

PCB CORNETS AND WEBSTER TRUMPETS: RUDALL CARTE'S PATENT CONICAL BORE BRASSWIND

Arnold Myers and Frank Tomes

Based on a paper read at the joint Galpin Society / Historic Brass Society Symposium, Edinburgh, June 1994.

Surviving brass instruments from the firm of Rudall Carte (famous for flutes) are remarkable for their fine workmanship. The attention to detail in some cases is taken so far as the use of tuning-slide tubing of nine or ten different diameters. In this paper their patent of 1903¹ and some of their previous and subsequent brass instruments are examined from historical, technological and acoustical viewpoints. Many of the brasswind developments in the late 19th century were intended to improve valve design, reducing the number and severity of the bends in the windway. Other inventions of the same period were concerned with intonation, such as Boosey & Co's compensating pistons, Besson's "Victory Compensator-Transpositor Cornet" of 1893, and Besson's "Enharmonic Patent" models from 1904. Rudall Carte had a different aim with their "Patent Conical Bore": the equalization of tone and response between open and valved notes.

Rudall Carte's 1903 (PCB) brasswind

Most of Rudall Carte's production of brasswind, clarinets, and saxophones, and many of the flutes, were sold for military use. In 1896 the firm tried to increase its share of the brass band market: in the *Brass Band News* for October they advertised that they had made "recent enlargements to their Brass Factory" and offered a cornet with "patent piston water key" and "short action pistons for euphoniums and basses." These short-action pistons had elliptical cross-section wind-ways so that the piston travel could be reduced; not many examples appear to have been made. In the March 1904 edition of *Brass Band News* they resumed advertising, claiming that they had been "established for 150 years" but making no mention of new models. However, from the May 1904 issue and in subsequent monthly issues they advertised the "Conical Bore Cornet." In February 1905 they advertised the "Great success of the PCB (Patent Conical Bore) instruments," coupling them with the great cornet virtuoso Paris Chambers, and offering the other valved brass band instruments on the same principle.

The surviving stock books of Rudall Carte give details of the entire production of PCB instruments (Appendix 1): a total of 423 were made between 1903 and 1933, more than half of them cornets and most of them in the first few years of the patent. Production was never high compared with that of the big manufacturers such as Besson and Boosey. After a promising start with orders coming from the furthest parts of the British Empire, sales

dwindled. There was a slight resurgence in the 1920s, particularly of trumpets, but the depression badly hit Rudall Carte along with other instrument makers. A proud tradition of brasswind making died with the production of the last batch of bugles in 1939. The stock books show that the instruments were virtually unsaleable in the 1930s—some new instruments were “sold as secondhand” after lying on the shelf for years and the remaining brass instruments on the books were sold, with the firm, to Boosey & Hawkes during World War II.

The PCB cornets were offered in a range of models: bore small, medium, or large; long model or short model; B \flat only or with slide change to A (later also a quick-change rotary valve option), plain brass or silver-plated. Figures 1 and 2 show two of the cornet models. The surviving specimens are nearly all different, and even where the authors have examined two instruments of the same model from the same batch there are slight differences in tubing diameter. As with Rudall Carte flutes, instruments were individually craftsman-made. The common feature of all the cornet models is that the windway goes from the mouthpipe via the main tuning-slide to the second valve, then to the first valve, then via the third valve to the bell. The short model has the A slide between the main tuning-slide and the 2nd valve; the long model has the A slide between the 1st and 3rd valves.

