The Bassoons of the Sax Family: Charles-Joseph and Adolphe, *père et fils*

Part I: The Charles-Joseph Sax Bassoons

David Rachor
Tempe, Arizona

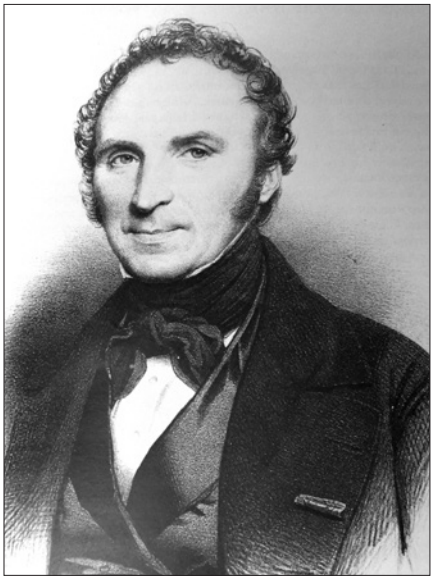

Figure 1. Charles-Joseph Sax (1790–1865).

Figure 2. Adolphe Sax (1814–1894).

This article is the first part of a session presented at the International Double Reed Society meeting on July 23, 2024, in Flagstaff, AZ. The second part, focusing on the bassoons by Adolphe Sax, will appear in a future volume of The Double Reed.

For a large part of the nineteenth century, the Sax family was an important and influential maker of wind instruments. Charles-Joseph Sax (1790–1865; portraits in Figures 1 and 7) and his son Adolphe (1814–1894; Figure 2) were arguably two of the most significant wind instrument makers of their time.[1] From around 1820, when Charles-Joseph Sax (Sax *père*) established his instrument making business in Brussels, to the death of Adolphe Sax (Sax *fils*) in Paris in 1894, the father-son duo produced some of Europe's finest and most innovative wind instruments.

Even though the bassoon never comprised a large portion of their output, the instrument was, in its own unique way, noteworthy to their enterprise. The father and son produced bassoons for approximately forty years between 1810 and 1850. During this period, Sax bassoons evolved from a wooden instrument with seven keys to a metal bassoon with

Significant Dates and Facts of Charles-Joseph Sax (1790–1865)

Early Life & Training

1790 Born on February 1 in Dinant, in the Southern Netherlands (now Belgium).

- Trains as an *ébéniste* [cabinetmaker], not as in instrument maker.
- Works as a machinist and manager of a *machines à filer* [cloth-making machine] manufacturer.

Early Years of Instrument Making

1815 Moves to Brussels at the age of 25 and starts his instrument-making business.

- Despite lacking formal music education, he plays the serpent in local amateur bands.
- He does not know the craft of instrument building but makes his own tools to start the business.
- Initially focuses on making serpents and flutes, and eventually expands to clarinets and bassoons.

Professional Success

1819 Appointed *Facteur de la Cour and fournisseur des régiments belges* [Court Instrument Maker and Supplier to the Belgian Regiments] by King William I of the United Netherlands, producing most of the instruments used by the Belgian Army.

1827 His company grows, employing 80 craftsmen at his factory.

1830–1833 The company faces disruptions and reduced instrument production during the Belgian Revolution.

1836 Awarded the prestigious "L'Ordre de Léopold" medal by the King of Belgium for his work in musical instruments.

1825–1852 Granted twelve Belgian and two French patents for improvements to wind and keyboard instruments.

Later Career

1842 Receives a *brevet* [patent] on his improved bassoon design. In the same year, his son, Adolphe, moves to Paris to continue his work in music and instrument making.

1853 Moves to Paris and begins working closely with his son Adolphe.

1865 Dies in Paris on April 26.

twenty-three keys. And even though the Sax family was essential to the bassoon's advancement, ironically, Sax *fils* was influential in removing the bassoon from the French Army, the Sax family's most important customer and consumer of their wind instruments.

Developing the bassoon was a Sax family endeavor, with both father and son influencing the nineteenth-century bassoon. Significantly, Sax *fils* borrowed design characteristics of Sax *père* and, as we will see, used the ideas and innovations developed by his father in his patents.

Charles-Joseph Sax

The Sax family genius and his unusual path to the craft of wind instrument making

In my opinion, Charles-Joseph was the genius of the Sax family. There are several reasons for my assessment: first, his path to becoming a significant wind instrument maker was very different from that of most other wind instrument manufacturers. Unlike many devotees to the instrument making craft, Sax *père* did not have the advantage of being born into a family of instrument makers, as did his son Adolphe. In addition, he did not have any formal musical instrument making training or an apprenticeship with another instrument maker. Charles-Joseph did not even have any formal training in the playing of wind instruments. His only musical experience was playing the serpent in an amateur town band.[2] Before starting his musical instrument making firm in 1815 in Brussels, he was an *ébéniste* [cabinetmaker] and a machinist and factory manager at a firm in Ghent that made *machines à filer* [cloth-making machines].[3] It should be noted that even though his early career was far afield from musical instrument manufacture, those experiences undoubtedly aided him a great deal in the long run.

François Joseph Fétis (1784–1871; Figure 3) reports that Sax *père* taught himself musical instrument making, and because of a *lacuna* of resources, he made his own instrument making tools.[4] His early career endeavors as a cabinet maker and a machinist served him well in instrument making. As an *ébéniste*, he could have learned not only how to form and shape wood but also how to select the best wood for each intended propose. Fétis, in the *Revue Musicale* of 1834, comments that Charles-Joseph was very attentive to selecting the woods for his wooden instruments. Fétis also states that after securing the wood for his instruments, Sax *père* reamed the initial rough bore and set the wood aside to dry for seven or eight years.[5] As a machinist and factory manager who made *machines à filer*, Sax *père* had to deal with machines made with wood and metal parts. More importantly, the managerial experience

Figure 3. François Joseph Fétis (1784–1871), biographer and supporter of the Sax family.

he gained was undoubtedly valuable as his workforce later grew and his production of instruments increased.

Another indication of the genius of Charles-Joseph Sax was the rapid pace at which he developed his wind instrument making enterprise. In the span of only four years between 1815 and 1819, he developed his firm to the point that, in 1819, he was named *Facteur de la Cour et fournisseur des régiments belges* [Official Instrument Maker to the King of the United Netherlands for Belgian Regiments]. By the early 1820s, he had become one of the French-speaking countries' most important wind instrument makers. Fétis reports that in 1827, Charles-Joseph employed 80 artisans in his factory. (See Sidebar for important events in the life of Charles-Joseph Sax.)

Although Adolphe is generally viewed as the most significant instrument maker of the Sax family, Sax *fils* might not have been as important an instrument inventor and maker without the work of Sax *père*. Simply put, Charles-Joseph laid the groundwork for his son, Adolphe. Charles-Joseph's bassoon and wind acoustics patents are examples of this groundwork. Even though Sax *père* was not granted as many patents as Adolphe, the greater part of Charles-Joseph's patents relate directly to the future musical instrument inventions and innovations of his son.[6]

Commerce and manufacture of wind instruments for the French army in the nineteenth century

The French Army was an indispensable patron for the Sax family and all French wind instrument makers. Le Comte de Pontécoulant (1794–1882; Figure 4), soldier, musicologist, and an important commentator on French musical instrument making, provides statistics demonstrating the number of wind instruments required by the French Army.[7] Pontécoulant reports that in the 1860s, there were 229 regiments in the French Army, and each regiment had a *musiques* [wind band].[8] According to this source, there were approximately 8,000 musicians in the French Army.[9] These musicians required an enormous number of wind instruments to be manufactured by French wind instrument makers, leading one to deduce that most wind instruments manufactured during this time were produced for use by the French Army.

