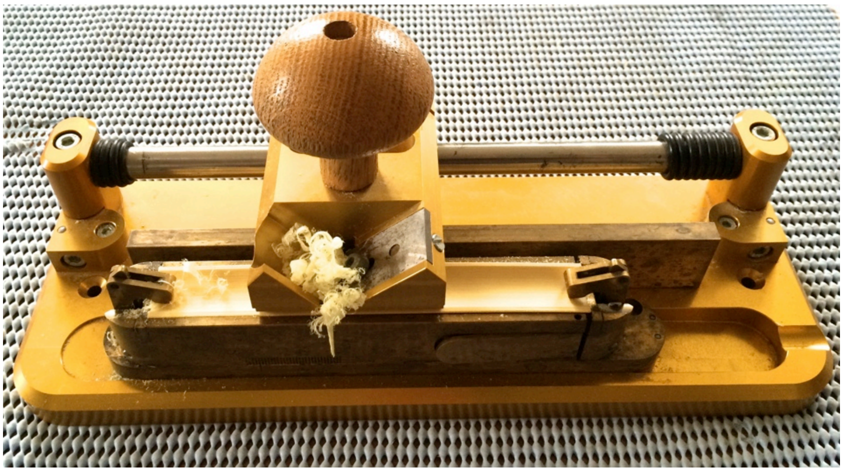

Figure 5.7. Cane on gouging machine

Figure 5.8. Hardness tester with cane

TABLE 5.2. HARDNESS RANGE		
Cane Sort	**Hardness range**	**Mean**
Madame Ghys	16.3–32.0	21.15
Medir	15.6–39.6	24.23
Marca	17.0–28.3	22.04

How useful was this information? Slight variations were noted within the ranges of density and hardness between the three groups of cane samples [table 5.1] , but by removing the highest and lowest values of pieces "spiking" the results from each group, the differences were not significant [tables 5.1 and 5.2].[238] As the remaining reed-finishing steps will ideally be adapted to suit each specific piece of cane and an experienced reed maker can choose finishing methods that will optimize the reed's performance, these variations can be minimized by taking characteristics of density and hardness into account.[239]

A similar but more extensive experiment dealing with cane hardness was conducted by oboists and their professor from the University of Wisconsin in Eau Claire, and documented in an article in *Double Reed* by Christa Garvey in 2012:

> We learned that the relative cane hardness range that we had did not inhibit us from making usable reeds. . . . In addition to our scientific findings, we found we gained a better understanding of cane processing, developed a wider curiosity of the many variables in reed making, and became more experienced, efficient and independent reed makers. [240]

Repeating this time-consuming process regularly might prove to be impractical in the daily lives of most reed-making performers, but more simple means of judging hardness requiring no special equipment were described by bassoonist and professor Edwin Lacy in 2001, and also by bassoonist and author James B. Kopp, in an article about reed cane published in 2003.[241] Whatever method is ultimately chosen, learning to recognize the hardness of cane is

[238] See total values of all samples in appendix 3.

[239] Depending upon the vibration and resistance that the reed offers, it can be made weaker or stronger, for example, by adjusting the wires or removing cane.

[240] Christa Garvey, 'Effects of Relative Cane Hardness on Oboe Reeds: A Student-Faculty Collaborative Research Project from the University of Wisconsin, Eau Claire', *Double Reed,* 35/3 (2012), 93.

[241] Edwin V. Lacy, 'Testing the Density or Specific Gravity of Bassoon Cane', *Double Reed,* 24/4 (2001), 45–46. In for example, the "flotation test", cane is submerged in water and the percentage of the cane that sinks is measured. Additionally: Kopp, 'Counting the Virtues of Bassoon Cane', http://koppreeds.com/virtues.html [accessed November 14, 2013]. One simple technique ["flex test"] is twisting cane ends in opposite directions to test its degree of flexibility.

undoubtedly a highly-relevant skill, serving to increase the sensitivity to the material and enabling a reed maker to react both consciously and intuitively to variations found in each piece.

