Eugenia Mitroulia/Arnold Myers

The Saxhorn Families

Introduction The saxhorns, widely used from the middle of the nineteenth century onwards, did not have the same tidy, well-ordered development in Adolphe Sax's mind and manufacture as the saxophone family appears to have had.[1] For a period Sax envisaged two families of valved brasswind, the saxhorns and saxotrombas, with wider and narrower proportions respectively. Sax's production of both instruments included a bell-front wrap and a bell-up wrap. In military use, these were intended for the infantry and the cavalry respectively. Sax's patent of 1845 made claims for both families and both wraps,[2] but introduced an element of confusion by using the term "saxotromba" for the bell-up wrap as well as for the instruments with a narrower bore profile. The confusion in nomenclature continued for a long time, and was exacerbated when Sax (followed by other makers) used the term "saxhorn" for the tenor and baritone members of the narrower-bore family in either wrap.

The question of the identity of the saxotromba as a family has been answered by one of the present authors,[3] who has also addressed the early history of the saxhorns.[4] The present article examines the identity of the saxhorns (as they are known today) in greater detail, drawing on a larger sample of extant instruments. In particular, the consistency of Sax's own production of saxhorns is discussed, as is the question of how close to Sax's own instruments were those made by other makers.

The bell-front saxhorns The Distin quintet of father and four sons[5] was the first established ensemble to use saxhorns as a coherent group,[6] and may have influenced the

1 Robert S. Howe: The Invention and Early Development of the Saxophone, 1840–55, in: Journal of the American Musical Instrument Society 29 (2003), pp. 97–180.

2 Adolphe Sax: Un instrument de musique dit Saxotromba, dont la construction, au moyen de légères modifications, peut être appliqué aux Sax-horns, cornets, trompettes et trombonnes, French patent No. 2306 (13 October 1845).

3 Eugenia Mitroulia: The Saxotromba. Fact or Fiction?, in: Journal of the American Musical Instrument Society 21 (2009), pp. 123–149.

4 Eugenia Mitroulia: Adolphe Sax's Brasswind Production with a Focus on Saxhorns and Related Instruments, Edinburgh 2011, www.era.lib.ed.ac.uk/handle/1842/5490 (22 June 2018).

5 Margaret Christopoulos: In and Out of the Limelight: Ann Matilda Distin. Her Life and Times, Nottingham 2013.

6 Adam Carse: Adolphe Sax and the Distin Family, in: Music Review 6 (1945), pp. 194–201; Ray Farr: The Distin Legacy. The Rise of the Brass Band in 19th-Century Britain, Newcastle upon Tyne 2013.

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design of some of the instruments and perhaps even suggested the name "saxhorn".[7] In any case their highly accomplished playing and extensive concertising popularised the saxhorns in Britain and elsewhere. Figure 1 shows the Distin family quintet in 1845, and is possibly the earliest representation of saxhorns in the hands of players. The instruments were of bell-forward wrap with either double-piston or Berlin-type piston valves.

George Distin died in April 1848 while they were preparing their concert tour of the United States of America for the following year. As well as having to re-arrange their repertoire, their publicity materials also had to be updated. A second lithograph by Baugniet (Figure 2) can be dated to the period between April and October 1848.

Some of the saxhorns are different from those in the 1845 lithograph. The seven instruments shown in these two lithographs are a soprano saxhorn, probably in 3¼-ft E♭, a contralto, probably in 4½-ft B♭, an alto, possibly in 5-ft A♭, a tenor, probably in 6½-ft E♭, two different baritones, probably in 9-ft B♭, and a bass, also probably in 9-ft B♭.

The only surviving instrument that is definitely a candidate for having been used by the Distin family is in the Carse Collection at the Horniman Museum, London, shown in Figure 3. This is a tenor in E♭ with shanks and crooks for lower tonalities (in its present state the mouthpipe has been shortened). With its rotary valves this is clearly not one of the instruments pictured by Baugniet, but it might have been one of the instruments acquired by the Distins in 1844 or an early replacement. Sax and the Distins fell out when Henry Distin started making instruments himself in 1851 rather than merely selling imports from Sax. So this instrument almost certainly dates from the period 1844 to 1851.

The bell-forward wrap of the Distins' saxhorns is represented today only in the flugelhorn, whose lineage, in its French and British forms, can be traced back to the contralto saxhorn. This wrap is also represented in Sax's 1843 patent, see Figure 4.[8]

Sax's 1843 patent was taken out before the saxhorn designs were fully worked out. Indeed, the valved bugle shown here was not actually covered by the patent, which is concerned with various technical features such as the valve ports and the circular valve loops (these are seen on the contralto held by Henry Distin in Figures 1 and 2). Nevertheless, it shows that a bell-forward wrap was envisaged by Sax right from the beginning.

Figure 5 shows the drawings from Sax's patent of 1845, the year of the first Baugniet lithograph. This is actually the patent for the saxotromba, but most of the illustrations are of saxhorns, now in bell-up wrap. Some of these instruments would not have been

7 Eugenia Mitroulia/Arnold Myers: The Distin Family as Instrument Makers and Dealers, in: *Scottish Music Review* 2, No. 1 (2011), http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.849.4175&rep=rep1&type=pdf (22 June 2018).