Figure 4. Le Comte de Pontécoulant (1794–1882), important commentator on French musical instrument making.

Pontécoulant reports that in 1861, 900 bassoons were made yearly in France.[10] Why was such a large number of bassoons produced each year? Pontécoulant also writes that a bassoon was serviceable for only five years; the same was true

for all regimental instruments.[11] Perhaps a bassoon was serviceable for only such a short period because playing in a regimental *musiques* involved, for the most part, performing outdoors. There are a number of other reasons bassoons lasted only five years: it seems that regimental musicians did not have cases for their instruments (the requirement that instruments have cases was included in an army regulation only passed later in the nineteenth century); the musicians walked with the regiment, probably playing often; and when not on campaign, the *musiques* were required to present two outdoor public concerts a week.[12] Pontécoulant was a soldier in the armies of Napoleon I, and he fought in the invasion of Russia and the campaign of 1814. One can imagine that he had first-hand knowledge of the rigors of the 1,700-mile march from Paris to Moscow (the distance between New York and Denver) in the 1814 Russian campaign without instrument cases and the effect this had on the serviceability of the wind instruments, not to mention the musicians themselves.

Belgium, the native region of the sax family and of great importance to their success

The modern state of Belgium did not exist when either Charles-Joseph or Adolphe Sax were born. The somewhat complicated history of Belgium needs to be discussed since it had a considerable influence on the success or failure of the Sax family's instrument making business. Before 1830, the region known today as Belgium was always a part of another kingdom or state. In brief: the area was annexed in 1794 by the French First Republic (1792–1804) during the French Revolutionary Wars (1792–1802). Before this annexation, this region had been under Habsburg rule since the sixteenth century and was known as the Austrian Netherlands. In 1814, after the fall of Napolean, the United Kingdom of the Netherlands was formed under King William I (1772–1843). The region of modern Belgium, then part of the Netherlands, was known at that time as "Southern Netherlands" or "Catholic Netherlands." In August 1830, the Belgian Revolution took place, and the Southern Netherlands became the kingdom of Belgium under Leopold I (1790–1865).[13]

The story only gets more interesting from here. It appears that Belgium was created as the result of an opera performance. On August 25, 1830, riots erupted in Brussels, aided by theatergoers who had just seen the grand opera *La muette de Portici*, written by the French composer Daniel Auber (1782–1871). In the opera (see twentieth-century production photo in Figure 5), the final act culminates with a popular uprising in seventeenth-century Naples against the Spanish in a neighborhood called

Figure 5. Photograph from a production of the grand opera *La muette de Portici*, written by the French composer Daniel Auber (1782–1871).

Portici. The opera's final aria led to thunderous applause and the crowd spilling out into the streets of Brussels, reinforcing the uprising that became the Belgian Revolution of August 1830. This social rebellion led to the independence of Belgium from the United Kingdom of the Netherlands.[14]

Charles-Joseph Sax was fortunate to be born and work in the Southern Netherlands, a region second only to Britain in driving technological advancements during the early nineteenth-century Industrial Revolution. Belgium had several critical natural resources to support industry, which formed the basis of the newly developing "factory system" used by both Sax *père* and *fils* to their advantage. Coal mines necessary for iron making, a system of navigable rivers, and canals for transporting raw materials and finished products played a crucial role in the expansion of the Sax family's wind instrument firm.[15]

Belgium, the battlefield of Europe

Since the Middle Ages, and especially during the Napoleonic wars (1803–1815), European armies regularly crossed through or were garrisoned in the region of the Southern Netherlands. For example, the famous Battle of Waterloo was fought on June 18, 1815, only sixteen kilometers from Brussels where Sax *père* had his workshop (see Figure 6). These large armies had regimental bands that included bassoons. One can speculate that Sax profited from exposure to wind bands of foreign armies stationed not so distant from where he worked in Brussels by observing and then copying the modern improvements made to

Figure 6. Modern Belgium. Note the short distance between Brussels and Waterloo.

the instruments that marched through. It should be noted that Charles-Joseph Sax was not the only wind instrument maker who could have access to foreign regiments crossing the region; Antoine Tuerlinckx (1753–1827) of Malines (now Mechelen, Belgium) was another woodwind instrument maker who undoubtedly benefited from this movement of armies. Although not very well known today, Tuerlinckx was a prominent manufacturer of wind instruments who produced many exceptional bassoons.[16]

Charles-Joseph Sax's instrument making innovations

Both father and the son were innovative in their wind instrument making, but history, perhaps unduly, gives most of the credit to the son, Adolphe. One of Charles-Joseph's most significant innovations was the implementation of a division-of-labor system. This system assigned each worker one specific task (e.g., one craftsman would be assigned to drill tone holes or to fit keys), and they would perform this task for all woodwind instruments, not just on a specific instrument like the bassoon. This system of labor division is the opposite of what had been the traditional system in which one craftsman completed most, if not all, of the tasks needed to build a particular instrument. Another advancement of Sax *père* (something he most likely observed in other factories in Brussels) was his use of a vertical integration system.[17] In the case of Charles-Joseph, this system entailed housing all the instrument making steps in his factory, including key making, which in the past had typically been completed by specialized producers. Charles-Joseph also was one of the first instrument makers to have a large enough factory to manufacture any woodwind or brass wind instrument. Traditionally, wind instrument making establishments specialized in woodwinds or brasswinds. Last, he developed instrument making machines using steam power, significantly lowering the use of expensive manual labor.

Charles-Joseph Sax could have also been one of the first instrument makers to intensely study the acoustics of wind instruments and then apply that acoustical knowledge to his products. Typically, wind instrument makers learned how to improve their instruments by trial and error: for example, drilling a tone hole on a bassoon, then redrilling it in a different position if the intonation or tone quality was found faulty. Significantly, Sax *père* discovered it was not the instrument's material that determined the timbre but the tube proportions.[18] Félix Savart (1781–1841), the eminent French acoustician wrote of Charles-Joseph Sax: "Mr. Sax discovered laws that not a single acoustic treatise could teach him, it is necessary to admit, the work of savants like Bernoulli [Daniel Bernoulli (1700–1782)], d'Amembert [Jean le Rond d'Amembert (1717–1783)], Euler [Leonhard Euler (1707–1783)] and even Lagrange [Joseph-Louis Lagrange (1736–1813)] was only very little useful to the making [of musical instruments]. Their theories of sounds and their calculations could never guide them where to drill the tone holes on conical bores."[19] Savart also wrote of Charles-Joseph that, "Mr. Sax possess an infallible law of vibration, that large tone holes give a fuller sound."[20] Charles-Joseph's "*loi de vibration*" manifested itself in his *brevet* [patent] on the bassoon of 1842, but more importantly, Charles-Joseph's research on large tone holes was adopted by his son, Adolphe, in the woodwinds that he designed and built. It is quite possible that Adolphe based his newly invented saxophone on the acoustical principles developed by his father.