Constructions with C.J.F. reed dimensions and variations

Four of the C.J.F. reed dimensions [nos.1–4] described in chapter 3 had been the focus of my earlier constructions, chosen because of their special dimensions. The results of these first attempts had been very encouraging; it was actually possible for me to play the top notes up to e♭^{2} using these replicas, albeit with some force from the embouchure. The tone quality, however, was far from being ideal, and the high notes could not readily be produced with the natural ease required for real music-making. Unfortunately, the lowest register was very resistant and almost impossible to control. Was the cane quality mismatched to the reed dimensions? I concluded that this might indeed be the problem, and that the material might be too hard or dense to work well with the exact dimensions and scrape style of the C.J.F. reeds, given the likely discrepancy between modern-day cane quality and that of the nineteenth century.

The area around the top wire tends to shrink with age and influences tone quality. Original reeds, with few exceptions, will probably have thus decreased in size from their original dimensions, particularly at this crucial point in the middle of the reed. Experience had already taught me that by slightly increasing the diameter at the top wire, a fuller, rounder tone quality could be obtained and the tones of the lower register would respond more easily. Conversely, a smaller diameter adds resistance, improves high notes, but worsens low notes, and can make the tone quality unpleasantly "bright". It is therefore essential to find an ideal compromise serving both extremes, and to this end I additionally decided to try using more softer layers of cane with an outer profile, or modern scrape.

Starting anew with the next reed constructions from the sample cane groups, manual profiling of the cane was done with a knife [fig. 5.9] on the entire length of the blade.[242] A clearly significant advantage of this method is that it allows the reed maker to test the resistance in each individual piece of cane with each knife stroke, as opposed to using a modern profiling machine that removes the outer bark according to fixed parameters.[243] Hardness/density can immediately be taken into account and each piece given a thicker or thinner profile, accordingly. A basic manual on the hand-profiling technique can be found in appendix 2.[244]

Figure 5.9. The first phase of bark removal in manual profiling

Taking probable shrinkage of the original reeds into account, I increased the diameter at the top-wire slightly, and counteracted the presence of more material by thinning the area at the bottom of the blade near the wire, which I suspected would alleviate the above-mentioned problems of response and tone quality caused by hard cane. The consequences of enlarging the

[242] In this process, layers of cane are removed from the outside of the vibrating blade part of the reed, and results in a "modern scrape".
[243] If profiling with a machine, it would be best to pre-select cane on the basis of hardness/density in order to match the machine's fixed settings for removing bark.
[244] Additional instructions on hand-profiling can be found in: James R. McKay, *The Bassoon Reed Manual: Lou Skinner's Theories and Techniques* (Bloomington, IN: Indiana University Press, 2000), 42–43.

diameter finally had to be adjusted by shortening the entire reed for reasons of pitch [see a comparison of measurements in tables 5.3 and, 3.4 on page 155].[245]

The second series of reeds was constructed using soft brass wire measuring 0.6 mm and a thread wrapping, covered with a hardening nail polish. Imitating the C.J.F. reeds, initially only two wires were placed on the reeds, instead of three [fig. 5.10]. During the scraping process however, it became too difficult to maintain control of the reed tip opening in general and therefore a middle wire was added. Tip openings of reeds with two wires (left) and three (right) are illustrated in figure 5.11. The tip from the two-wire reed is too open to control with the embouchure, while that from the three-wire reed exemplifies a moderate tip opening. A third wire eliminated the problem by providing extra tension, which did not allow it to open as widely as with only two wires.[246]

Figure 5.10. "Modern scrape" reeds with two wires; uncut (left); cut and wrapped (right)

[245] A larger diameter at the first wire lowers pitch. This can be rectified by shortening the blade length, which then raises it again.

[246] The tip opening determines how much embouchure control is necessary; ideally, this should not be excessive. Several students constructed some well-functioning reeds using only two wires, but no substantial conclusion could be drawn about the advantage of using two wires, as opposed to three. It is also feasible that the differences in tip openings between the original reed and those made of contemporary cane are in part caused by hardness of material.