8 Adolphe Sax: *Pour un système d'instruments chromatiques*, French patent No. 15364 (13 June 1843).

Figure 1 Lithograph by Charles Baugniet (1814–1886) showing George, Henry, John, Theodore and William Distin with their saxhorns, London 1845 (photo Antonia Reeve)

Figure 2 Lithograph by Charles Baugniet showing John, Henry, Theodore and William Distin, with their saxhorns, published in 1848. Reproduced courtesy of Tony Bingham

Figure 3 Bell-forward tenor saxhorn in E♭ (Adolphe Sax, Paris). Inscribed on the bell "La Famille Distin / Ad. Sax & Cie à Paris"; inscribed on the garland "T. Distin, London"; stamped on the case "Ad. Sax & Co" (© Horniman Museum, London, 14.5.47/91)

developed by 1844, when the Distins were in Paris. Figure 6 is Sax's prospectus of 1848,[9] the year of the second Baugniet lithograph. By this date, most of these instruments illustrated by Sax are easy to accept as early versions of familiar brass band instruments: flugelhorns, tenor horns, baritones, euphoniums and bombardons.

Defining a saxhorn Given that Sax produced bell-forward and bell-up saxhorns, and both in a range of sizes, it is a legitimate question to ask what defines a saxhorn: what do they all have in common? A related question is how closely Sax's instruments were copied by other makers. From 1855 to 1865, subsequent to Sax's success in a lawsuit brought by rival French instrument makers disputing the originality of saxhorns, other French makers had to pay a licence fee to Sax for each saxhorn that they made, and for each instrument resembling a saxhorn; they also had to have the bell stamped by an agent of Sax.[10] There is a corpus of extant instruments bearing the Sax licence stamp that can confidently be dated to this period. Figures 7, 8, and 9 show tenor, bass and contrabass saxhorns respectively; on the left in each case is an example by Sax, and on the right a comparable instrument made under licence.

9 Adolphe Sax: Prospectus (1848), in: *Catalogue des Instruments Sax au Musée Instrumental de Bruxelles*, ed. by Malou Haine and Ignace De Keyser, Brussels [1980], p. 135.

10 Malou Haine: Les licences de fabrication accordées par Adolphe Sax à ses concurrents. 26 juin 1854–13 octobre 1865, in: *Revue belge de musicologie* 34/35 (1980/81), pp. 198–203; Bruno Kampmann: Licences accordées par Adolphe Sax à ses concurrents pour la fabrication des cuivres, in: *Larigot* 42 (September 2008), pp. 9–17.

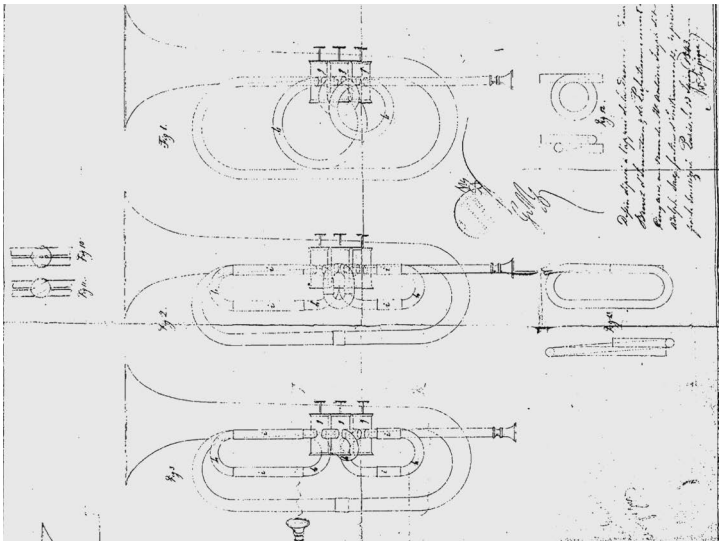

Figure 4 Bell-forward valved bugle from Sax's patent of 1843

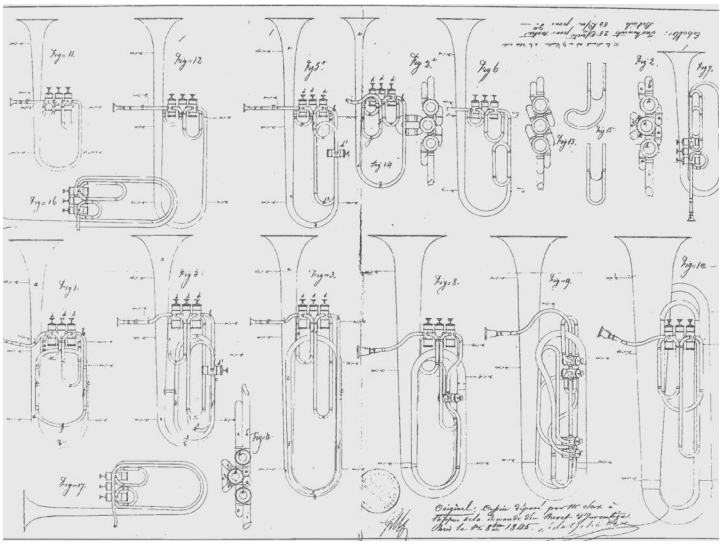

Figure 5 The drawing section of the 1845 saxotromba patent. From left to right: fig. 11 small saxhorn in E♭, fig. 12 contralto saxhorn in B♭, fig. 5+ contralto saxhorn with four valves, fig. 14 cornet in saxotromba form, fig. 2+ valve section with the middle valve tubing not bent, fig. 6 saxhorn in A♭, fig. 13 valve section of the saxhorn in A♭, fig. 15 crooks for the saxhorn in A♭, fig. 2 detail of the valve section, fig. 7 saxhorn in A♭, fig. 16 trumpet in saxotromba form, fig. 1 saxotromba in E♭, fig. 5 [alto] saxhorn with four valves, fig. 3 baritone saxotromba in B♭, fig. 8 [bass] saxhorn in B♭, fig. 9 bass saxhorn, fig. 10 contrabass saxhorn in E♭, fig. 17 tenor trombone in B♭ in saxotromba form, fig. 4 detail of valve section of the baritone saxotromba