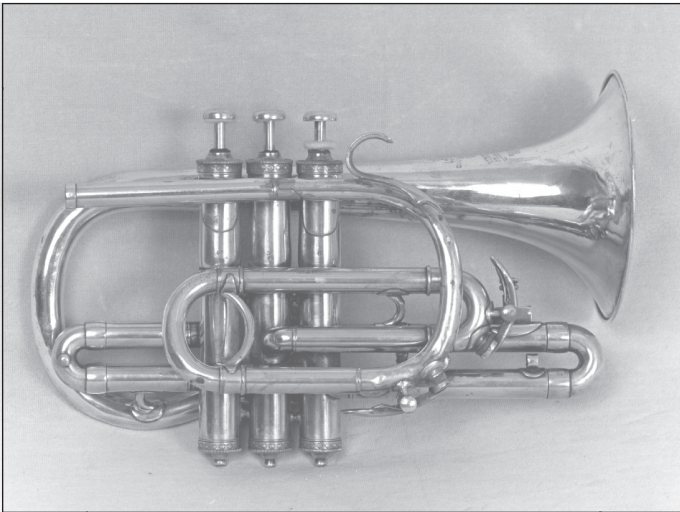


Figure 1

Rudall Carte & Co. Patent Conical Bore Cornet No. 5521. This is a short (Artists') small bore model with A slide; Edinburgh University Collection of Historic Musical Instruments (2988). Bore: main tuning-slide 10.1 - 10.5; A slide 10.5 - 10.7; 2nd valve (?); 1st valve 11.2 - 11.4; 3rd valve 11.7 - 11.9.

The appellation “Conical Bore” derives from an incrementally increasing bore through the bows of the main and valve tuning-slides and the *coquilles* (valve passages), strictly speaking an alternation of cylindrical and expanding bore profiles. The fully developed form with an A slide employs ten different diameters of tubing in the ten slide legs. The degree of “conicity” in the windway depends on the use of valves, and the difference between a PCB instrument and a conventional model is the more striking when the valves are actuated. Figure 4 shows the bore profiles of a PCB and a common cornet through their valves. Playing tests have shown that the cornet is indeed very responsive and well in tune with two or three valves used in combinations. 257 PCB cornets were made.

Fewer trumpets have survived than cornets. Of the 120 made, the authors have had access only to five. It appears that the B \flat trumpet design was modified between 1914 and 1921: a 1914 instrument, described in the stock book as a trumpet, now in the Bate Collection at the University of Oxford, has a bell not very different from cornet proportions; later trumpets (1921-27) such as that in Figure 3 have a narrower but more flared trumpet bell, a mouthpiece with trumpet cup (but cornet shank) and are stamped “WEBSTER TRUMPET.” Webster was the craftsman employed by Rudall Carte to make brass instruments. According to Charles Morley², who worked for the firm from 1925 until 1939, Mr. Webster was an old man in 1925, and very old in 1939. He made whole instruments himself—bells, valves, everything. He had a young assistant called Hellaby who did the rough work. Hellaby would probably have been liable for military service in 1939; otherwise he would have transferred with the rest of Rudall Carte staff to Boosey & Hawkes in 1943 on the take-over.

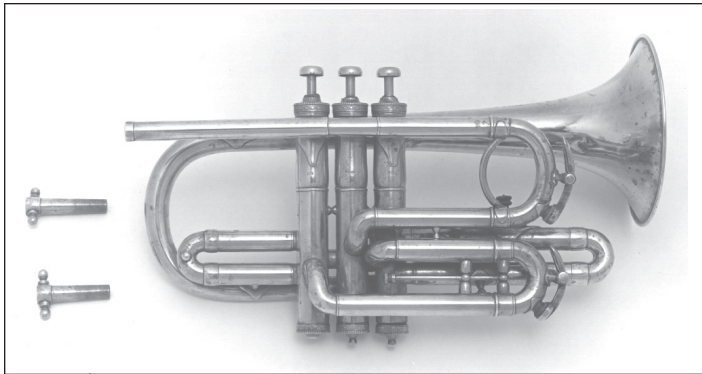


Figure 2

Rudall Carte & Co. Patent Conical Bore Cornet No. 5171. This is a long (military) large bore model with A slide; Edinburgh University Collection of Historic Musical Instruments (619). Bore: main tuning-slide 10.7 - 11.2; 2nd valve 11.1 - 11.2; 1st valve 11.4 - 11.6; A slide 11.7 - 11.9; 3rd valve 12.2 - 12.3.

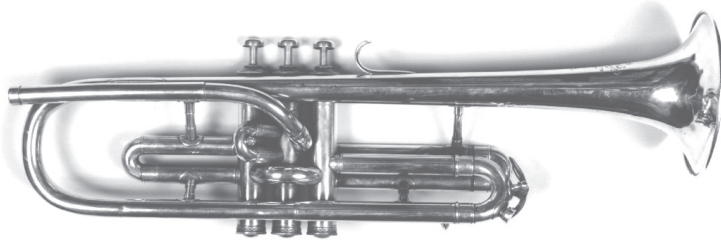


Figure 3

Rudall Carte & Co. Webster Trumpet No. 6832. This is the later model of trumpet; Edinburgh University Collection of Historic Musical Instruments (3460). Bore: 2nd valve 10.4 - 10.5; 1st valve 10.65 - 11.0; 3rd valve 12.0 - 12.5; main tuning-slide 14.0 - 17.0.

