Tubas, Tubists, and Composers: a mixed-methodological approach to performer- and composer-instrument relationships

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Abstract

This thesis assesses, through self-reflective practice, how the instruments of the tuba family have functioned as interfaces between composers and performers from the earliest records to the present day. A lack of knowledge surrounding the instruments and their capabilities and limitations has persisted since they were first employed by composers in the late seventeenth century, which suggests that study is needed from alternative perspectives to analysis of interpersonal artistic practices. As such, the methodologies which are employed are based upon a performer's perspective on organology and acoustics, and examine the nature of the instruments themselves, and how they can be most effectively interacted with by performers and composers. A history of tuba family performance practice provides evidence as to which instruments historical composers would have encountered, and shows the organological development of these instruments, how individual composers' relationships with the tuba family developed over their careers, how specific performance practices emerged by the early twentieth century, and how today's practices emerged over the course of the later twentieth century. In light of these findings, resources are presented, which have been developed through performance-based experience, in order to deepen critical practice methods for engaging with historical repertoire, and to establish and cultivate performer- and composer-tuba relationships into the future. Audio-visual recordings comprise of collections of orchestral repertoire examples which are performed using thirteen representative historical instruments, as well as comparative recordings made with a selection of six instruments commonly employed today. A guidebook to the instrument, annexed to this thesis, explains how the codification of the contemporary tuba can facilitate future composer-performer relationships, demonstrated via recordings of score excerpts, and four new pieces for solo tuba, which present the benefits provided by the existence of such a guidebook, and show the importance of establishing and maintaining dialogues between performers and composers.

Publications and Presentations

The following publications and presentations are based, in whole or part, on material from this thesis:

- Adler-McKean, Jack. “Brass instruments, techniques, and repertoire in the early twenty-first century” in *The Handbook of Wind Instruments* (Graz: Internationale Gesellschaft zur Erforschung und Forderung der Blasmusik, in preparation).
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- Adler-McKean, Jack. *Exploring nineteenth-century tuba/composer relationships*. Paper presentation at the Historical Performance Institute Fifth Annual Conference, January 2021 (Indiana University Jacobs School of Music, USA / Online).
- Adler-McKean, Jack. *The Techniques of Tuba Playing / Die Spieltechnik der Tuba*. Kassel: Bärenreiter, June 2020.
- Adler-McKean, Jack. “The Cambridge Encyclopedia of Brass Instruments. Ed. by Trevor Herbert, Arnold Myers, and John Wallace.” *Music and Letters* 100/4 (November 2019): 757–760.
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Introduction

As a tubist with international experience in performing both new and old music, my self-reflective practice has forced me to confront the ever-changing role that my instrument has had across a wide variety of musical contexts over the last two-and-a-half centuries. In order to examine this role in more detail, uncover the roots of contemporary practice, and propose methods for future development, this project forms a practical investigation into the instruments of the tuba family, by assessing how they have functioned as interfaces between composers and performers from the earliest records to the present day. Following religious, military, and vernacular use in the seventeenth and eighteenth centuries, these instruments found their way, over the course of the first half of the nineteenth century, into orchestras, opera houses, and pedagogical institutions across Europe. Today, however, there is a widespread disconnect between specific instrumental practices, repertoire (old and new), and players themselves.

Among both composers and performers, there persists a lack of awareness of the instruments' capabilities and limitations, with music of the last two-hundred years routinely played using instruments chosen largely without knowledge or recognition of any historical contexts. This thesis demonstrates how a mixed-methodological approach is necessary in order to build new performer- and composer-instrument connections, for the benefit of both historical-critical and contemporary performance practices. The absence of established, significant relationships between tubists and composers to date suggests that study is needed from alternative perspectives to analysis of interpersonal artistic practices. As such, I primarily employ methodologies based upon a performer's perspective on organology and acoustics; in other words, a study into the nature of the instruments themselves, and how they can be interacted with by performers and composers.

Part One presents the hitherto unconsolidated history of tuba family performance practice, which, following analysis of contemporaneous compositions and writings, details evidence of which instruments (and, on occasion, instrumentalists) orchestral composers would have encountered from the late seventeenth century onwards. This shows the organological development of these instruments, how individual composers' relationships with the tuba family developed over their careers, and how specific performance practices emerged by the early twentieth century. It also details how and why these traditions shifted dramatically over the course of the twentieth century to result in contemporary practices, and the effect that these changes have had on the roles of both the tubist and composer in creating and performing new and old works today.