One can assume that at the beginning of his career Charles-Joseph made the instruments himself because, in 1819, he was named *"Facteur de la Cour et fournisseur des régiments belges"* for the King of the United Netherlands. Later in his career, though, it would have been impossible for him to construct all his instruments personally, as is shown by the fact that by 1827, he employed approximately 80 craftsmen at his factory.[21] It is noted that Charles-Joseph personally taught his craftsmen their tasks and worked alongside them, which indicates that he kept close contact with his employees and oversaw the quality of instruments they produced.[22] This also means that when I refer to a "Charles-Joseph Sax bassoon," it means that the instrument was most likely made in the factory with the aid of craftsmen employed by Charles-Joseph and not necessarily by Sax alone.

Figure 7. Charles-Joseph Sax later in life.

The state of the bassoon ca.1815 when Charles-Joseph Sax started his business

The bassoon changed considerably during the nineteenth century, both externally and internally. When Charles-Joseph Sax began making bassoons, probably around 1815 when he moved to Brussels, the keywork was noticeably less complex than the basson made thirty or forty years later, by which point several more keys had been added. A bassoon made in 1815 typically had seven or eight keys (for the right hand little finger, the F and A-flat keys; for the right thumb, the F-sharp key; and for the left thumb, low D, low B-flat, and low E-flat keys; plus one or possibly two wing keys, controlled by the left hand thumb). Most bassoons made at this time, including many by Charles-Joseph, also had saddle mounts to connect the keys to the instrument's body. Such saddle mounts (see Figure 8) were well established and were sturdy enough for army regimental use.

Bassoons of 1815 also had six long and narrow finger holes drilled obliquely, with the three finger holes of each hand with the same pattern: the first drilled obliquely up toward the reed and the second and third drilled obliquely down away from the reed (see Figure 9).[23] As I will discuss later, these long, narrow tone holes significantly affected the bassoon's tone color and playing characteristics.

Compared to its relatively simple external features, the internal conical bore profile of an 1815 bassoon was notably complex (see Figure 10). The instrument that Charles-Joseph Sax began making had three different degrees of conicity:

Figure 8. Saddle key mounts on a Charles-Joseph Sax bassoon from the Kampmann Collection, Paris, France.

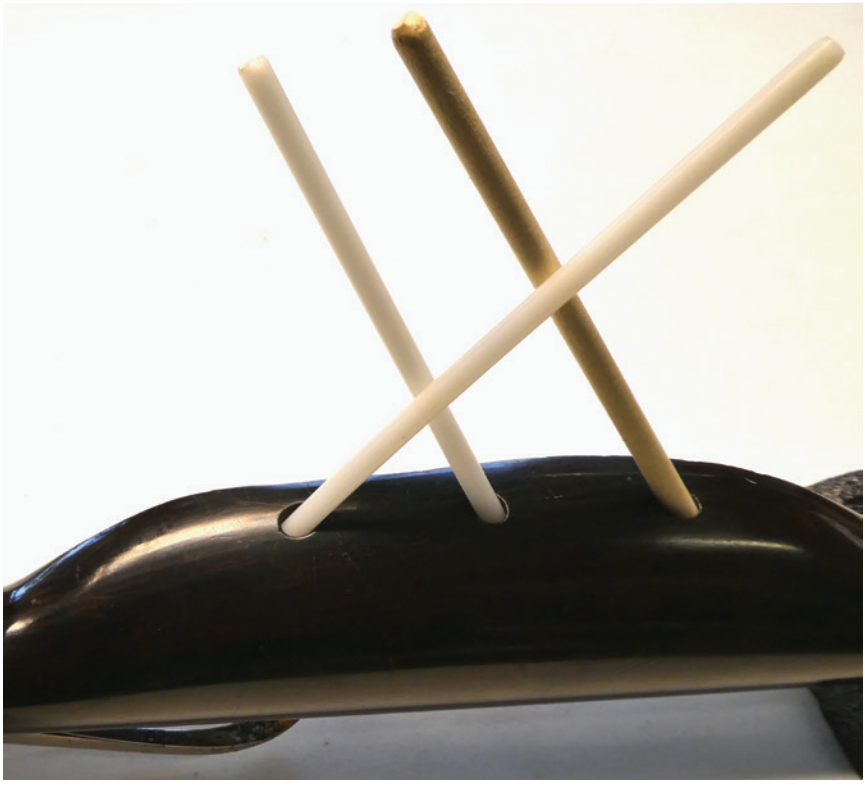

Figure 9. Bassoon wing joint showing the oblique angles of the finger holes.

- the first taper can be found in the wing joint, the large bore (or up-side) of the boot joint, and the long joint (see Figure 10, Green line);
- the second taper can be found in the small bore (or down-side) of the boot joint (see Figure 10, Red line);
- the third taper is found in the bell (see Figure 10, upper right corner).

The second and third bore tapers deserve some discussion. I call the portion of the bassoon bore in the downside of the boot the "transitional bore" since it transitions the wing joint taper back to the exact taper of the boot up-bore and the long joint. This "transitional bore" has less of a taper than the first taper[24] and is essential in maintaining the boot joint finger holes within reach of the right hand fingers and keeping the right thumb finger hole within a comfortable reach of the thumb.[25] This reduced degree of conicity (flare) of the downside of the boot became unnecessary once keys were added for the right hand, especially the G key (A tone hole). When the G key was added to the bassoon, making it no longer necessary to keep the A tone hole in reach of the third finger of the right hand, that tone hole could be more correctly positioned further down the bore.

The third bore taper, in the bell of the 1815 bassoon, was also complex in that it had a reduced taper that was almost cylindrical or even a reversed conicity. Note that the outside form of the bell does not reflect the internal bore taper. For example, the Charles-Joseph Sax bassoon, accession number 1977.017, located in the Brussels Musical Instrument Museum (MIM), has a bell bore length of 260 millimeters but across that length increases in diameter only about one millimeter.[26]

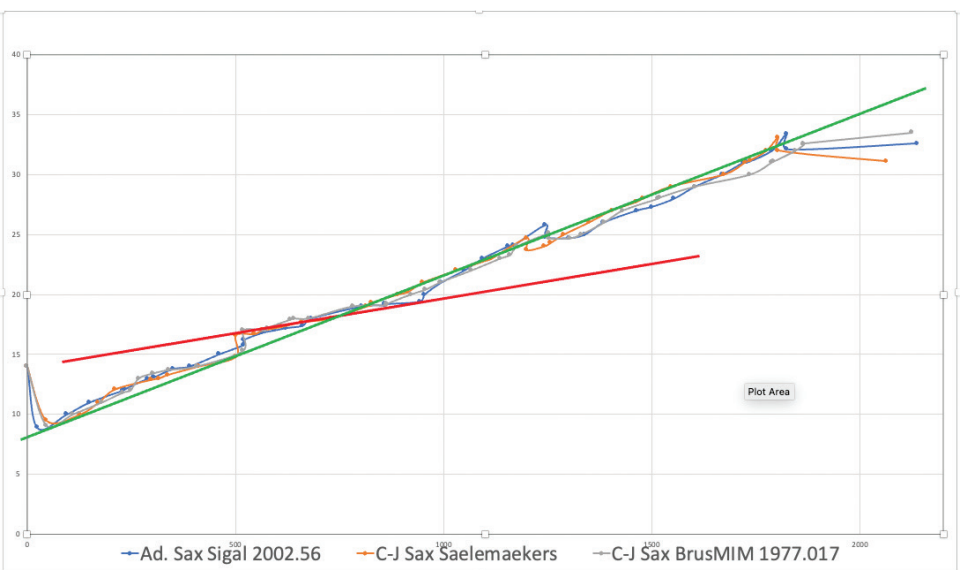

Figure 10. Graph showing the different tapers of a Charles-Joseph Sax bassoon bore.