Webster may well have been responsible for making the PCB instruments from the beginning. The earlier stock books (circa 1870) give the name of the actual maker of brass instruments (at that time Goodison); the stock books for circa 1875-1895 are missing, and the later stock books give no names. Charles Attwood Goodison (1837-1898) was still foreman when Algernon Rose was gathering material for "Talks with Bandsmen."³ At this time Henry Klussman was "director of the military instrument making department." Of the other two partners who took out the 1903 patent "trading as Rudall Carte & Co.," Montague Sidney George continued with the firm and was the proprietor by the late 1930s; nothing is known of Julius Zambra.

Previous conical-bore designs

The conical bore ideal was not, of course, new in 1903. As with many other brass instrument patents, the actual novelty is tenuous. It is doubtful if Rudall Carte were influenced by Conn's 1901 cornet model, patented in the United States but not in Britain.⁴ In fact, Rudall Carte themselves had produced numerous instruments with an incremental bore profile thirty to forty years previously: one feature of Samson finger-slide valved instruments was that the mouthpipe led to the second valve and the bore expanded in the windway between valves. The finger-slide cornet in the Edinburgh University Collection of Historic Musical Instruments, illustrated in the Catalogue of the Collection⁵, has such a conical bore.⁶ Indeed, George Samson's 1862 patent⁷ for his finger-slide valved instruments claims the conical bore as an advantage (perhaps his only innovation, since finger-slide valves themselves had been previously used by Pace on trumpets).

The concept of a conical bore with single valve loops may well have been new in 1862, and Rudall Carte were for a long time the only firm to have conical-bore instruments in regular production, but an even closer approach to the ideal had been formulated in 1848 by Alphonse Sax, as his Belgian patent 4363⁸ shows. Alphonse Sax's idea, double valve loops

with expanding bore for both valve positions, was very sound from an acoustic viewpoint, though it would have made for rather heavy instruments. Its only known application in production models seems to have been for the fourth valve for some models of euphonium, for example by Thibouville-Lamy circa 1880 (example in private collection), and Hawkes & Co. circa 1900;⁹ the elimination of the great length of cylindrical tubing introduced by the fourth valve of an instrument as conical as the euphonium was rightly seen as a desideratum.

A feature of Rudall Carte's 1903 patent not present in the 1862 patent is the fixed mouthpipe. In 1862 many bands used cornets crooked in A \flat , some used B \flat and a few used A \sharp . By 1903 the cornet was widely used orchestraly and, like the clarinet, it was required to be either in B \flat or A, with only these two transpositions used in parts; bands in 1903 only used B \flat cornets. It was thus viable to produce fixed-mouthpipe cornets in B \flat with a slide that could be drawn for A; for band use, the A slide was dispensable (many PCB cornets were made without the A slide). The 1903 patent specification emphasizes the advantages of the fixed mouthpipe for cornets. The acoustical advantage is that the important bore profile of the mouthpipe can be uniform, eliminating the discontinuity between shank and instrument seen in Figure 4; the manufacturing advantage is that the leadpipe taper does not need to be carefully formed in each shank and crook. This feature of cornets, however, was also far from new in 1903, since it formed the substance of the Registered Design for Bayley's "acoustic cornet" of 1862¹⁰ with its "inventionshorn"-type tuning-slide crooks.

There has been little description or illustration of PCB instruments in the literature. Borland¹¹ reproduces plates showing eight PCB models. Apart from this, the only surviving record of the wider range of PCB instruments is in the advertisements and trade catalogues produced by Rudall Carte. A trade catalogue of 1907 or soon after is in the collection of Tony Bingham, London. Interestingly, it gives model numbers and prices for instruments never actually produced, such as alto and contrabass PCB piston trombones.

Later designs

Besson's "Proteano" model cornet of 1904 had a fixed mouthpipe and an A slide, but not a conical bore. Couturier's first model of a conical bore cornet¹² of 1913 adopted the principle with a vengeance, even sacrificing valve tuning-slides to achieve a smooth bore. Couturier's late conical bore cornets of the 1920s were more practical, having short (20mm) valve tuning-slides and an increasing bore between valves.