Figure 5.11. Tip openings

**Figure 5.12. Original two-wired *C.J.F.* reed (left);
a contemporary three-wired reed (right), with modern scrape**

Successful reeds

I gradually developed a better sense of intuition about cane quality during reed constructions. Even after just a dozen reeds of the next series were finished, tested, and "played in", I noticed that each one, although having typically unique characteristics, was invariably "better-than-average", ranging to "very good".[247] I had apparently been able to find a successful compromise between dimensions and material; a three-and-a-half octave range was consistent, with an even tone quality from the low to high registers. If somewhat oversimplified, suffice it to say that a broad diameter at the first wire provided a good response in the low register and a full tone quality; the relatively short dimensions favored the high notes. These two factors, combined with a rather lighter than heavier blade scrape, offered advantages at both extremes of the range [see a comparison in fig. 5.12]. Three wires were used in place of two, providing more tension in the blades and more control over the tip opening. Once convinced of the possibility of playing the highest notes, most of my constructed reeds afterwards seemed to produce at least a d^2, if not the top $e\flat^2$, as well. My reed-making had dramatically improved, or I had learnt to play the high notes on the new examples better, or both; it was impossible to conclude if one had more influence on this outcome than the other. As with other acquired skills such as bicycle riding or skiing, I couldn't return to a previous "unknowing" state of not being able to play c^1– $e\flat^2$; subsequently, tests made with my old reeds produced almost the same successful results in the high register.[248] It is probable that even small, critical differences in the dimensions of the new reeds were enough to propel me into the last half-octave, making it easier to reach these notes with my original set-up.[249]

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[247] "Playing-in" or "breaking-in" a reed is the process in which the cane swells and shrinks repeatedly when wet and dry until reaching a more stable phase; the amount of time this takes is not always predictable.
[248] Certainly the dimensions of the old reeds were not ideal, but they were close enough for me to be able to produce the highest tones, as I now "knew" (in a physical sense) what I had to do.
[249] My previous reed dimensions were similar to those of C.J.F. nos. 1–4, although slightly longer and narrower at the top wire.

As constructions proceeded, the overall percentage of useable reeds remained exceptionally high, regardless of variation in hardness and relative density values; I was convinced that I was instinctively reacting to the qualities of the material in a better and more perceptive manner during each finishing step than previously. Figure 5.13 and table 5.3 illustrate the dimensions of some exceptionally successful examples constructed from Madame Ghys cane.[250]

[Table 3.4, with the original C. J. F. reed dimensions, is reproduced here again in order to facilitate comparson.]

Figure 5.13. Reeds G17, 21, 25

[250] See chapter 3 for a comparison of dimensions with other historical reeds.

TABLE 5.3. DIMENSIONS OF FIVE REED REPLICAS

Reed Name	Total length In mm A	Blade length In mm B	Tube length In mm C	Tip width In mm D	1. wire Ø In mm E	2. wire Ø In mm F	H	RD
7G	55.60	27.37	28.23	15.57	8.66	7.50	19.00	0.41
17G	55.45	26.54	28.91	15.40	9.12	7.65	19.30	0.40
21G	56.25	26.58	29.40	15.44	9.00	7.49	20.60	0.36
25G	54.31	25.94	28.37	15.70.	9.00	7.36	16.30	0.44
30G	55.98	27.56	28.42	15.24	9.54	7.81	26.20	0.40

H=Hardness, RD=Relative Density

TABLE 3.4. C. J. F. REED DIMENSIONS (FROM CHAPTER 3)

Reed No.	Total length in mm A	Blade length in mm B	Tube length in mm C	Tip in mm D	1. wire Ø in mm E	Above wrapping Ø in mm F
1.	57.50	27.50	30.00	15.00	8.00	7.50
2.	56.50	25.50	31.00	15.00	8.00	7.25
3.	58.00	29.00	29.00	14.00	8.00	7.25
4.	57.50	27.00	30.50	13.50	8.00	7.25
5.	65.00	27.00	38.00	13.00	8.50	7.25
6.	66.50	26.60	40.00	14.50	9.25	-

A comparison of the two sets of measurements in tables 5.3 and 3.4 shows small but important discrepancies, primarily found in the diameter above the first wire [E] and total length [A]; the tube length [C] is difficult to compare, as the C.J.F. reeds have no defined end of tube/beginning of blade points.

Individual taste in timbre, and physical attributes of each bassoonist, as well as tuning requirements of a specific instrument, determine how much and what kind of finishing is required. The reed-making process consists of numerous stages before one reaches an optimal result, but it is not my intention to go into detail about all of these steps within the scope of this study. Many manuals, articles and books are available on this subject, and James B. Kopp provides thorough explanations and illustrations concerning the physics involved in bassoon reeds in several excellent articles.[251] A final word about reed dimensions should emphasize that these also ultimately depend upon the bocal length and diameter, including its conical tapering. An ideal combination of bocal and reed, or "set-up", will provide the desired tonal characteristics and response, as well as the appropriate pitch and adequate dynamic possibilities.