In light of these findings, Part Two provides resources that I have developed through my practice, which can be used to establish and cultivate performer- and composer-tuba relationships into the future. Audio-visual recordings provide collections of orchestral repertoire examples performed using thirteen historical instruments, the selections of which are limited by the evidence presented in Part One regarding which members of the tuba family were in common usage at particular time points and locations when and where the relevant repertoire was premiered. Selections of these are then presented in comparison with recordings made using six modern instruments that could conceivably be employed for performances of such works across the world today. I then present how the codification of the contemporary tuba according to its acoustic properties and sonic resources can facilitate future composer-performer relationships through production of a guidebook for use by both parties. This approach is illustrated via recordings of score excerpts from extant pieces to demonstrate selected sound generation and modification techniques, and also of four new pieces for solo tuba, which, through my own practice experience, present the benefits provided by the existence of such a guidebook, as well as the importance of establishing and maintaining dialogues between performers and composers.

Terminological clarifications

A “labrosone” (Baines 1976, p. 40) generates sound through vibration of the lips without any external membrane. At the time of writing, the term “has not yet caught on widely in vernacular usage” (Yeo 2021, p. 81), but will be used in this document to reflect the fact that several of these instruments, traditionally referred to as ‘brass’ or ‘brasswind’ instruments, are neither made of metal (see chapters 1.1, 1.2), nor does their sound directly result from any flow of wind through the instrument (Campbell, Gilbert, and Myers 2021, pp. 43–44).

The “tuba family” (cf. Bevan 2000, p. 29) includes labrosones with a broadly conical bore, a fundamental frequency of C2 or lower, and a means of producing a variety of resonant frequencies through use of holes, keys and/or valves.[1]

1 Regarding sounding lengths and fundamental frequencies of tuba family instruments, see Annex, p. 36. For further technical clarifications, see Annex, pp. 16–17.

PART ONE: A history of tuba family orchestral performance practice

Over the last two centuries, while the principles of sound production have remained the same, instruments of the tuba family have undergone significant transformations in terms of overall form, mechanisms for pitch alteration, and resonant capabilities. A systematic, chronological overview of the developmental processes that facilitated these transformations can not only uncover the origins of modern instruments and their employment, but also inform performers and composers as to what tools are needed in order to further develop such practices in manners that benefit their respective relationships with the instruments. By detailing these processes alongside contemporaneous literature and repertoire, one can observe how and why various instruments were employed by both performers and composers, and how any such relationships evolved alongside broader organological, societal, and aesthetic trends. These processes began with the earliest low-pitched labrosone to feature a method of creating specific, reproducible pitches: the serpent.

1: First encounters between composers and the tuba family

1.1 The church, the military, and the royal court

Jean (Abbé) Lebeuf's memoires credited Edmé Guillaume, a canon in Auxerre, with the invention of the serpent (Fig. 1) around 1590 (Lebeuf 1743, p. 643). However, current research suggests that "Guillaume's invention was very likely a transformation, achieved by simplifying and standardizing lower members of the group of pre-existing snake-shaped cornetti" (Fig. 2) (Klaus 2013, p. 163).[2] In any case, as an effective plainchant support (Hostiou and Conte 2015, pp. 138–40), the serpent was in widespread use in France by the late seventeenth century (Dompiner, Langlois, and Mailhot 2013, p. 64; Hostiou 2015, pp. 203–5). This presence facilitated the first specification of the instrument by composers, as seen in Marc-Antoine Charpentier's *Offerte pour l'orgue et pour les violons, flûtes et hautbois* (ca. 1685), it being noted that "we can be sure that it [the serpent] was readily available, and therefore that it may have been used more

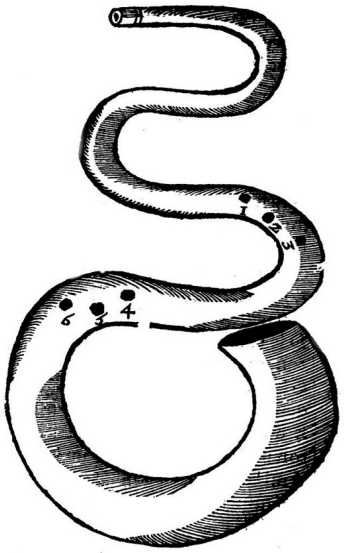

Figure 1: Serpent. Mersenne 1637, p. 279.