The *Brevet* on the Bassoon, 1842: *"Basson construit d'après une nouvelle théorie acoustique"* ["Bassoon constructed after a new acoustic theory"]

Fétis reports that since 1825, Charles-Joseph Sax had researched the laws of vibration, and through this work he invented a totally new bassoon.[27] In 1842, seventeen years after starting his research, Charles-Joseph was granted a Belgian patent for his *nouveau système* bassoon, as he named it.[28] Notably, his *nouveau système* has large tone holes approximately the same diameter as the bore at all points down its conical bore. The tone holes are placed in the correct position in relation to the bore, which, according to Charles-Joseph, would produce perfect intonation. At that time, there was widespread agreement that the bassoon was severely out of tune.

In his *brevet*, Charles-Joseph does not change the old fingering system. Sax *père* was a good businessman; he knew professional musicians were loath to change fingerings that they spent years learning and would not readily purchase an instrument with a new fingering system. Charles-Joseph also did not change the length or bore profile of the "*basson ancien*" [old bassoon] in use at that time. As one can see in Figure 11, Sax draws his *nouveau système* and *basson ancien* with a straight tube, including the bocal.

In his *brevet*, Charles-Joseph Sax introduces a single reed mouthpiece for the bassoon, which replaces the traditional double reed. This may represent the first documented proposal of a single reed mouthpiece for the bassoon (refer to Figures 11, top right, and 12). Additionally, Sax outlines a novel concave key cup system that incorporates a rubber ring in place of the conventional leather pad (refer to Figure 11—top left, Sax's new key flap design; top right, older key flap). The concave (as viewed from the outside) design of the key cup suggests that Sax aimed to minimize the length of the tone hole by creating a key that extends into the tone hole. This design indicates Sax's awareness that even a closed tone hole's length can influence the bassoon's acoustic properties. Sax may have opted for a rubber ring over a leather pad due to the belief that the rubber would provide a more effective seal.

Sax *père* writes in his *brevet* that he reserves the right to make the instrument from brass and to make larger bassoons. He also says a brass instrument will be interesting to *harmonies* [military bands] because a brass bassoon would have a better tone quality.[29] [Sax *fils* will go on to appropriate this proposed brass bassoon of Charles-Joseph, which will be discussed in detail in a future issue of *The Double Reed*.] Last, Sax *père* states that the superiority of his *nouveau système* will be incontestable.

In addition to the brass construction, there are two other important details that Sax *fils* will copy from Charles-Joseph's 1842 *nouveau système* bassoon patent: 1) the large tone holes, approximately the diameter of the bore, and 2) a tone hole for every half step (see Figure 11). These two design characteristics of the *nouveau système* bassoon will be critical features of Adolphe Sax's 1851 bassoon, as well as his newly invented saxophone.

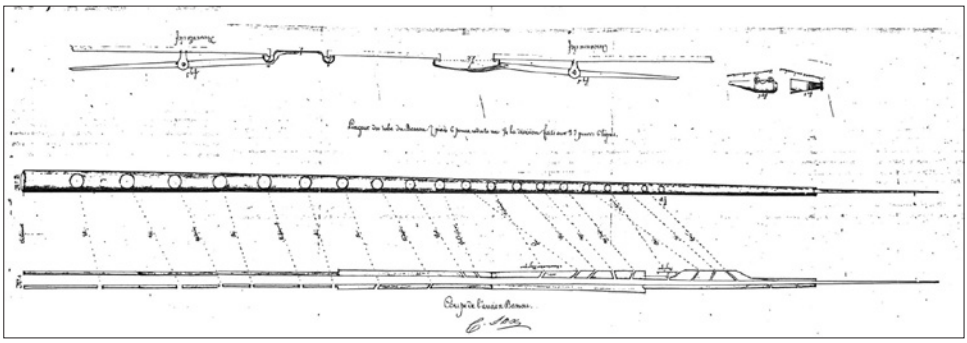

Figure 11. Charles-Joseph Sax's drawing of his *basson ancien* and "*Basson construit d'après une nouvelle théorie acoustique*" from his 1842 *brevet*.

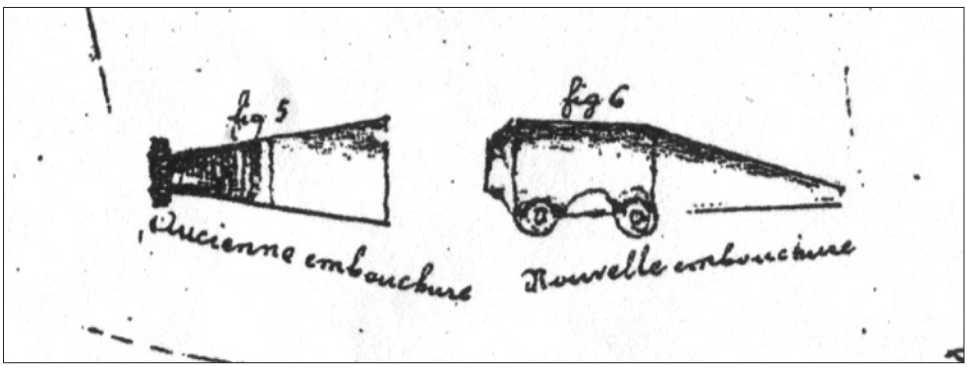

Figure 12. Detail from Charles-Joseph Sax's bassoon patent of 1842 of his single reed bassoon mouthpiece [*embouchure*].

The Eleven Extant Bassoons of Charles-Joseph Sax[30]

Even though Charles-Joseph was not a specialist in bassoon or even woodwinds, Fétis reports that the bassoon was one of the first instruments he made before he began producing the other winds. From Fétis, we can also intuit that Sax was likely personally involved in manufacturing at least a portion of the eleven Charles-Joseph Sax bassoons still extant and was interested in making the best quality instrument possible.[31] Fétis notes that the quality and sturdiness of Sax's woodwinds were due to the quality of the wood he used, and that he went to great expense to purchase a large quantity of billets that were subjected to a slow drying process of seven or eight years after being roughened and drilled.[32] The high quality of the wood could be one of the reasons we have eleven Charles-Joseph Sax bassoons to study today.