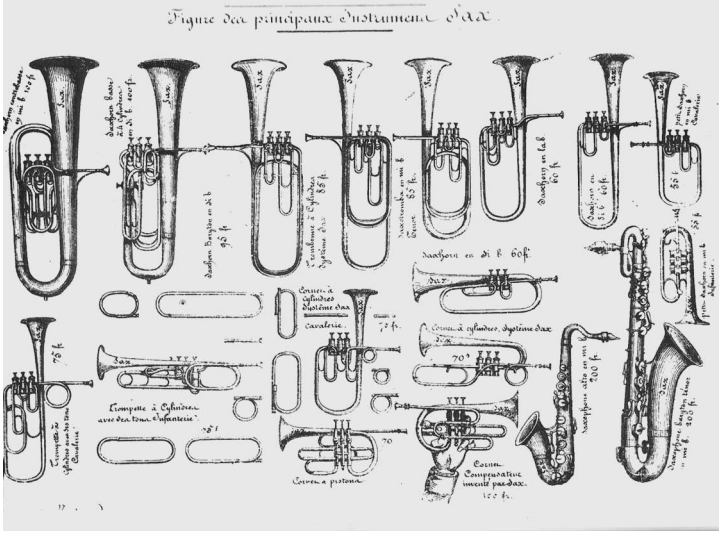

Figure 6 Figures from Sax's prospectus of 1848

Figure 7 Tenor saxhorns in E♭: by Sax (1855) and by Husson & Buthod (1855–65) (© Edinburgh University Collection of Historic Musical Instruments, inventory numbers 4543 and 5699, photos Raymond Parks)

Figure 8 Bass saxhorns in B♭: by Sax (1864) and in C with B♭ tuning-slide extension by Gautrot (1855–65) (© Edinburgh University Collection of Historic Musical Instruments, inventory numbers 4470 and 4135, photos Raymond Parks/Antonia Reeve)

Figure 9 Contrabass saxhorns in B♭: by Sax (1854) (© MIM, Brussels inventory number 2459) and by Lecomte (1860–65) (© Edinburgh University Collection of Historic Musical Instruments, inventory number 3883, photos Raymond Parks)

In these examples, Sax's saxhorns and those made by other makers have somewhat different wraps. In general, saxhorns made by Sax do not always follow a strictly prescribed wrap, and those by other makers including saxhorns made under licence show slightly more variation. The differing numbers, lengths and positions of curved portions of tubing in the windway do not in themselves have a significant effect on the sound, nor does the fact that the bass by Sax has four valves and the bass made under licence has three. Whether the response to the player and the sound heard by the audience are the same depends more on the bore profile of the instruments.

Figure 5 was examined in court during the abovementioned lawsuit. These drawings, which formed part of the 1845 patent, include various measurements of bore diameter, but the measurements do not lead to any firm conclusions. The positions at which the tube diameter is indicated are not themselves precisely located. In the court hearings, neither the engineer (Surville) brought in as an expert witness nor Sax himself had the

acoustical knowledge necessary to give a proper answer. They realised that the important feature was the bore profile, but to specify a bore profile completely would need tens or hundreds of measurements and still leave the problem of how to make comparisons. The acoustical knowledge enabling valid comparisons has only been developed recently.

In 2007, the acoustician Bob Pyle introduced a parameter that reflects the effect of bore profile on timbre, "brassiness potential".[11] This is derived from acoustical theory and is an indication of potential for brightening the sound as sound waves pass through a non-cylindrical tube. At high dynamic levels, some instruments are readily sounded in a *cuivré* (brassy) manner: it is now recognised that this phenomenon is due to shock wave generation over the length of the instrument. As a sound wave travels down the tube of a brass instrument, the wave front gradually gets steeper; energy in low frequency components is transferred to higher frequencies; sound with more of its energy at high frequencies is perceived as "brassy". This non-linear propagation is also evident to some extent in playing at lower dynamic levels and contributes to the overall tonal character of the various kinds of brass instrument. We would expect the trombone to be readily playable in a brassy manner; we would expect the euphonium to give a more rounded sound even at high dynamics.

Figure 10 shows the bore profile of five very different instruments. Their difference in bore profile accounts for their differences in timbre. Of these, the saxhorn is the middle line, in blue.

The sound made by a brass instrument depends on the instrument itself, the mouthpiece, the room acoustics, and on what the player does. The brassiness potential parameter (B) characterises the contribution of the instrument to the mix; this is defined by

$$B = (1/L_{ecl}) \int_0^L \left(D_0 / D(l) \right) \, dl$$

where L_{ecl} is the equivalent cone length of the instrument (the length of a pure cone which has the same fundamental mode of vibration as the nominal pitch of the instrument), L is the sounding length of the instrument, D_0 is the minimum bore diameter (in the region of the mouthpipe), and D is the bore diameter at a distance l from the mouthpipe end. B lies between zero and one: it approaches one for very cylindrical instruments and approaches zero for instruments with rapidly expanding bore profiles.