2 Regarding hybrid forms of the bass cornett and serpent and their possible co-existence, see Köhler 2015. 1590 is arguably when the instrument was brought to wider public attention by Guillaume once François I's *chapelle de plain-chant* (founded in 1525–26) became attached to the *chapelle de musique* in the 1580s (Auzeil 2013, p. 63).

often in Charpentier's works than the single reference in the autographs suggests" (Thompson 1997, p. 162). This instrumental composition also takes the serpent beyond mere support of voices, a development also found in Jean-Baptiste Matho's *Arion* (1714), which requires two serpents for some instrumental sections (ibid., p. 162), and instrumental works by Sébastien de Brossard, such as his *Symphonie pour la graduel* (ca. 1688) (Hostiou 2015, p. 210).

Figure 2: Bass cornett. Anon., Italy, 16th century (?). Cité de la musique, E.577.

Such experimentation with the serpent was also taking place elsewhere in Europe. In England, John Eccles's music for William Shakespeare's *Macbeth* (1694/95/96) uses the serpent to "perhaps emulate the jerky movements thought to be characteristic of witches dancing" (Eccles et al. 2004 [1694/95/96], p. viii), while in his *Rinaldo and Armida* (1698), it is indicated in the stage directions to be "play[ed] softly under the stage" (Eccles 2011 [1698], p. 61) to "represent the brewing tempest of Armida's vengeance" (ibid., p. xvi), although without any notational suggestions as to what this might entail. Four of Gottfried Heinrich Stölzel's church cantatas, written in 1736–37 for the court of Sondershausen which had acquired a serpent in 1730, specify a "basso serpentini" or "basso serpendini", yet the instrument is primarily used to support the basso continuo line of the organ (Klaus 2013, p. 158).[3] An 1803 account of the instrument by Ernst Ludwig Gerber, son of the Sondershausen organist who likely premiered Stölzel's works, omits mention of these cantatas, or indeed any awareness of the serpent in Germany prior to its introduction into the military bands "roughly thirty years earlier" (Gerber 1803, col. 19).

This time-period (around the 1770s) appears to pinpoint accurately when serpents were first found in European military bands, and thus made known to a wider audience of composers. In England, serpent parts from William Abington and Samuel Wesley date from 1777 (Bevan 2000, p. 98) and military band serpentists are recorded from 1783 (Palmer 1990, p. 140). The instrument was found in military bands in France from 1795 (ibid., p. 142),[4] in Russia by the mid-eighteenth century

3 Ahrens notes that the parts contain rapid notes and frequent large leaps, but also agrees that, given the lack a *violone* or double bass part, the instrument is fundamentally used to support the bass (although there are numerous similar works also without such bass parts) (Ahrens 2001, pp. 68–69). He also hypothesises that the diminutive *serpentini* could be used to refer to a bass cornett rather than a serpent (Ahrens 2015, p. 285).

4 Joseph Brousse dates usage in the Gardes françaises as early 1764, but without providing a source (Brousse 1925, p. 1674).

(Matvejčuk 2019, p. 91),[5] and in Austria from "around the end of the [eighteenth] century" (Nagy 1985, p. 57). However, there is nothing to suggest that composers had any working knowledge of the instrument, with works even from those well known for their innovative instrumentation such as Joseph Haydn (Haydn 1782), Ludwig van Beethoven (Beethoven 1864 [1816]), and Luigi Cherubini (Cherubini 1992 [1816]), reflecting that it was being used only because it was part of the instrumentation available. In Haydn's works, for example, while occasionally forming the base of a three-part harmony with the bassoons, the serpent is generally used to double the second bassoon in octaves or unison (Yeo 2015, p. 265), a tradition that would be sustained as the instrument began to find use in orchestral ensembles.

1.2 Entering the opera house and the concert hall

Figure 3: *Serpent ordinaire*. Pierre Ribo, Brussels, 2018 (after anon., Brussels, ca. 1801). Private.

The serpent was found in Parisian orchestras shortly after their founding in the 1770s, with existing repertoire suggesting that it was used to invoke religious overtones, as seen in François-Joseph Gossec's *hymne des sacrificateurs* (which accompanied Jean Racine's *Athalie* in 1785) (Audéon 2013, p. 267), and in Henri-Montan Berton's *Montano et Stéphanie* (1799) where it is separated from the bassoons only in the *marche religieuse* (Berton 1799, p. 138). Hector Berlioz only included the serpent in religious contexts—*Messe solennelle* (1825) and the *Dies Irae* in *Symphonie Fantastique* (1830)—although he later described its "barbarous quality of tone" as being "suited better to the rites of Druid cults than those of the Catholic religion" (Berlioz 1843, p. 230), while Fanny Hensel included a serpent in a mythological context in *Hero und Leander* (1831) in order to "heighten musical tension" (Todd 2010, p. 161).