The Military Model Bassoon

According to my research examining ten of the eleven extant bassoons of Charles-Joseph Sax (one is in Japan and is not available for study), it is apparent that he made two different styles of instruments: I call these two versions a Military Model and a Deluxe Model.[33] In

general, his Military Model bassoon is a standard bassoon with seven or eight keys that one could find made by many makers in the first third of the nineteenth century and is similar to the ca.1815 bassoon described earlier. The seven military bassoons I examined are all made from maple, the same wood generally used for bassoons and other woodwind instruments.

The Military Model did not need to be an attractive bassoon, but it did need to be sturdy enough to withstand the rigors of use in a regimental band. In the Military Model, a more robust construction can be observed in the instrument's bell, a part of that bassoon that could easily find itself in harm's way. (The bells of many historical bassoons have gone missing, many likely due to similar environmental hazards.[34]) Charles-Joseph turned these Military Model bells with a thicker body (see Figure 13, top), which is easily seen when comparing it with the thinner and more delicate bell found on a Savary *jeune* bassoon from the same era (see Figure 13, bottom). Even though these military instruments were not as delicately detailed, Charles-Joseph still went to great expense to use quality, seasoned wood.

Figure 13. Top, Charles-Joseph bassoon bell, accession number 1967.001.157, Museum Vleeshuis, Antwerpen, Belgium. Bottom, Savary *jeune* bassoon bell, Peebles Collection, SC, USA.

Another feature on Military Model bassoons is the use of saddle key mounts to attach the keys to the wooden body. These saddle mounts were more secure than other forms of mounts, such as pillars, since saddle mounts were attached to the body of the bassoon with at least two screws and were positioned in grooves chiseled out of the wooden bassoon body.

The Deluxe Model Bassoon

Of the eleven extant bassoons of Charles-Joseph Sax for this study, I have classified four as Deluxe Model bassoons (one such instrument is shown in Figure 14).[35] Deluxe Model bassoons were not intended for military use but were instead crafted as showpieces or possibly for wealthy clients. In general, Sax *père* Deluxe bassoons are distinguished by the addition of premium keywork and the use of more expensive materials, such as high-quality wood for the instrument's body. The species of wood from which the bassoon was made was not the sole determining factor: Charles-Joseph did make one Deluxe bassoon from

maple, like he used for all the Military Models. However, he manufactured two Deluxe bassoons of granadilla and ebony, both exotic and expensive woods.

Figure 14. Charles-Joseph Sax sixteen key Deluxe Model bassoon, accession number 1977.017, Musical Instrument Museum [MIM], Brussels.

The Deluxe Model bassoons have several keywork items in common, for example: more than ten keys (the seven or eight keys already discussed, plus one or more of the following: a G or B-flat key for the right third finger, a C-sharp key on the wing, a C-sharp key on the boot, a spatula for the low C); and an innovative system for the left thumb low C, B, and B-flat keys (see Figure 15).

Figure 15. Innovative system for the left thumb low C, B, and B-flat keys. Charles-Joseph Sax sixteen key bassoon, accession number 1994-214, Haus der Musik, Württembergisches Landesmuseum, Stuttgart, Germany.

In addition to the increased number of keys, the Deluxe Model bassoons were built with innovations such as pillar key mounts and a double-vented A tone hole [G key]. These bassoons were often equipped with key guides for keys with long shanks, such as the A-flat key on the boot and C-sharp key on the wing.[36]

Charles-Joseph's sixteen ivory key bassoon: a *tour de force* of bassoon manufacture

The Sax *père* bassoon with sixteen ivory keys (see Figure 16) is a *tour de force* of instrument making craftsmanship and must have been very time consuming and therefore expensive to create.[37] The most striking and immediately noticeable feature is that all the keywork is made from ivory, a costly and delicate material to craft. Special mention also needs to be given to an exceptional technique of Charles-Joseph Sax, *Clef guilloché*. *Clef guilloché* is a particular style of embellishment or decoration usually found on the key flaps on bassoons and other woodwinds. Although used by several makers, Charles-Joseph elevated this technique to new heights. His key flaps are ornamented with a seashell design of several types. *Clef guilloché* can be found on two of the four Deluxe Model bassoons.[38] It seems that whenever possible, Charles-Joseph ornamented every component of this sixteen key bassoon. In addition to *Clef guilloché* on the key flaps, the key touches, key shanks, saddle mounts, key guards, and even the ferrules between the joints are all highly ornamented.

Figure 16. Deluxe Model ebony bassoon with sixteen ivory keys.

This sixteen ivory key bassoon is exceptional, as it can be seen as a demonstration model showcasing all the keywork features Sax *père* could incorporate. While other Deluxe Model bassoons may include one or two of these features, the sixteen ivory key bassoon encompasses them all. It contains the following noteworthy details:

- Alternate keys; Two C-sharp keys, for the right thumb and the left thumb
- Two A-flat keys, for the right thumb and the right little finger
- Low B key and low D-flat keys, not often found on bassoons of this period
- An innovative key system for left thumb keys on the up-bore
- Key guides on many keys with long shanks
- Double-vented and repositioned A key
- Special saddle mounts (see Figure 17).

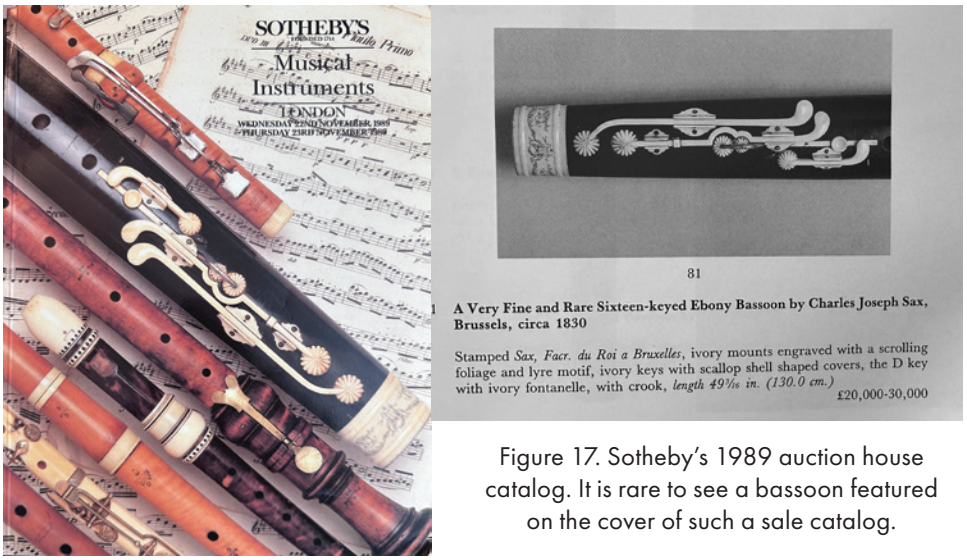

Figure 17. Sotheby's 1989 auction house catalog. It is rare to see a bassoon featured on the cover of such a sale catalog.