Part 2: Learning processes

5.4 Details of my journey to the top register

The first attempts at duplicating the C.J.F. reeds had given me the possibility of actually screeching out the very top notes up to e♭^{2}, but with a primitive tone quality. With perseverance, and using the reed dimensions described above, I was eventually able to produce high and low register notes with equal ease and an acceptable quality of timbre, and begin to weave these into a fluid, musical technique. Any extra pressure on the reed or upward jaw position, known as "biting", proved to be detrimental; a relaxed jaw position ensured an even tone quality and prevented a "squeezed" or forced sound. After repeated and regular practice, I could increasingly control articulation and dynamic levels, adjusting intonation with air pressure and a choice of fingerings (see "A flexible fingering system" below).

A significant and unanticipated aspect concerning high note production only became fully apparent after I had successfully "mastered" the full range. Reflecting on the learning process during my high-register quest, I realized that I had been previously hindered by a belief system dictating that the range of my instrument ended with b♭^{1} or c^2. Although costing me more

[251] Kopp, 'Physical Forces at Work in Bassoon Reeds', *Double Reed,* 26/2 (2003), 69–81. A second, more recent article from Kopp is: 'Tube, Tip and Aperture: The Functional Geometry of your Bassoon Reed', Ibid., 36/3, 69–78.

energy and time than initially expected, I passed over the hurdle again and again playing to $e\flat^2$. Eventually, I was able to alter my fixed mindset, recognizing the potential impact that a strong “conviction of possibility”, or “self-efficacy”, could have on students attempting these tones for the first time. Some were anxious about the high register, particularly if they had been working with an inadequate set-up or had previously experienced difficulties with this range on the modern bassoon; others didn’t expect to encounter any problems, possessing a sense of self-efficacy which would prove to be to their advantage.

An observation: modeling and self-efficacy

Bearing my own experiences in mind, experiments continued in my two classes as I casually played the notes a^1 – $e\flat^2$ chromatically when students entered the classroom, noting what responses were evoked. I observed that such a demonstration triggered motivation along the lines of, “If she does it, I could do it!”[252] The students could hear and see that I was not using any unusual physical effort or a special reed and their curiosity led to questions regarding the pitch of the note or fingering used to obtain it, followed afterwards by inquiries about the compositions requiring this range.

I consciously avoided suggesting absolute fingerings, knowing that differences in instruments, reeds, air pressure and embouchure might require alternate positions. Instead, trials combining the many factors involving bassoon hardware and individual physical aspects were spontaneously initiated to find out how to facilitate reaching the highest notes, using various reed dimensions, bocals, and fingerings with different bassoon models. This approach, in combination with confronting and breaking down personal psychological barriers concerning range, influenced the learning process very effectively, as seen in the following examples 1–6. Again and again, I demonstrated that I could produce the highest tones with ease.

[252] WP, http://en.wikipedia.org/wiki/Self-efficacy [accessed April 10, 2015.]. Bandura's four factors of self-efficacy, “Experience”, “Modeling”, “Social Persuasion” and “Physiological Factors”, are summarized here.

This simple pedagogical strategy, bearing similarity to modes used by athletes developing new motor skills, is described by psychologist Albert Bandura, who compares "trial and error" with that of "modeling":

> The correct form of a skill can also be discovered through the more rudimentary form of learning based on trial and error experiences. By varying their actions and observing the results they produce, novices may eventually figure out how best to perform the activity. This is a toilsome mode of acquisition, however, especially during early phases of learning of skills with complex features. One can spend many dreary hours in trial and error labor searching for the proper form of a skill without finding it.
> The acquisition process can be accelerated by transmitting the rule structure of the skill through modeling and then refining and perfecting it experientially. [253]

Bandura includes an example about music students, describing how the physical learning process can evolve one step further through modeling, or demonstration:

> Informative comparisons of different modes of motor learning are not as common as expected. . . . In the view shared widely by investigators in this field, people learn by the results of their actions. . . . By contrast, most motor skills involve complex structures in which multiple subskills must be spatially organized and temporally sequenced to achieve desired results. As previously noted, it would take an inordinate amount of time to learn the dynamic structure of complex skills by response feedback alone. Intricate skills can be symbolically constructed much faster by seeing the behavior modeled in an already integrated form than by trying to construct it gradually from observing the results of one's trial and error efforts.…Thus for example, in teaching aspiring violinists how to become better instrumentalists, master mentors correctively model how to play troublesome passages both technically and with greater emotional expressiveness. Students are not merely told to add some life to their spiritless play. They are shown how to do it.[254]

Once high-register skills were secure, the next goals were to transform the new technique into a true musical fluency, with control over appropriate aesthetic characteristics, using articulation, dynamic nuance and expression.

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[253] Albert Bandura, *Self-efficacy: the exercise of control* (New York: W. H. Freeman, 1997), 372.
[254] Ibid., 378–79.

5.5 Pedagogical examples

My findings could be correlated by my students at the Royal Conservatoire in The Hague and Schola Cantorum Basiliensis, as I observed their attempts to extend their ranges beyond $b\flat^1$, noting their experiences and outcomes as outlined in these points:

- Set-ups, or individual reed dimensions combined with bocals for each student's bassoon, monitored by accuracy of pitch, even intonation and tone quality.[255]
- Physical factors of embouchure, jaw position, posture
- A fingering system for the tones $b\flat^1$–$e\flat^2$
- Mental attitude and "positive transfer"

Set-up variations

The three fundamental elements of a set-up can be classified according to the degree in which they can readily be altered: reed, bocal, and instrument. Reed dimensions are easily modified, but the choices of available bocal models can be limited, depending upon the bassoon in question. Furthermore, almost imperceptible differences in weight and dimensions render each bocal unique, and players may notice substantial divergence in tuning and/or timbre between even two of the same model made by one builder. Alterations in the last element, the bassoon (for example of the instrument's tone holes or bores) are only recommended in accordance with the builder's instructions. An example of the consequence of a set-up change is illustrated in example 1.

Example 1:

Gergõ could play up to c^2 with his set-up, but not with complete accuracy and consistency. Although he carried out various reed experiments over a period of time, he was not able to

[255] These are obviously subjective values to a certain degree, but can be evaluated by an experienced player. An example would be to test if the set-up allows equal response and even intonation in all registers.

make a breakthrough. He could occasionally access c^2 from c^1 using a kind of *legato* between the two notes, but the top octave didn't speak independently. Finally, testing a lighter bocal of the same length, his previous efforts came together and were manifested in a stable and beautiful c^2. With the new set-up, he reported that most of his reeds worked very well. He explained further that whenever he needed to rediscover the physical sensation of the c^2 in his body, the easiest approach was to start an octave below, at c^1, or even from g^1, using a slurring exercise. In this manner, the increase of air pressure making the higher octave speak was re-identified and could easily be repeated:

> The sensation that helps me attack and sustain c^2 on the bassoon is similar to the one I have when I try to play a very high note on the recorder really softly – it needs a very specific air concentration and this concentration I can somehow control by focusing on a certain point in the upper part of my back. After having mastered c^2, then the tone b^1, which I had not been able to play before, this came more or less automatically by experimenting with $b\flat^1$ and c^2 positions and moving a couple of fingers around.

Instrument: Grenser model, Peter de Koningh / Bocals: de Koningh, "8S" and Nicholson, "Grenser".

Physical factors and tension

Posture, head and jaw position are all visible physical aspects that significantly influence tone production and can be easily monitored, while positions inside the mouth, nose and throat must be observed by the player her/himself and are difficult to observe. Two students demonstrated their progress with range extensions [to c^1] in examples 2 and 3, concentrating on various physical issues.

Example 2:

Salomé had been working on perfecting the c^2 with the assistance of a physical therapist, and reported that her head position appeared to influence how well she could produce this tone accurately. She noticed that if she consciously pulled her head slightly backwards, while maintaining a relaxed jaw position, she could attack the note more cleanly and consistently. Focusing on a relaxed position and re-enforcing new physical habits, she became familiar with the posture needed for the high register; after a few weeks she could produce the c^2 using various reeds. This implied that Salomé's success was not just due to one "special" reed, but the newly-learnt physical technique, as well. After six months, she successfully performed Antoine Dard's *Sonate 3* [fig. 5.14] which requires c^2 twice in measure 13, on her final masters recital.