11 Robert W. Pyle Jr./Arnold Myers: Scaling of Brasswind Instruments, in: *Journal of the Acoustical Society of America* 119, Issue 5/2 (May 2006), p. 3259; Arnold Myers/Robert W. Pyle Jr./Joël Gilbert/D. Murray Campbell/Shona Logie/John P. Chick: Effects of Nonlinear Sound Propagation on the Characteristic Timbres of Brass Instruments, in: *Journal of the Acoustical Society of America* 131, Issue 1/2 (January 2012), pp. 678–688.

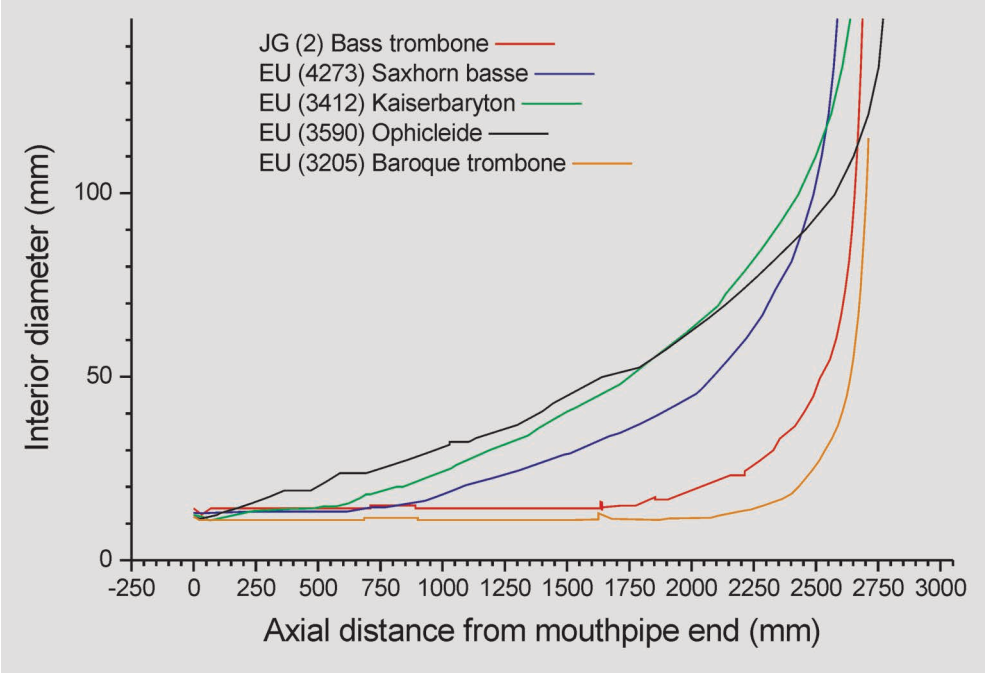

Figure 10 Five bore profiles

Measuring the bore at every point over the length of the instrument is impractical, but measuring it at ten to twenty places distributed over the length of the tube can give a very good approximation to the value of B, given by the sum

$$B \approx \sum_{1}^{N} \frac{l_n}{L_{ecl}} \left(2D_0 \Big/ (D_n + D_{n+1}) \right)$$

where D_n is the bore diameter at the start of the nth section of N sections and l_n is the length of the nth section. Most brass instruments can be measured at an acceptable number of points in an hour or so. The level of detail is comparable to the "recipe" that an instrument maker could use to record the bore profile. The results for the five instruments shown in Figure 10 are:

Instrument	Nominal Pitch	Maker, Place, Date	B
EU3590	Ophicleide, keyed for A	Gautrot, Paris, circa 1860	0.31
EU3412	Kaiserbaryton, 9-ft B♭	Cerveny, Königgrätz, circa 1900	0.37
EU4273	Saxhorn basse, 9-ft B♭	Ad. Sax, Paris, 1867	0.51
JG2	Bass trombone, 9-ft B♭	Courtois, Paris, 2000	0.67
EU3205	Tenor trombone, 9-ft B♭	Huschauer, Vienna, 1794	0.81

(EU = Edinburgh University Collection of Historic Musical Instruments, JG = lent by Joël Gilbert)

The results can be shown on graphs in which brassiness potential is plotted against the minimum bore of the instrument. Figure 11 shows the plots for typical 8-ft and 9-ft instruments, with B on the vertical axis and bore diameter in the mouthpipe on the horizontal axis. Each recognised type of instrument occupies its own area. The trombones seem to cover a large area, but they include everything from Renaissance sackbuts to modern bass trombones. Baritone and bass saxhorns (here designated "euphoniums") are clearly distinguished from trombones and horns in B♭ alto.