Charles-Joseph Sax's Two Maker's Stamps

Fortunately, Charles-Joseph Sax only used two distinct maker's stamps on his bassoons, which appear on both Military and Deluxe Models (see Figure 18). The two stamps are similar but depend on the date of production. The first stamp he used, beginning in 1819 when he became supplier to the King's Belgian military bands through the 1830 Belgian

Figure 18. The two maker's stamps used by Charles-Joseph Sax.
Left: 1819–1830; Right: 1831–1853.

Revolution, contains the phrase "FACr DU ROI" [*Facture du Roi* or Maker of the King]. The second stamp he used, from 1831 until 1853 when he moved to Paris and ceased making all wind instruments, is nearly identical to the first but omits the words "FACr DU ROI" on the second line. The bottom phrase is the same on both stamps: "A BRUXELLES" [In Brussels]. These two stamps not only help in determining the approximate date of manufacture, but also clearly render Charles-Joseph's instruments identifiable. As we will see in the second article, this is not the case with the bassoons of Charles-Joseph's son Adolphe.

Charles-Joseph Sax and his bassoon innovations

Although Charles-Joseph Sax was one of the rare wind instrument makers who manufactured both brasswind and woodwind instruments, it is clear from his keywork innovations that he was a significant maker of bassoons. Two such innovations are concerned with the portions of the mechanism that produce the desired notes: first, the "salt spoon" [*pelle à sel*] key cup with leather pads stuffed with wool (see Figures, 19, 20, and 21); and second, rounded tone hole seats (see Figure 22). By late in the eighteenth century, bassoon makers had likely realized that leaks between the pad cup and tone hole caused lower notes to respond poorly. Although Sax *père* apparently did not invent this salt spoon flap design, he

Figure 19. A salt spoon [*pelle à sel*].

Figure 21. Pad cup on salt spoon [*pelle à sel*] key, Charles-Joseph Sax bassoon, accession number 1994-214, Haus der Musik, Württembergisches Landesmuseum, Stuttgart, Germany.

Figure 20. Low B key featuring a salt spoon design, Charles-Joseph Sax, fifteen key bassoon, accession number 1994-214, Haus der Musik, Württembergisches Landesmuseum, Stuttgart, Germany.

Figure 22. Rounded tone hole seats on the Charles-Joesph Sax bassoon, accession number 1308 in the National Music Museum, Vermillion, South Dakota, USA.

used it on an early bassoon dating from the 1820s.[39] Salt spoon flap design greatly improved the seat on the pad cup, making the closed key more air-tight. The rounded tone hole seats, which he installed on both Military and Deluxe Models, also made the pads more air-tight by giving the leather pad a smooth and tapered area to seat.[40]

Another feature that demonstrates that Charles-Joseph's bassoon making was ahead of its time is his use of pillar key mounts with axles (posts and rods; see Figure 23). These are found only on one instrument: his Deluxe sixteen key bassoon, accession number 1977.017, in the Musical Instrument Museum [MIM], Brussels. This bassoon, featuring pillar mounts and made after 1833 (possibly dating to the late 1830s), demonstrates that Charles-Joseph's craftsmen and factory had achieved a remarkable level of sophistication. The small metal pillars were challenging to machine and much more difficult to install than the conventional saddle mounts.[41] These pillars are soldered onto a plate that makes the pillars sturdier than if they were screwed directly into the wood.

Figure 23. Pillar key mounts with axles (posts and rods), Charles-Joseph Sax sixteen key bassoon accession number 1977.017, Musical Instrument Museum [MIM], Brussels.

Although Charles-Joseph made the majority of his bassoon keywork from brass, he used German silver (nickel silver) for the keywork on this same bassoon. Again, Sax *père* was ahead of his time since German silver, only recently perfected in the early nineteenth century in Germany and England, was not yet a common material used to make woodwind instrument keys. Because of its hardness, resistance to corrosion, and silvery appearance, nickel silver proved to be an excellent material for making these parts.[42]

Throughout the history of woodwind instruments, makers have been adding keys in order to stabilize intonation. In particular, forked-fingered notes on the bassoon were unstable and makers added keys to alleviate these "problem" fingerings. Charles-Joseph added the following keys to Deluxe Model bassoons: a C-sharp key for the right thumb (see Figure 24), a C-sharp key for the left thumb, and a B-flat key for the right hand third finger (see Figure 25).

Figure 24. Right thumb C-Sharp key, Charles-Joseph Sax, fifteen key bassoon, accession number 1994-214, Haus der Musik, Württembergisches Landesmuseum, Stuttgart, Germany.

Figure 25. Boot joint of Charles-Joseph Sax, sixteen key bassoon, accession number 1977.017, Musical Instrument Museum [MIM], Brussels. Note the B-flat key and double-vented G key [A tone hole].

The B-flat key for the right-hand third finger warrants further discussion, as it presented mechanical challenges that Charles-Joseph and other bassoon makers had to resolve (see Figures 26, 27, and 28). First, after it became convention to have the B-flat key commanded by the right-hand third finger (which is logical since the right-hand third finger is a part of the forked B-flat fingering), this meant that the key touch, shank, and flap had to be placed on the same side of the boot joint as the finger holes.[43] Next, because the tone hole needed to be positioned on the same side as the boot finger holes, it had to be drilled in a challenging location, very close to the up-bore of the boot joint. Last, this long, narrow tone hole had to be drilled under keys and saddles (or pillars). In order to correct the flatness caused by the long length of the B-flat tone hole, the tone hole had to be slightly misplaced and drilled with a larger diameter than would normally be the case.[44]

Figure 26. B-flat key for right hand third finger. accession number 1967.001.157, Museum Vleeshuis, Antwerpen, Belgium.

Figure 27. B-flat tone hole for right third finger of boot joint of Charles-Joseph Sax, sixteen key bassoon, accession number 1977.017, Musical Instrument Museum [MIM], Brussels.

Figure 28. Detail of boot joint of Charles-Joseph Sax sixteen key bassoon, accession number 1977.017, Musical Instrument Museum [MIM], Brussels.

Last, it is safe to say that Charles-Joseph was probably one of the first bassoon makers to correct one of the most conspicuous problems of the bassoon: the A in both octaves (A_2/A_3). He most likely was one of the first bassoon makers to move the A finger hole [right hand third finger, or tone hole VI] further down the bassoon bore and add a key. This corrected an intonation problem that the narrow, obliquely drilled A finger hole could not resolve. In addition, he double-vented the A_2/A_3 tone hole into both boot bores. Double-venting this tone hole entails drilling a larger hole venting into the down-bore of the boot and a smaller hole venting into the up-bore of the boot. In effect, the G key has two flaps on the same shank, both controlled by the right third finger. Double-venting notably improved the intonation of the octave A_2/A_3, though it should be noted that as soon as the A tone hole was moved further down the boot joint bore, the forked B-flat no longer functioned. A closed-standing B-flat key had to be added.[45]

In 1823, Carl Almenräder published his *Abhandlung über die Verbesserung des Fagotts* [*Treatise on the Improvement of the Bassoon*], where he describes both the double-vented and repositioned A.[46] Two Deluxe Model Charles-Joseph Sax bassoons are equipped with this double-vented and repositioned A tone hole: the sixteen key bassoon with ivory keys and the sixteen key bassoon, accession number 1977.017, Musical Instrument Museum [MIM], Brussels, Belgium. While it is impossible to definitively date these two Sax *père* bassoons, it is likely that they were made shortly after Charles-Joseph resumed production of wind instruments ca.1833 following the challenging period of the 1830 Belgian Revolution.[47]

The Diapason of Charles-Joseph Sax Bassoons

Historically, wind instrument makers tuned their instruments to different pitch levels [*diapason*], so if a band included instruments from different manufacturers, the pitch level of each of these winds could be drastically different. Case in point: before the Belgian Revolution of 1830, King William I of the United Netherlands wanted all the regimental bands to play together at a ceremony. A musical disaster ensued due to the different pitch levels of the bands. Charles-Joseph Sax was particularly concerned that his instruments not only play in tune, but also play at the same *diapason*. Once he was named "*facture du*

Roi" he made all his instruments, both woodwind and brasswinds, for the King's army at the same pitch level.