Conclusion

Given the high standard of craftsmanship of the PCB instruments, their rewarding response (when played today), and the fact that their prices were comparable to other good quality instruments, how do we account for the modesty of their commercial success? There are many other cases of instrument models where good ideas have never been widely adopted, for no more obvious reason than the whim of fashion. In the case of Rudall Carte, however, their recognized pre-eminence in flute making was such that they hardly needed to advertise to flourish as flute makers. With brass band instruments, the market leaders

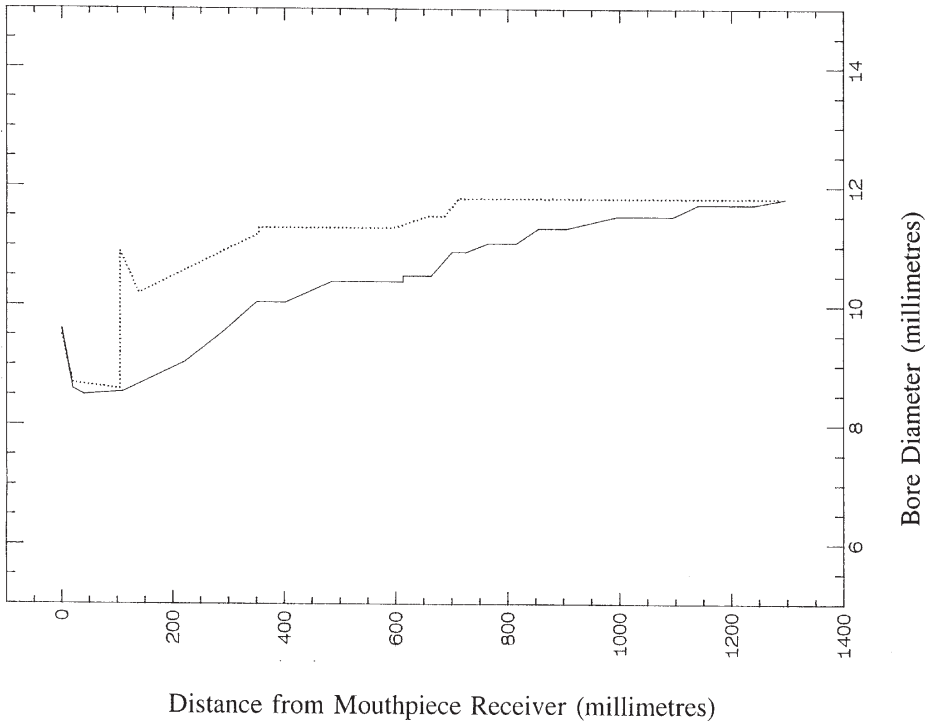


Figure 4

Bore profiles of two cornets from mouthpiece to the exit of the bellpipe from the valves, with all three valves operated. The dotted line shows a Besson cornet with a B \flat flat shank, its bore suddenly increasing from shank to leadpipe and about 400mm of cylindrical bore through the valves. The solid line shows a PCB cornet, only cylindrical for short portions at the tuning-slide legs.

(Besson, Boosey and Hawkes) never neglected to continue advertising, and they kept the lion's share of the market.

The authors wish to thank Mole Benn, Robert Bigio, Tony Bingham, John R. T. Davies, Jeremy Montagu, and John Webb for help in preparing this paper.

Arnold Myers is the current Reviews Editor of the Galpin Society Journal and Vice-President of the Committee for Musical Instrument Collections of, the International Council of Museums. He has been Honorary Curator of the Edinburgh University Collection of Historic Musical Instruments since 1980 and is currently editing a new Catalogue of the Collection. He carried out much of the research and planning of the touring exhibition "Brass Roots: 150 Years of Brass Bands" and contributed the technical appendix "Instruments and Instrumentation in Brass Bands" to the recent book "Bands: The Brass Band Movement in the 19th and 20th Centuries."

Frank Tomes apprenticed as a model maker and studied sculpture at the Royal Academy Schools, London. He is a jazz sousaphone player, and has an extensive collection of early musical instruments, mainly brass. He made brass instruments for the late Christopher Monk, and now maintains his own instrument-making workshop.