Figure 12 shows that the 6-ft and 7-ft instruments follow a simpler pattern. The saxhorns (in red) have a much less cylindrical bore than trumpets. At 4-ft pitch, shown in Figure 13, there is a distinction between flugelhorns, cornets and trumpets, but the smallest saxhorns are barely distinguishable from flugelhorns of the same pitch. Finally, the large instruments plotted in Figure 14 show a very clear pattern. Here the large saxhorns are lumped in with tubas. Instruments of the same family seem to occupy roughly the same area on each graph. We can see this clearly for saxhorns by plotting all sizes together (Figure 15): Here the saxhorn family is limited to instruments made in Sax's own workshop, but over a forty-year period. It would be more accurate to describe the saxhorns as two families. There is a clear distinction between instruments from 9-foot B♭ baritone upwards, and instruments from 9-foot B♭ bass downwards.

Sax's saxhorns compared with those by other makers To examine the saxhorn family in more detail, we have used a population of 255 nineteenth-century instruments from 37 museums and private collections. This may seem like a large number, but for some categories the sample size has been unavoidably small.

Each red dot in Figure 16 shows the position of a saxhorn in 6-ft F or 6½-ft E♭ from Sax's workshop made in the period up to 1865. The outlier here ($D_0 = 9.30$, $B = 0.47$ is the early rotary-valve, bell-forward instrument made for the Distin Family. Each blue dot in Figure 16 shows the position of a saxhorn in 6-ft F or 6½-ft E♭ from Sax's workshop made in the period from 1865 to 1885. The scatter shows no systematic design change by Sax.

In Figure 17 the early saxhorns (with red dots) are shown with early copies by other makers (with light green dots) and by other makers in the Sax licence period (1855–65; with dark green dots). Generally speaking, the saxhorns by other makers occupy the same area of the graph and could be regarded as copies of Sax's instruments.

In Figure 18, the later saxhorns by Sax (blue dots) are shown with later copies by other makers up to 1899 (orange dots). The others (olive-green dots) are instruments in 6-ft F or 6½-ft E♭ intended to fill a comparable musical role in the same period. These are mostly althorns, but also include an antoniophone and a sonorophone. As we would expect, the other instruments have a larger spread than the saxhorns.