Audéon argues that the contrabassoon replaced the serpent at the Opéra de Paris in around 1810, although he also cites an essay from 1804 stating that the contrabassoon creates "a reedy sound without force or clarity" and "is much inferior to the serpent" (Audéon 2013, pp. 268–69).[6] The

5 A march including two serpents by Carlo Canobbio is found in the pasticcio *The Early Reign of Oleg,* premiered in St. Petersburg in 1791 (Canobbio, Pashkevich, and Sarti 1893 [1790], p. 37; full score in Smith 1993, pp. 14–15).

6 In ca. 1790, the serpent appears to have been more widely used in France than the bassoon (Dompiner, Langlois, and Mailhot 2013, p. 75); for example, a serpent part for Wolfgang Amadeus Mozart's Symphony KV 385 *Haffner* (1782) created for the Société du concert in Lille appears to be a simplified reinforcement of the bassoons (reproduced in Audéon 2013, p. 280).

coexistence of the serpent alongside the bassoon and contrabassoon led to a fundamental misunderstanding of the instrument; its compromised acoustic structure was overlooked, and was described at the time thus:

> Only for the comfort of the fingers, [the tone holes are] placed three and three [see Fig. 1] close together so that a proper and complete scale is out of the question, and significantly more than half of its tones [must be] artificially created by half-closing a tone hole […], three or more neighbouring pitches have the same fingering, and [for] almost every note there is the necessity to push the pitch up or down with the lips [leading to] extremely limited usefulness in the orchestra and elsewhere. (Weber 1816, col. 700–1)

Nevertheless, the two instrument names were seen as interchangeable. In 1821, Castil-Blaze described the "contre-basson" as the bass of the bassoon section (Blaze n.d. (ca. 1825) [1821], p. 123), but it is later equated with the "serpent droit" (ibid., pp. 253–54), the most popular form of bass horn (upright serpent) in France at the time (Heyde 2015, p. 24; see also below).[7] In Germany in 1807, Johann Georg Krünitz described the "snake tube" [*Schlangenrohr*] or "Serpentin" as "a type of bassoon" that is "less dulcet […] but stronger" (Krünitz 1807). By the 1840s, Ferdinand Schlotthauer was using 'serpent' and 'contra-bassoon' interchangeably (Schlotthauer 1843, p. 8), Jean-Georges Kastner captioned one model of bass horn as an "Austrian contrabassoon" (Kastner 1848, Pl. XIII No. 9), and, as late as 1862, Franz Ludwig Schubert wrote that "the wonderful effect of the serpent in Beethoven's *Fidelio* [presumably referring to the contrabassoon part] is well-known" (Schubert 1862, p. 41).[8]

Figure 4: English bass horn. Griesling & Schlott, Berlin, ca. 1830. Collection Günter Hett.

Felix Mendelssohn's Overtüre: *Meeresstille und Glückliche Fahrt* (1828), Symphony No. 5 *Reformation* (1832) and *Paulus* (1836) (the latter two again evoking religious connotations) require the serpent and contrabassoon to read from the same part, a combination which acoustically balances well (Campbell 2002, pp. 54–55),[9] but also suggests that he thought them to belong to

7 Heyde referred to a "Serpent basson (Ophibaryton)" (Heyde 1982, p. 81) much as Kastner did (Kastner 1848, Pl. XIII No. 2), but more recently used the somewhat ambiguous term "continental bass horn" (Heyde 2015, p. 25).

8 Schubert also wrote that "the contrabassoon … [that] Beethoven used with great fondness and genius, has been eliminated from the group of bass instruments" (Schubert 1865, p. 305), suggesting that further research into the nineteenth-century employment of both instruments is needed to provide these assertions with appropriate context.