APPENDIX 1

PRODUCTION OF RUDALL CARTE & CO. "PATENT CONICAL BORE" INSTRUMENTS

These data have been extracted from the Rudall Carte manuscript stock books, now the property of Boosey & Hawkes. To give an idea of the models produced, we have listed the production by model, giving years and serial numbers. Entries were apparently made in the stock books when instruments were delivered from the workshop, and the names given to the models were not necessarily consistent, so the categories given here may overlap. The stock books also record production of instruments other than Patent Conical Bore, and details of the sales of instruments.

In the list that follows, numbers in square brackets at the end of each category give the total number of instruments of that model, as indicated by the stock books.

Soprano trumpet in E_b and D

1904: 5103 [1].

Bach trumpet in E_b

1920: 6423 [1].

Cornet in C and B_b

1907: 5519 [1].

Cornet in C, B \flat , and A

1912: 5858-9 [2].

Cornet in B \flat

1903: 4890, 4934-5, 4937-42; 1904: 4949-52, 4955-6, 4959-60, 4978-83, 4986-7, 4996-5005, 5011, 5014-8, 5053-57, 5071, 5074, 5076-77, 5090, 5097, 5104, 5107-09; 1905: 5402; 1910: 5780-82 (latest model); 1911: 5792 (bronze pistons), 5797 (bronze pistons), 5813 (bronze pistons), 5824-5 (bronze pistons), 5828; 1912: 5837-38 (bronze pistons), 5840-43; 1913: 5866-7; 1914: 5880-1; 1915: 6084 (old model pistons); 1916: 6288, 6289 (gold-plated); 1917: 6292-5; 1919: 6428; 1921: 6463-4; 1923: 6612-3, 6616, 6644-6; 1924: 6726; 1925: 6783 (new model); 1926: 6876-80 (old PCB pistons), 6883-4, 6891-2; 1927: 6968 (L.P.), 7002-3 (flat pitch); 1931: 7025-6 (L.P.), 7032; 1932: 7034 (gold-plated), 7035; 1933: 7038-9; 1934 (?): 7051 (light) [114].

Cornet in B \flat , short model

1904: 5066; 1908: 5629-33, 5638-9 [8].

Cornet in B \flat , long model

1904: 5078; 1906: 5504 (flat pitch); 1908: 5650; 1909: 5709-10, 5718, 5719 (Irish manufacture), 5720, 5724; 1912: 5834, 5835 [13].

Cornet in B \flat , small bore

1904: 5098-5102, 5130-4; 1905: 5142 [11].

Cornet in B \flat , small bore short model

1907: 5520-5 [6].

Cornet in B \flat , small bore long model

1905: 5391-6 [6].

Cornet in B \flat , medium bore

1904: 5112; 1906: 5417-20 [5].

Cornet in B \flat , medium bore short model

1907: 5526-30; 1908: 5628 [6].

Cornet in B \flat , large bore

1904: 5110-1; 1905: 5150 (French brass), 5151-3, 5186, 5187-91; 1906: 5498-5500, 5501-3 (French brass); 1907: 5562-4, 5589-92; 1910: 5772-5 (bronze pistons) [29].

Cornet in B \flat , large bore short model

1907: 5533; 1908: 5611 [2].

Cornet in B \flat , large bore long model

1905: 5143, 5147-9, 5154-9, 5168-74, 5245-9; 1906: 5443-8, 5466-71; 1908: 5617-21 [39].

Cornet in B \flat , $\text{\textcircled{f}}_{(1,2)}$ tone front

1910: 5738-43 [6].

Cornet in B \flat with rotary change

1922: 6522, 6566-7 [3].

Echo cornet in B \flat

1904: 5011; 1914: 5887 [2].

Echo cornet in B \flat , medium bore

1906: 5421 [1].

Echo cornet in B \flat , medium bore short model

1907: 5534, 5538 [2].

Echo cornet in B \flat , large bore long model

1905: 5160 [1].

Flugel

1906: 5463; 1909: 5714; 1922: 6568 [3].

Trumpet in C

1928: 6969 [1].

Trumpet

1911: 5827; 1924: 6733 (l. pitch slide), 6740 (l. pitch slide), 6742 (l. pitch slide), 6744 (l. pitch slide), 6745 (l. pitch slide), 6753-5 (l. pitch slide); 1924: 6735 (high pitch); 1929: 6981-2, 6990-1 [14].