Charles-Joseph and Adolphe Sax: *père et fils*

It appears that Charles-Joseph and his son Adolphe had a close relationship. Central to this narrative is that Charles-Joseph was Adolphe's teacher: Adolphe learned to be an instrument maker from his father while still at home in Brussels. Significantly, Adolphe most likely gained his acoustical and instrument design ideas from his father. It is even possible that Sax *père* gave Sax *fils* the idea for the saxophone while Adolphe was still working at his father's factory in Brussels.[48] One can imagine that Adolphe discussed the design of a conical bore, single reed woodwind instrument made from brass with his father before he moved to Paris in 1842. In fact, Charles-Joseph's 1842 *brevet*, "Basson construit d'après une nouvelle théorie acoustique" in which he describes his *nouveau système* bassoon, contains all of the elements needed to invent a saxophone: a conical bore instrument with large tone holes, a fingering system that overblows the octave, an instrument made from brass, and a single reed mouthpiece.

The development of the bassoon was truly a Sax family endeavor. The father's ideas can be found in the metal bassoon Sax *fils* created in 1851: indeed, it can be argued that the only manifestation of Charles-Joseph's bassoon described in his 1842 *brevet* was Adolphe's 1851 metal bassoon.

It has to be stated that Adolphe Sax clearly copied many of his father's innovative business practices. Adolphe made everything in his factory, as did Charles-Joseph. By using vertical integration, both father and son could control the quality of all the parts that would be assembled into their instruments. Again, like father, Sax *fils* organized his factory in divisions devoted to a particular task or process, not to a particular instrument. Adolphe was a competent maker of both woodwinds and brass instruments in no small part because of his father.[49] Since Adolphe was competent in both woodwinds and brasswinds, he was one of only three instrument makers in Paris at this time to produce both types of wind instruments.[50] This then gave him the tools to invent the saxophone—and a metal bassoon.

In 1842, at the age of 28, Adolphe *fils* moved to Paris. Charles-Joseph *père* followed nine years later, in 1853, and established a piano making firm that went bankrupt in 1855. After this, Charles-Joseph worked side by side with his son, managing the fabrication of saxophones until his death in 1865.

End of Part 1: The Charles-Joseph Sax Bassoons

David Rachor has enjoyed a career spanning teaching, bassoon performance, and woodwind organology. He has traveled extensively, presenting bassoon performance masterclasses as well as historical reed lectures at the Bate Collection, the Conservatorio di Milano, and the Bruckner Hochschule. Rachor has served as visiting Professor of Baroque Bassoon and Assistant Professor of Bassoon at the Conservatoire National Supérieur de Musique de Paris. He has concertized on the bassoon and period woodwinds both in Europe and the United States.

Rachor has performed numerous concerti for bassoon and wind orchestra, and has recorded noted Dutch composer Bernard van Beurden's Concerto for Bassoon and Wind Ensemble with the Wisconsin Wind Orchestra. Rachor has been guest clinician at the American Band College in Oregon since 1989. In addition, he held the position of principal bassoon with the Des Moines Symphony for eighteen years. A particular area of Rachor's research concerns the acoustics of Baroque and Classical bassoons. Information about this project can be found on the website davidrachor.com. Emeritus Professor of Bassoon at the University of Northern Iowa, Rachor holds the doctorate in bassoon performance from Indiana University.

Endnotes

1 This article discusses only Charles-Joesph and Adolphe Sax. There was another instrument maker in the Sax family, the son of Adolphe, Adolphe-Edouard Sax (1859–1945). He will not be considered here since he did not manufacture bassoons. Additionally, Adolphe Sax's given name was Antoine-Joseph, but he always was known as Adolphe.

2 François Joseph Fétis, Biographie Universelle des Musiciens, *Deuxième Édition*, vol. 7 (Paris: 1867), 412.

3 Fétis, *Biographie*, Tome Septième, 412.

4 Fétis, *Biographie*, Tome Septième, 412.

5 François Joseph Fétis, "Facture des instruments à vent. Sur l'établissement de M. Sax à Bruxelles,» *Revue Musicale*, XIV, no. 10 (March 9, 1834), 77.

6 Charles-Joseph was awarded 14 patents: 12 Belgian and 2 French; Adolphe was awarded 39 patents: 9 Belgian, 27 French, 3 English. See Malou Haine, *Adolphe Sax: Sa vie, son œuvre, ses instruments de musique* (Bruxelles: Université de Bruxelles, 1980), 188–207.

7 Louis Adolphe le Doulcet, comte de Pontécoulant was a soldier in the armies of Napoleon I; he fought in the invasion of Russia and the campaign of 1814. He also organized a French volunteer unit and fought in the Belgium revolution of August 1830; he was wounded at Louvain. See *Encyclopedia Britannica* Eleventh Edition, Vol. XII (Cambridge: University Press, 1911), 64.

8 Adolphe Le Comte Pontécoulant, *Organographie: Essai sur la Facture Instrumentale*, Tome II (Paris: 1861), 613.

9 Nicolas Prost, *Saxophone à la Français* (Studio France, 2007), 81.

10 Pontécoulant, *Organographie,* Tome II, 581. For comparison, Pontécoulant says that there were 3,000 flutes, 5,000 clarinets and 200 oboes made.

11 Pontécoulant, *Organographie*, Tome II, 613.

12 In 1845, Cases were required in infantry *musiques militaires* by a commission totally reforming the bands in the French Army. See Georges Kastner, *Manuel Général de Musique Militaire à l'Usage des Armées Français* (Paris: Firmin Didot Frères, 1848), 281–282.

13 Paul Augé, ed., *Larousse du XXe Siècle*, Tome Premier (Paris: Librairie Larousse, 1928), 632–4.

14 "La Muette de Portici," *Wikipedia*, accessed August 6, 2024.

15 Charles Singer, ed., *A History of Technology*, vol. 4, *The Industrial*

Revolution (Oxford: The Clarendon Press, 1958), 556–9.