9 As far as can be ascertained, Campbell's data was produced using a modern copy of an early nineteenth-century serpent, and a modern contrabassoon. Further research is required in order to investigate whether such results can be reproduced using historically and geographically contemporaneous instruments.

the same instrumental family. Wagner's serpent writing also leads one to believe that it could be "treat[ed] […] as a third bassoon" (Bevan 1997, p. 150), with his writing in *Rienzi* (1842) going notably lower than the serpent's range. Such a discrepancy is potentially due to a transposition mistake, as the French *ton de chapelle* (pitch for churches, where serpents were still commonly found) lay two semitones lower than the *ton d'orchestre* at the time (Haynes 2002, pp. 369–70; Hostiou 2015, p. 174; Overton 1985, pp. 40–42). Nevertheless, Wagner's complex fast chromatic writing implies that he was unaware of the instrument's inherent acoustic limitations. Gerber's text, noted above, made impractical claims of extreme registers (Gerber 1803, col. 22–23), with much of his text copied uncritically soon thereafter in translation by Pietro Lichtenthal (Lichtenthal 1826, pp. 193–94). In a recent collection of essays on the serpent, one paper references Gerber's text (Klaus 2013, p. 162), and another Lichtenthal's (Meucci 2013, p. 291–92), but both fail to show awareness of the links between them, and to comment on the practical feasibility of their authors' claims, suggesting a lack of critical reflection (or, at least a significant ambiguity) to this day regarding serpent performance practice. These parts are often omitted from modern performances; my own practice suggests that Mendelssohn's serpent parts can be effectively recreated using other instruments (see chapter 4.2; in particular, footnote 116), while others have argued that a driving factor behind Wagner's search for a new type of horn that would eventually become known as the Wagner tuba was a desire to recreate the timbre of the serpent, which, by the 1850s, was already largely absent from the orchestra (Overton 1985, p. 48).

Figure 5: 'Early' cimbasso. Nicholas Perry, St. Albans, 1998 (after Ubaldo Luvoni, Milan, ca. 1826). Private.

Bass horns, or serpents in upright form, were developed to improve reliability of serpent intonation, ergonomics, and structural stability. The creation of the earliest such *serpent droit* is credited to J. J. Régibo in 1789 (Heyde 2015, p. 21), and later variations included the *serpent Forveille* (in metal with a wooden bell), *basson russe* (in wood, often with a dragon-head metal bell), and the *ophimonocleide* (wooden body and a metal bell with one key).[10] Gottfried Streitwolf's *Chromatisches Basshorn* (in wood with fully keyed holes and a metal bell) was advertised as

10 For further details see Maniguet 2013, Heyde 2015, Meucci 2015, Heyde 2016, and Kampmann 2019. Given their common use in military bands, these instruments are also sometimes known as "military serpents", a term also used for instruments in 'S'-shape with additional metal bracing and keys (Bevan 2000, p. 79).

"serving to support the wind section in our orchestras" (Heinroth 1820, col. 688), a role these military instruments may indeed have undertaken, although the 'S'-shaped serpent (commonly known by this time in France without keys as a *serpent d'église*, and with keys as a *serpent ordinaire* (Palmer 1990, p. 137) (Fig. 3)) was also still commonly found.[11] Terminology appears to have been left vague enough to allow performance using any associated instrument, with one form or another of bass horn commonly found in German orchestral practice until around 1830 (Schreiber 1938, p. 177), although in his *Nocturno* in 1826, Mendelssohn specifies an English bass horn (all metal, with three keys) (Fig. 4) owing to its presence in the Bad Doberan band who commissioned the piece. He then included it in his overture to *Ein Sommernachtstraum* (1827), although it does not feature in the first draft of the score. Bevan proposes that it was added on the suggestion of his friend Adolph Bernhard Marx (Bevan 2000, pp. 483–84); Marx was later to describe the instrument as creating a "dull" sound (Marx 1847, p. 206), although my own practice suggests that it can create a tone across low and high registers considerably more stable than the serpent, and easily as strong as the more advanced fully-keyed bass horns that soon replaced it (see chapter 4.2; in particular, 4.2.3).

Figure 6: Keyed ophicleide. Wessex, China, ca. 2015 (after Gautrot aîné, Paris, ca. 1840). Private.

A more defined instrumental practice can be traced in Italy, where the serpent was found in 1816 at the theatres of San Carlo (Naples) (Meucci 2013, p. 287) and La Scala (Milan) (Koury 1986, p. 142).[12] Scores from this period, such as that of Gioachino Rossini's *Armida* (1817), refer to a "serpentone" (Rossini 1840 [1817]), a name which, by around this time, pertained to a form of bass horn commonly known as a cimbasso (Fig. 5) (Meucci 2013, p. 292), a portmanteau of *corno in basso* (Meucci 1996, p. 145).[13] Some composers adopted this name, but with little consistency: Gaetano Donizetti in *Parisina* (1833) employed "gimbasso" (Donizetti ca. 1833),[14] while in Vincenzo

11 Michael Nagy suggests that Mendelssohn's terminology *Serpente* indicates some form of bass horn (Nagy 1985, p. 51), a claim without primary source evidence. Christian Friedrich Michaelis contemporaneously described the "Serpante [*sic*]" as being "adept at giving a powerful sense of poise and dignity to the accompaniment" (Michaelis 1807, col. 249).