Instrument and bocal: Prudent copy, L. Verjat.

Figure 5.14. Antoine Dard, *Sonate 3,*
(from *6 Sonates pour le violoncelle (basson) avec la basse continue*), *Adagio,* measures 12–14

Example 3:

Another student, Kim, had been reflecting on several physical points as she attempted to produce the highest notes, playing both the recorder and historical bassoon. Although she knew that she should maintain substantial air support from her diaphragm, a feeling of tension or cramping in the upper chest muscles bothered her when she saw a high tone approaching in the music; at this moment, she tended to bring her shoulders forward, which negatively influenced her tone production. By deliberately drawing her shoulder blades back to stretch this area while playing long tones in the middle register, she was able to relax while focusing on maintaining a good sound quality. She then proceeded to the high register keeping the same focus and position of the shoulder blades. Furthermore, she reported that she had previously noticed a sensation of closing "something inside her nose" at some point in the high register, and when she could open this passage by imagining she was releasing some air though the nose (but not actually doing this), this sensation disappeared. A last observation regarded advice she had already heard from various teachers concerned facial expression, namely: it is essential to avoid any tension or movement in the forehead or eyebrows while approaching high notes, as this also induces tension in the throat or elsewhere. Awareness of these specific physical issues improved her tone quality of the upper notes, and gave her the confidence and certainty required to perform an aria with an obbligato bassoon part, 'Ah, nos peines serront communes' from Luigi Cherubini's opera *Médée,* featuring several prominent c^2s [fig. 5.15, measure 18 and fig. 5.16, measures 103–06].

Instrument and bocal: Grenser copy, L. Ross.

Figure 5.15. Luigi Cherubini, *Médée,* 'Ah, nos peines serront communes', *Andantino,* measures 1–23

Figure 5.16. Luigi Cherubini, *Médée,* 'Ah, nos peines serront communes', *Andantino,* measures 98–108

A flexible fingering system

High-register fingerings on any bassoon, whether modern or historical, may seem complicated and illogical; learning all of the variations that are additionally possible on period instruments can be even more daunting. In 1990, bassoonist Paul J. White compiled a collection of seventeen fingering charts for early bassoons, even collating them for practical use; this serves as an excellent starting point for experimentation.[256]

Students are often surprised at the great variety of options presented, and then attempt to test them while numbly staring at sets of unfamiliar fingerings.[257] I observed that when excessively concentrating on a fingering chart, the rest of the body may do the opposite of what it should to play an instrument, and tension may hinder the breathing apparatus and facial muscles. Moving between notes with new, complicated finger combinations may trigger additional tension in the hands. By taking focus away from one or more unfamiliar fingerings and instead using a general system of raising and lowering pitches described as below, assimilating new information is less formidable. How this valuable learning tool can function is shown in example 4.

Example 4:

Fingering choices were efficiently and successfully approached while Andrew was learning how to find the highest tones on his new bassoon. Instead of attempting to make one specific fingering per note work, he followed the simple pattern of lifting a finger and/or opening a closed key to move to the next pitch, although this did not always immediately result in the difference of a full half-step. The ascending notes from c^2 upwards could be found by opening the remaining keys or tone holes one by one (or more), and the tuning adjusted by changing air pressure, as necessary. Instead of concentrating on learning only one exact and definite position per note, Andrew quickly found that he could move from one fingering or tone to the next, casually testing one option and then another, varying air pressure to correct pitch. In this manner he could eventually choose which combinations were most in tune and had the best response; soon he achieved playing chromatically up to d^2 with natural ease and later also

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256 White, 'Early Bassoon Fingering Charts', GSJ, 43 (March 1990), 68–111.
257 Ibid., 81–82. For example: No fewer than 19 options are given for $g\#^1/a\flat^1$, and 10 for c^2.

reached $e\flat^2$. In order to facilitate the production of these notes during experimentation, I suggested that he close the pinhole in the bocal during this session by means of a piece of adhesive tape.[258]

Instrument: Grenser copy, P. Orriols & A. Sibila; Bocal: V. Onida.