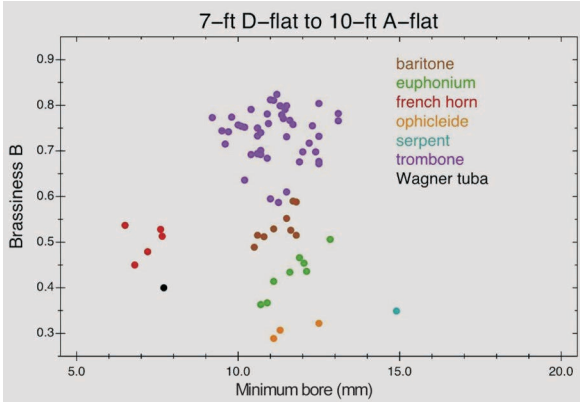

FIGURE 11 Plot of B against D_o for 8-ft and 9-ft instruments

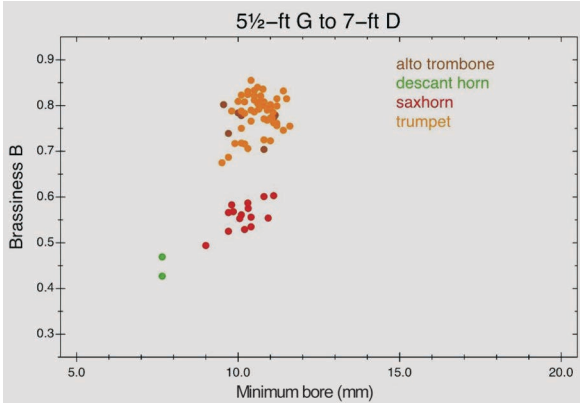

FIGURE 12 Plot of B against D_o for 6-ft and 7-ft instruments

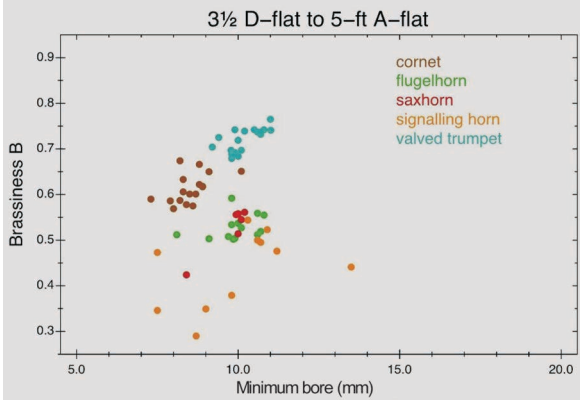

FIGURE 13 Plot of B against D_o for 4-ft instruments

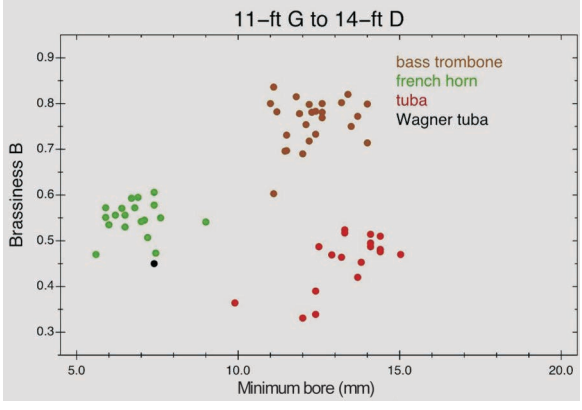

FIGURE 14 Plot of B against D_o for 11-ft to 14-ft instruments

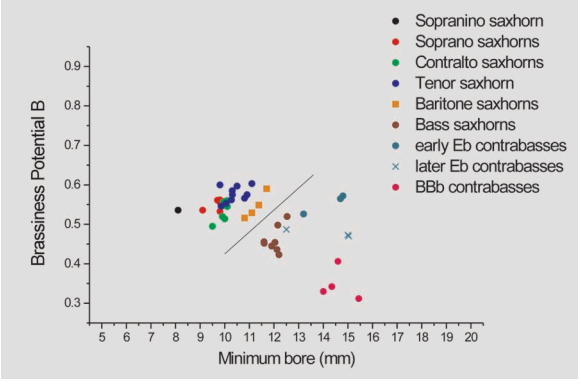

Figure 15 Plot of B against D_o for saxhorns by Adolphe Sax (1844–1885), with dividing line

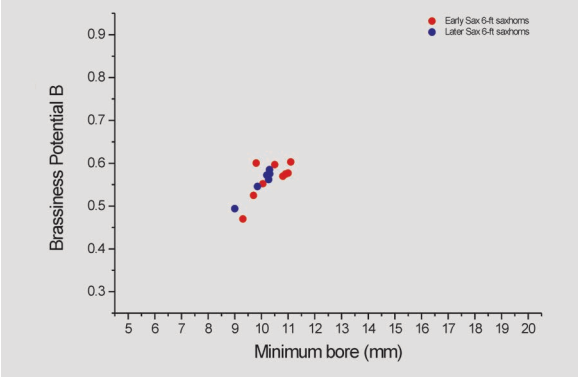

Figure 16 Plot of B against D_o for alto/tenor saxhorns made by Sax

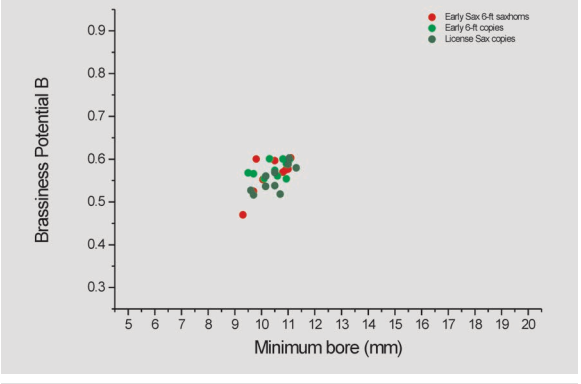

Figure 17 Plot of B against D_o for early alto/tenor saxhorns made by Sax and other makers

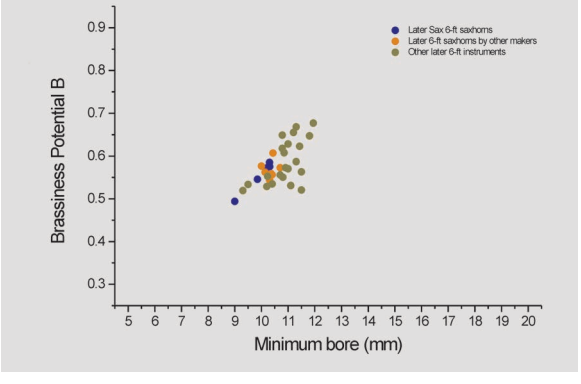

Figure 18 Plot of B against D_o for later alto/tenor saxhorns made by Sax and other makers

We now look at instruments in 8-ft F and 9-ft B♭. Each red dot in Figure 19 shows the position of a saxhorn from Sax's workshop made in the period up to 1865. Most of these are basses; the outlier (D_0 = 11.60, B = 0.57) is the one surviving baritone from this period. Each blue dot shows the position of a saxhorn in 8-ft C or 9-ft B♭ from Sax's workshop made in the period from 1865 to 1885. Here the division into baritones and basses is clear. As we would expect, the basses have a wider bore and are less brassy than the baritones.

In Figure 20 the early saxhorns (red dots) are shown with early copies by other makers (light green dots), and in the Sax licence period (1855–1865; dark green dots). The other makers appear to follow the division into baritones and basses, but with some spread.

In Figure 21 the later saxhorns by Sax (blue dots) are shown with later copies by other makers up to 1899 (orange dots). The instruments by other makers are French and English instruments that can be regarded as being in the Sax tradition. The others (olive-green dots) are instruments intended to fill a comparable musical role in the same period. These include German Tenorhörner, Italian flicorni, and some American instruments. The instruments high on the graph approach the proportions of valve trombones.

We now look at saxhorns in 12-ft F and 13-ft E♭ (Figure 22). Each red dot shows the position of a saxhorn from Sax's workshop made in the period up to 1865. Each blue dot shows the position of a saxhorn in 12-ft F or 13-ft E♭ from Sax's workshop made in the period from 1865 to 1885. Looking at the dates of manufacture, it appears that with the E♭ contrabasses Sax made a definite design change. From perhaps 1855 onwards, the instruments were re-proportioned to be less brassy and to better support the harmony (the lowest red dot here is the 1855 contrabass saxtuba in the Metropolitan Museum of Art, New York, so it is perhaps anomalous).

In Figure 23 the early saxhorns (red dots) are shown with early copies by other makers (light green dots) and the Sax licence example (dark green dot). The limited data does not suggest a significant difference.