Trumpet in B \flat

1904: 5095; 1905: 5116; 1907: 5539-40; 1908: 5634-6; 1909: 5733-4; 1912: 5849; 1916: 6195; 1925: 6788 (h.p.), 6794-5 (h.p.), 6807 (h.p.), 6810-1, 6815 (trumpet h. & l.p.), 6816 (trumpet h. & l.p., marked in error 6866); 1926: 6822-3, 6831-2, 6835-6, 6838-9, 6841-2, 6845, 6849-50, 6861-2, 6885-6, 6888-9; 1927: 6893-4, 6897-6900, 6903; 1928: 6955-6, 6958-62, 6966-7, 6970-72, 6975-6, 6978; 1929: 6995 (frosted), 6998-7001;

1930: 7013 (L.P.), 7017-8 (L.P.); 1933: 7040-4 [73].

Trumpet in B \flat , small bore 1931: 7027 (2nd class, marked 7207) [1].

Trumpet in B \flat , large bore

1927: 6933; 1931: 7028 (2nd class) [2].

Trumpet in B \flat , combination

1913: 5878-9; 1914: 6022-3; 1915: 6033-4, 6133-4; 1918: 6327; 1919: 6342, 6361-3;
1920: 6416, 6417; 1921: 6488-9 1923: 6610, 6720-1 [20].

Trumpet in B \flat , quick-change

1927: 6904; 1929: 6994 [2].

Trumpet in A \natural and B \natural

1908: 5612 (no stop) [1].

Trumpet in F and E \flat

1905: 5181; 1909: 5688; 1919: 6364; 1920: 6420 [4].

French horn in B \flat

1907: 5604 [1].

French horn in F

1907: 5600 (light piston) [1].

French horn in F and E \flat combination

1904: 5115; 1905: 5403; 1906: 5449; 1907: 5601, 5606-7 [6].

Tenor cor in F and E \flat

1904: 5045-6; 1905: 5182-3; 1918: 6312-3; 1919: 6411 [7].

Tenor horn in E \flat

1904: 5091; 1905: 5250; 1906: 5462 [3].

Baritone in B \flat

1904: 5114; 1905: 5423-4 [3].

Valve trombone in B \flat , three pistons

1904: 4994, 5072; 1905: 5400 [3].

Valve trombone in G, three pistons

1905: 5167 [1].

Euphonium in C, B \flat and A, 4 pistons

1905: 5401 [1].

Euphonium in B \flat

1905: 5129, 5144; 1905: 5184; 1918: 6336 [4].

Euphonium in B \flat , 4 pistons

1922: 6595-6 [2].

Euphonium in B \flat , 4 pistons, small bore

1905: 5416 [1].

Bombardon in F, 5 pistons

1908: 5680 (flat pitch) [1].

Bombardon in E \flat , 3 valves

1904: 5096; 1905: 5146, 5415 [3].

Bombardon in E \flat , 4 valves

1907: 5599 (bell left); 1922: 6574-5 [3].

Bombardon in E \flat , 4 valves, compensating

1908: 5776 [1].

Bombardon in B \flat

1922: 6571-2 [2].

Bombardon in BB \flat , circular

1904: 5106 [1].

Flugel

1906: 5463; 1909: 5714; 1922: 6568 [3].

Trumpet in C

1928: 6969 [1].

Trumpet

1911: 5827; 1924: 6733 (l. pitch slide), 6740 (l. pitch slide), 6742 (l. pitch slide), 6744 (l. pitch slide), 6745 (l. pitch slide), 6753-5 (l. pitch slide); 1924: 6735 (high pitch); 1929: 6981-2, 6990-1 [14].

Trumpet in B \flat

1904: 5095; 1905: 5116; 1907: 5539-40; 1908: 5634-6; 1909: 5733-4; 1912: 5849; 1916: 6195; 1925: 6788 (h.p.), 6794-5 (h.p.), 6807 (h.p.), 6810-1, 6815 (trumpet h. & l.p.), 6816 (trumpet h. & l.p., marked in error 6866); 1926: 6822-3, 6831-2, 6835-6, 6838-9, 6841-2, 6845, 6849-50, 6861-2, 6885-6, 6888-9; 1927: 6893-4, 6897-6900, 6903; 1928: 6955-6, 6958-62, 6966-7, 6970-72, 6975-6, 6978; 1929: 6995 (frosted), 6998-7001; 1930: 7013 (L.P.), 7017-8 (L.P.); 1933: 7040-4 [73].