16 Raymond van Aerde, Les Tuerlinckx: Luthiers à Malines (Malines: L. & A. Godenne, 1914).

17 Kimberly Amando, "What Is Vertical Integration?" *The Balance*, July 8, 2022.

18 Fétis, *Biographie*, Tome Septième, 412.

19 "M. Sax [père] découvert les lois qu'aucun traité d'acoustique n'a pu lui enseigner; car, il faut l'avouer, les savants travaux des Bernouilli, des d'Alembert, des Euler, et même des Lagrange n'ont été que de peu d'utilité à la facture. Leurs théories des sons et leurs calculs n'ont jamais pu la guider dans le percement des tubes extra cylindriques.» See Fétis, *Biographie*, Tome Septième, 413.

20 «M. Sax [père] possède la loi des vibrations d'une manière infaillible, et que les trous les plus grand donnent les sons les plus plein.» See Fétis, *Biographie*, Tome Septième, 413.

21 Fétis, "Facture des instruments à vent," 77.

22 "Joseph Sax n'avait aucun secret pour ses ouvriers dont il faisait lui-même l'éducation industrielle; Il travaillait devant eux et les admettait à tous les détails de ses essais.» See Adolphe de Pontécoulant, "Joseph Sax" (Nécrologie), *L'Art Musicale*, May 25, 1865, vol. 5, no. 26: 204; François Joseph Fétis, "Facture des instruments à vent," 77.

23 The direction of these six finger holes was a pattern found on most large double reed instruments from the Renaissance and brought the finger holes within comfortable reach of the human hand.

24 This reduced taper of the transitional bore could be almost cylindrical in a few eighteenth or nineteenth century bassoons made by Scherer, Lott, IA Crone, and Cuvillier.

25 Mathew Dart, *The Baroque Bassoon: Form, Construction, Acoustics, and Playing Qualities* (PhD thesis, London Metropolitan University, 2011), 277–85.

26 The bell bore begins with a diameter of 32.6 millimeters at the bell socket and at the top of the bell bore is 33.5 millimeters in diameter.

27 Fétis, *Biographie*, Tome Septième, 411–3.

28 Charles-Joseph Sax Belgian patent on the bassoon "Un basson construit d'après une nouvelle théorie acoustique, également applicable aux autres instruments à vent," No. 2254, dated 7 July 1842.

29 Sax *père* uses the French term *harmonies* for bands and not *musiques*. He does not explain what he means by a better tone quality, but I would assume that he means a louder tone quality.

30 I personally examined ten Charles-Joseph Sax bassoons; details are found in the Hichwa-Rachor database on the website "davidrachor.com." One bassoon not examined is apparently in Japan and not available for study.

31 Fétis, *Biographie*, Tome Septième, 412. Fétis.

32 Fétis, «Facture des instruments à vent,» 77.

33 Examined Charles-Joseph Sax Military Model bassoons: No. 2001.44, Sigal Music Museum, Greenville, South Carolina, USA; No. 2625, Musée des instruments de musique, Brussels, Belgium; No. 404, Kampmann Collection, Paris, France; Saelemaekers Collection (no accession number), Leuven, Belgium; No. 02226, STAM, Ghent, Belgium; No. 1308, National Music Museum, Vermillion, South Dakoda, USA; No. 301501, Royal Military Museum, Brussels, Belgium.

34 Two Charles-Joseph Sax bassoons are missing bells: No. 2625, Musée des instruments de musique, Brussels, Belgium; No. 404, Kampmann Collection, Paris, France; See Hichwa-Rachor database on the website "davidrachor.com."

35 Examined Charles-Joseph Sax Deluxe Model bassoons: No. 1977.017, Musée des instruments de musique, Brussels, Belgium; No.1994-214, Haus der Musik, Württembergisches Landesmuseum, Stuttgart, Germany; No. 1967.001.157, Museum Vleeshuis, Antwerpen, Belgium; Not examined: bassoon with sixteen ivory key bassoon, probably in Japan.

36 There are two Military Model bassoon equipped with key guides: No. 2001.44, Sigal Music Museum, Grenville, South Carolina, USA; and No. 404, Kampmann Collection, Paris, France.

37 This sixteen ivory key bassoon was sold in 1989 at Sotheby's in London to a private collector for 27,500 British Pounds.

38 The two Deluxe bassoons with clef guilloché: 1977.017, Brussels MIM, and the sixteen ivory key bassoon.

39 Salt spoon key design is found on bassoon No. 1994-214, in the Haus der Musik, Württembergisches Landesmuseum, Stuttgart, Germany. This bassoon is labeled „ FAC^{r} DU ROI."

40 All of the Charles-Joseph bassoons examined have at least one rounded tone hole seat except bassoon No. 1994-214, Haus der Musik, Württembergisches Landesmuseum, Stuttgart, Germany.

41 Thanks to Denis Watel for this information in March 2024.

42 German silver is an alloy composed of copper, zinc, and nickel; it does not contain silver. The production process for this alloy was perfected as the result of a German competition in 1823. For information on German silver, see Murry Campbell, Clive Greated, and Arnold Myers, *Musical Instruments: History, Technology, & Performance of Instruments of Western Music* (Oxford: Oxford University Press, 2004), 132, 174; Voichita Bucur, *Handbook of Materials for Wind Musical Instruments* (Cham: Springer, 2019), 53, 275, 284.

43 These problems of the right third finger B-flat key were alleviated when the B-flat key touch was moved to the opposite side of the boot and commanded by the right thumb.

44 The B-flat tone hole for the right hand third finger is approximately thirty millimeters in length and about eight or nine millimeters in diameter. These dimensions are considerable larger than most tone holes on the down-side bore of the boot joint.

45 While personally play testing several early Heckel bassoons with the double-vented A tone holes, if the small vent drilled into the up bore is covered, it is nearly impossible to play a clear A3 (A in the second octave).

46 James B. Kopp, *The Bassoon* (New Haven: Yale University Press, 2011), 115–20.

47 Pontécoulant notes that the export of wind instruments was a significant aspect of Charles-Joseph's business. However, during the challenging period following the Belgian Revolution, from August 1830 until around 1833, this became impossible. Although, in principle, the maker's stamp he used during this period was applied to his bassoons until 1853, it is likely that he stopped producing bassoons around 1836, after receiving the *Ordre de Léopold* that year. Pontécoulant also states that Charles-Joseph ceased making wind instruments after 1842, as he did not wish to compete with his son's business in Paris. See Adolphe Le Comte Pontécoulant, "Joseph Sax Nécrologie," *L'Art Musical*, May 25, 1865, vol. 5, no. 26: 204–5.

48 Haine reports that the saxophone was in the works no earlier than 1838 and later than 1840, years before the 1846 patent. However, according Fétis, Charles-Joseph worked on the improvement of the bassoon starting about 1825. See Malou Haine, *Adolphe Sax: Sa vie, son œuvre, ses instruments de musique* (Bruxelles: Université de Bruxelles, 1980), 52, 53.

49 In the 1844 Paris exhibition, Sax was the only exhibitor registered in both woodwind and brass categories. Bryan Kendall, *In Search of the Saxophone: Its Origins & Functions* (Kendallhouse Publishing, 2022), 268.

50 The other two instrument makers who produced both woodwinds and brasswinds were Louis-Auguste Buffet and Goudet jeune. Kendall, *In Search of the Saxophone*, 58, 59.