In Figure 24 the later saxhorns (blue dots) are shown with later copies by other makers up to 1899 (orange dots). It is a small sample, but does suggest that other makers opted for a narrower bore than Sax. The others (olive green dots) are instruments in 12-ft F and 13-ft E♭ intended to fill a comparable musical role in the same period. These include German bass tubas, and indeed the later contrabass saxhorns are not significantly different from tubas. The very lowest dot on this graph is a bass tuba or Herkulesophon by Šediva of Odessa with a very rapidly expanding bore.

We finally look at saxhorns in 16-ft C and 18-ft B♭ (Figure 25). The two red dots show the positions of saxhorns in 18-ft B♭ from Sax's workshop made in the period up to 1865, both from 1854 in fact. Each blue dot shows the position of a saxhorn in 16-ft C or 18-ft B♭ from Sax's workshop made in the period from 1865 to 1885. There is no evidence of a design change.

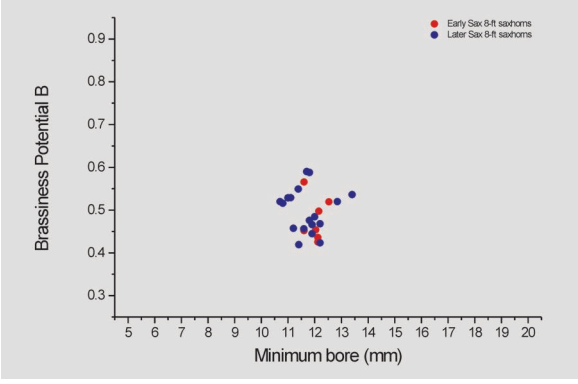

Figure 19 Plot of B against D_0 for baritone and bass saxhorns made by Sax

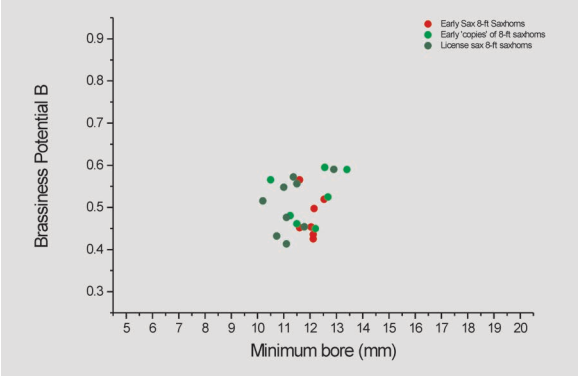

Figure 20 Plot of B against D_0 for early baritone and bass saxhorns made by Sax and other makers

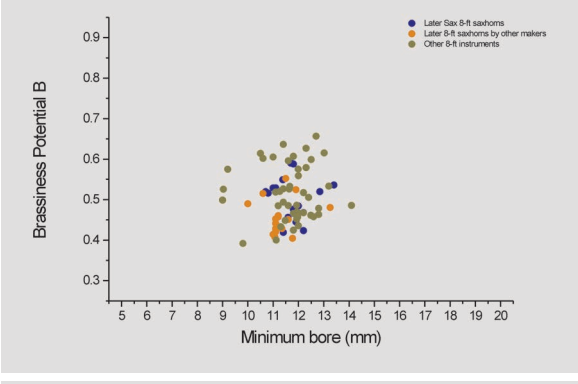

Figure 21 Plot of B against D_0 for later baritone and bass saxhorns made by Sax and other makers

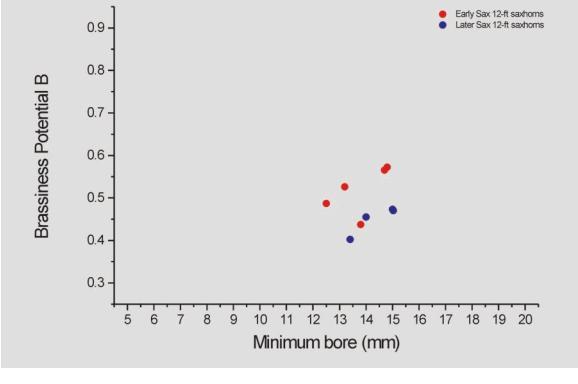

Figure 22 Plot of B against D_0 for smaller contrabass saxhorns made by Sax

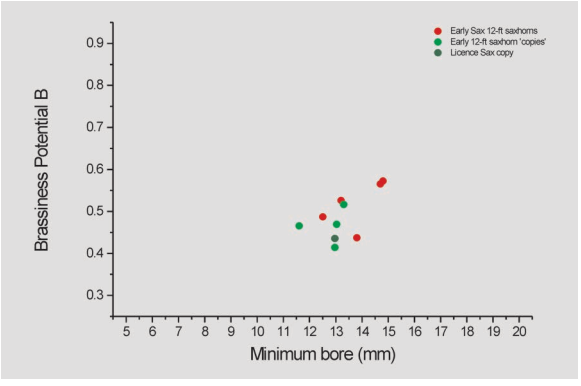

Figure 23 Plot of B against D_o for early small contrabass saxhorns made by Sax and other makers