Trumpet in B \flat , small bore

1931: 7027 (2nd class, marked 7207) [1].

Trumpet in B \flat , large bore

1927: 6933; 1931: 7028 (2nd class) [2].

Trumpet in B \flat , combination

1913: 5878-9; 1914: 6022-3; 1915: 6033-4, 6133-4; 1918: 6327; 1919: 6342, 6361-3; 1920: 6416, 6417; 1921: 6488-9 1923: 6610, 6720-1 [20].

Trumpet in BB \flat , quick-change

1927: 6904; 1929: 6994 [2].

Trumpet in A \natural and B \natural

1908: 5612 (no stop) [1].

Trumpet in F and E \flat

1905: 5181; 1909: 5688; 1919: 6364; 1920: 6420 [4].

French horn in B \flat

1907: 5604 [1].

French horn in F

1907: 5600 (light piston) [1].

French horn in F and E \flat combination

1904: 5115; 1905: 5403; 1906: 5449; 1907: 5601, 5606-7 [6].

Tenor cor in F and E \flat

1904: 5045-6; 1905: 5182-3; 1918: 6312-3; 1919: 6411 [7].

Tenor horn in E \flat

1904: 5091; 1905: 5250; 1906: 5462 [3].

Baritone in B \flat

1904: 5114; 1905: 5423-4 [3].

Valve trombone in B \flat , three pistons

1904: 4994, 5072; 1905: 5400 [3].

Valve trombone in G, three pistons

1905: 5167 [1].

Euphonium in C, B \flat and A, 4 pistons

1905: 5401 [1].

Euphonium in B \flat

1905: 5129, 5144; 1905: 5184; 1918: 6336 [4].

Euphonium in B \flat , 4 pistons

1922: 6595-6 [2].

Euphonium in B \flat , 4 pistons small bore

1905: 5416 [1].

Bombardon in F, 5 pistons

1908: 5680 (flat pitch) [1].

Bombardon in E \flat , 3 valves

1904: 5096; 1905: 5146, 5415 [3].

Bombardon in B \flat , 4 valves

1907: 5599 (bell left); 1922: 6574-5 [3].

Bombardon in E \flat , 4 valves, compensating

1908: 5776 [1].

Bombardon in B \flat

1922: 6571-2 [2].

Bombardon in BB \flat , circular

1904: 5106 [1].

APPENDIX 2

CONICAL BORE RUDALL CARTE INSTRUMENTS IN PUBLIC COLLECTIONS AND THE AUTHORS' COLLECTIONS

This list includes instruments with finger-slide valves (which have bore increments between valves), and Patent Conical Bore instruments.

- 753 Cornet, finger-slide valves: Boosey & Hawkes Museum, Edgware, Middlesex (719).
- 772 Vocal horn, finger-slide valves, narrow mouthpipe. Edinburgh University Collection of Historic Musical Instruments (3486)
- 854 Vocal horn, finger-slide valves: Horniman Museum, London (Carse Collection '45.47/102).
- 946 Bugle *ténor en Sib*, finger-slide valves: Musée Instrumental, Brussels (Mahillon 3158).
- 967 Cornet, finger-slide valves: Edinburgh University Collection of Historic Musical Instruments (220).
- 1253 Euphonium, finger-slide valves: Edinburgh University Collection of Historic Musical Instruments (198).
- 5074 Cornet, conical bore: Frank Tomes, Merton Park, London.
- 5171 Cornet, long model large bore PCB: Edinburgh University Collection of Historic Musical Instruments (619).
- 5521 Cornet, short model small bore PCB: Edinburgh University Collection of Historic Musical Instruments (2988).
- 6022 Trumpet in *B \flat -A*, combination PCB: Bate Collection, University of Oxford (711).
- 6644 Cornet, PCB: Frank Tomes, Merton Park, London.
- 6832 Webster trumpet in *B \flat* : Edinburgh University Collection of Historic Musical Instruments (3460).
- 7025 Cornet, L.P. PCB: Boosey & Hawkes Museum, Edgware, Middlesex (720).