Mental attitudes and "positive transfer"

Examples 5 and 6 illustrate how two students, both with previous modern bassoon experience, could assess what actions were necessary to produce a three-and-a half-octave range with their current set-up. Modeling and self-efficacy played significant roles in how easily and rapidly Dorothy and Hugo learnt to extend their registers with little or no intervention on my part. Possessing sufficient knowledge from experience with the modern instrument which could also be implemented on the period bassoon, they used the method of "positive transfer" to attain the high-register notes.[259]

Example 5:

Dorothy, a professional modern and historical bassoon player, reacted quite quickly to the method of modeling and produced all the top notes up to $e\flat^2$ in relatively short order after hearing me play them. Her long-standing experience with the modern instrument (where these notes are more easily produced with additional keys) had undoubtedly already given her an intuitive feeling of where and how she could locate them. As seen with Andrew [ex. 4], she could easily experiment with different fingering combinations that I suggested until she discovered those that worked optimally with her set-up and instrument. She now approaches

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[258] Experience has shown that high and low notes have an easier response when the bocal hole, or pinhole, is closed; some tones in the middle register might be adversely affected, however. Modern bassoons have a "whisper key" which serves to open and close this tiny opening in the bocal.

[259] Jeanne Ellis Ormrod, *Human Learning* (4th edn.; Upper Saddle River, N.J.: Pearsen Education, 2004), 361. Ormrod calls the type of learning facilitated by previous knowledge in a similar situation "positive transfer".

this register with self-efficacy on the period bassoon and is able to implement her newly-gained knowledge in professional situations.

Instrument and bocal: Grenser copy, P. Orriols & A. Sibila, "Bonaire".

Example 6:

Hugo was unfettered by the idea that notes above the $b\flat^1$ could be at all problematic and also relied on his solid ability of high-register facility on the modern bassoon to find solutions for the period instrument's highest register. Beginning by approaching the goal as one easily attainable on the historical bassoon, he rapidly and independently discovered how to reach the top notes on his nineteenth-century instrument. When queried about this process, Hugo reported that he looked for the "right" overtones in the reed, and described an intuitive sense that helped him seek appropriate combinations of air speed, throat opening, and embouchure pressure, and was additionally able to experiment freely with various fingering combinations. He eventually performed Du Puy's Quintet, which ascends chromatically to $e\flat^2$.[260]

Instrument: Anonymous French, nineteenth century, from the collection of B. Aghassi.

5.6 Outcomes

My sensitivity to the qualities of *Arundo donax* noticeably increased as I compared hardness and density in three sample groups of cane, subsequently improving my reed construction. After experimenting with the dimensions based on the original C.J.F. reeds, I can conclude that specific modifications of these, in combination with a finishing style better adapted to harder contemporary cane, led to a more successful set-up with my Grenser & Wiesner bassoon than

[260] See the description and examples of this piece in chapter 4.

previously obtained, and enabled me to develop a range of three-and-a-half octaves.[261]

While this new set-up was an obvious turning point influencing my own results, it must be concluded that no single reed dimension can absolutely and generally guarantee an extended range. My students, for example, all used individual reed dimensions suited to their own set-ups, proving that not one specific shape, size, or style of reed alone, but rather a complex combination of physical and mental factors, in addition to their material, were responsible for their success with high register extension. We found that it was initially necessary to ensure that an individual set-up was adequate; the next priority was to produce an even tone quality with impeccable intonation throughout the whole range. After establishing a functional set-up, it was vital to avoid any unnecessary physical tension from the embouchure, jaw or elsewhere, as this potentially limits dynamic possibilities and timbre character.

After learning to overcome my own self-imposed limit of range, I realized how modeling could be implemented as a powerful and valuable pedagogical tool and witnessed the effectiveness of self-efficacy. My students were also eventually successful in extending their ranges as they observed demonstrations, analyzed their physical positions and experimented with fingerings, using various reed dimensions, models of bocals and instruments. Although some important material and technical tools have been investigated and reported in this chapter, a high level of technical facility and a strong musical sense of *cantabile* playing remain to be developed further, and present worthwhile challenges for present and future generations of period bassoonists wishing to perform the nineteenth-century works composed for Frans Preumayr.

261 This conclusion does not rule out the older style of internal gouging as a valid approach; the choice of a scraping/finishing method, however, is best determined by the quality of each piece of *Arundo donax* being used.