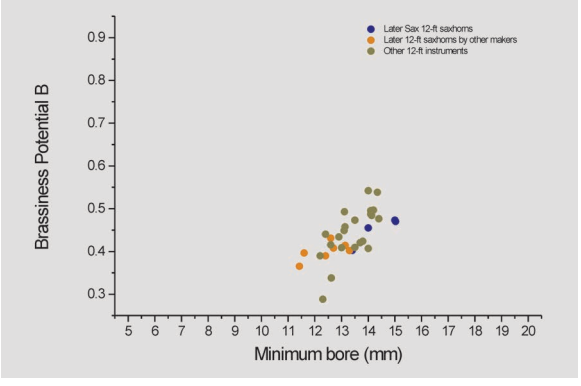

Figure 24 Plot of B against D_o for later small contrabass saxhorns made by Sax and other makers

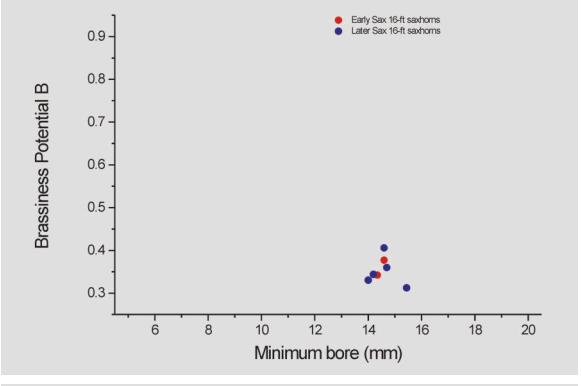

Figure 25 Plot of B against D_o for larger contrabass saxhorns made by Sax

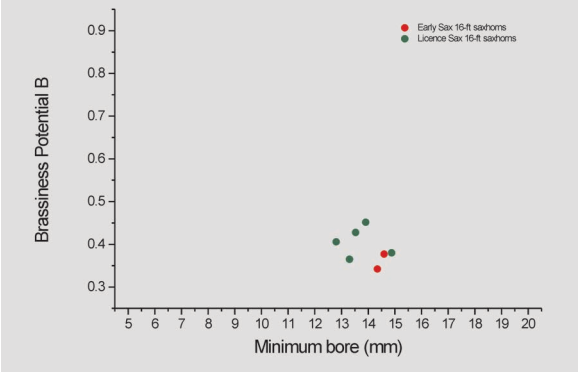

Figure 26 Plot of B against D_o for early large contrabass saxhorns made by Sax and other makers

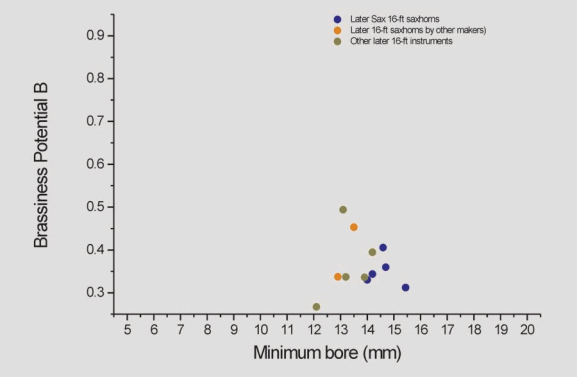

FIGURE 27 Plot of B against D_0 for later large contrabass saxhorns made by Sax and other makers

In Figure 26 the early saxhorns (red dots) are shown with early copies by other makers, all of which are from the Sax licence period (dark green dots). There is no obvious trend.

In Figure 27, the later Sax saxhorns (blue dots) are shown with two later French and English instruments (orange dots). This small sample perhaps suggests that other makers opted for a narrower bore than Sax. The others (olive green dots) are instruments intended to fill a comparable musical role in the same period.

Conclusions This study of surviving saxhorns shows that Sax's own instruments do not have very narrowly defined bore profiles. Sax licence instruments and other copies also have a spread in bore profile parameters. The bore profiles of Sax saxhorns and saxhorns by other makers have similar ranges of diameter and brassiness potential, and therefore similar ranges in acoustic properties. There is significant evidence of acoustical development in Sax's saxhorns only with the E♭ contrabass, and only at this pitch do other makers' instruments diverge consistently. And, not surprisingly, other instruments developed to serve comparable musical functions have a much larger spread in taxonomic parameters. The detailed results could give us confidence to use carefully selected instruments by other makers in reconstructions of saxhorn ensembles.

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– Musical Instrument Museum, Berlin
– Brighton Museum
– Musical Instrument Museum, Brussels

– Musikhistorisk Museum and Carl Claudius Sammling, Copenhagen
– Edinburgh University Collection of Historic Musical Instruments
– Accademia, Florence
– Viadrina Museum, Frankfurt (Oder)
– Royal Conservatoire of Scotland, Glasgow
– Händel-Haus, Halle
– Horniman Museum, London
– Musica (Streitwieser Foundation), Kremsmünster
– Musikinstrumenten-Museum, University of Leipzig
– Music Museum, Lisbon
– Civic Museum, Modena
– Stadtmuseum, Munich
– Musikinstrumenten-Museum, Markneukirchen
– Metropolitan Museum of Art, New York
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– Germanisches Nationalmuseum, Nuremberg
– Bate Collection, University of Oxford
– Musée de la Musique, Paris
– Musical Instrument Museum, Phoenix
– National Museum of Czech Music, Prague
– Schubert Club (Kugler collection), St Paul
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– National Music Museum, Vermillion
– Swiss National Museum, Zurich

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Inhalt

Das Saxhorn

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Musikforschung der
Hochschule der Künste Bern

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