APPENDIX 3

CONFIGURATIONS OF SOME PATENT CONICAL BORE INSTRUMENTS

The layouts of the various models of PCB instruments show considerable variety. The position of the valve section and the tuning-slides in the windway are important features of the acoustical design of an instrument. Several of the models also have a tuning-slide between the first and third valves. The number of surviving examples is small, and the authors have

not been able to examine examples of many of the models that were produced. It is also quite possible that there were inconsistencies and variations *within* models.

Conical bore cornets 5074 (1904) and 7025 (1931): mouthpipe - main tuning-slide - 2 - 1 - 3 - bell.

Conical bore cornet 5521 (1907) and “artists’ (short) model” in Rudall Carte’s trade catalogue: mouthpipe - main tuning-slide - A slide - 2 - 1 - 3 - bell.

Conical bore long model B \flat -A cornets 5169 and 5171 (1905) and 6644 (1923) and “military (long) model” in Rudall Carte’s trade catalogue: mouthpipe - main tuning-slide - 2 - 1 - A slide - 3 - bell.

Combination trumpet in B \flat -A 6022 (1914): mouthpipe - 2 - 1 - 3 - A slide - main tuning-slide - bell.

Webster trumpet 6488 (1921): mouthpipe - main tuning-slide - 2 - 1 - 3 - bell.

Webster trumpets 6832 (1926) and 6903 (1927): mouthpipe - 2 - 1 - 3 - main tuning-slide - bell.

NOTES

- 1 Henry Ernest Klussman, Montagu Sidney George and Julius James George Zambra, “Improvements relating to wind musical instruments made of brass or other metal.” Great Britain Patent 21295, issued 31 December 1903.
- 2 Charles Morley, Personal communication, 1994.
- 3 Algernon Sidney Rose, *Talks with Bandsmen: A Popular Handbook for Brass Instrumentalists* (London, 1895; reprint edition, London, 1995), pp. 102ff.
- 4 Charles Gerard Conn, “Valve musical instrument.” United States Patent 676029, issued 11 June 1901. This claims a cornet with the windway running mouthpipe - 1 - main tuning-slide - 3 - bell “allowing an instrument with more conic or taper tubing.” However, it appears not to have been made even with bore increments between valves, though this may have been envisaged.
- 5 *Historic Musical Instruments in the Edinburgh University Collection: Catalogue of the Collection* (Edinburgh, 1990), 1: 132.
- 6 Rudall, Rose, Carte & Co.’s cornet no. 967 (circa 1865) with Samson’s finger-slides has the bore: main tuning-slide. 10.5 - 11.0; 2nd valve 11.0; 1st valve 11.25; 3rd valve 11.5.
- 7 George Robert Samson, “Improvements in valves or cylinders for wind instruments.” Great Britain Patent 1245, issued 29 April 1862.
- 8 Alphonse fils Sax, “Un nouveau système de pistons à tubes coniques pour instruments de cuivre.” Belgium Patent 4363, issued 3 May 1848.
- 9 Arnold Myers and Raymond Parks, “Cornets and Tubas.” *Historic Musical Instruments in the*

Edinburgh University Collection: Catalogue of the Collection, vol. 2, part H, fascicle ii (Edinburgh, 1994), item (3410).

- 10 John Webb, "Designs for Brass in the Public Record Office," *Galpin Society Journal* 38 (1985): 48-55.
- 11 John E. Borland, "The Brass Wind Instruments," in T.L. Southgate, ed., *English Music [1604 to 1904] being the lectures given at the Music Loan Exhibition of the Worshipful Company of Musicians held at Fishmongers' Hall, London Bridge, June-July 1904* (London, 1906), pp. 445-477. Three plates show eight PCB models (despite the caption claiming ten—the F horn and the Flugel PCB models had not been made by early 1906). The examples shown are: trumpet in F (Fig. 108); baritone in B \flat , upright bombardon in E \flat , French horn in F and E \flat with rotary key change (Fig. 109); euphonium in B \flat , circular contrabass bombardon, tenor horn in E \flat , *cornet-à-pistons* in B \flat (Fig. 110).
- 12 Ernst A. Couturier, "Cornet." United States Patent 1073593, issued 23 September 1913. Couturier subsequently took out patents for other conical bore instruments, including one for a slide trombone.