12 The serpent was used earlier in Johann Simon Mayr's *Zamori, ossia L'eroe dell'Indie*, which was first performed in Piacenza in 1804 (Maehder 2020, p. 163), although this was as part of a separate military band.

13 Gerhard Zechmeister's alternative portmanteau "'Trombone Contra in misura Basso' (F bass trombone) = 'cimbasso'" (Zechmeister 1998a, p. 25) is logical in the context of the word's later usage (although such instruments were in B-flat, see chapter 2.4), but lacks connection to any earlier nineteenth-century instruments.

14 Niccolò Paganini, who created perhaps the first orchestral part for cimbasso in his Violin Concerto No. 1 (1816), also wrote "serpentone, e gimbasso" in his Violin Concerto No. 3 (1826) (Bevan 2000, p. 407).

Bellini's *Norma* (1831), the description of a "tromboncino" (Bellini, n.d. [1831]) is unclear.[15] Ever since, the term has been broadly used as "everyday musicians' jargon" (Meucci 1996, p. 145) to refer to a wide variety of instruments (see chapters 1.3, 2.4, 4.2), and so this form of bass horn is now referred to as an 'early' cimbasso (Bevan 2000, p. 406).[16]

Figure 7: Contrabass ophicleide (bombardon). Georg Saurle, Munich, ca. 1845–55. Musikinstrumentenmuseum der Universität Leipzig [MIMUL], 1605.

Jean Hilaire Asté (Halary) is credited with the invention of another all-metal form of bass horn in Paris in 1817: the ophicleide (Fig. 6).[17] Unlike the cimbasso and other military bass horns defined by vernacular traditions, the ophicleide (a portmanteau of the Greek *ὄφις* (serpent) and *κλείς* (keys)) was quickly recognised as a valuable addition to the orchestra, being found at the Opéra de Paris as early as 1819 (see chapter 1.4). Aided by improved levels of intonation by means of acoustically optimised key sizes and positioning, it was written for by many composers preparing (or hoping) for premieres in Paris, including Rossini, Verdi, and Wagner. Outside of France, however, it was generally only used as a replacement for earlier instruments. Italian ophicleide references date from 1825 (Asioli 1825; see also chapter 1.3), with parts by Cesare Pugni published in 1831–32 (Meucci 1996, p. 149), but it was commonly used interchangeably with the 'early' cimbasso (see chapters 1.3, 2.4). In England in 1837, the ophicleide had "been lately introduced into [the] orchestras", although "not […] into the theatre or the concert-room", while the serpent "is still used in very great orchestras" (Hogarth 1837, pp. 132–33).[18] Nineteenth-century orchestral music

15 Melchiorre Balbi's treatise of 1845 suggests that a tromboncino is "a trumpet slightly larger than the normal one" (Balbi 1845, p. 143). In the first published edition of the parts (Bellini n.d. (ca. 1862-63) [1831]) it is named as a "bombardone", and in an early published score (Bellini n.d. (1898) [1831]) as a "cimbasso".

16 In *Nabucco* (1842), Roger Parker believes that Verdi expected a "bass flicorno or "baritone horn" (Verdi 1987 [1842], p. xxvi), although it is unclear as to which instrument(s) he may be referring to, as the only noted use of the term before the 1880s was in reference to a valved signal horn (Meucci 2019b, p. 175). Bevan suggests that an 'early' cimbasso might have been used for the premiere (Bevan 2000, pp. 488–89), yet he elsewhere refers to "the four trombones at the opening of the overture to *Nabucco*" (Bevan 1997, p. 152).

17 Some argue it was developed from an earlier form of keyed metal bass horn by Prospero Guivier in 1805/06 (Reuter 2002, p. 447), perhaps created upon a commission to copy an English keyed bugle horn following the Battle of Waterloo (Kirnbauer 2015, p. 216). Despite the etymological tautology, in order to avoid confusion with valved instruments (see chapter 1.3), this instrument at times is also referred to as a keyed ophicleide.

18 The hibernicon, another form of bass horn, was played by William Ponder in Thomas Harper's "professional brass band" in 1832, although when the instrument was used orchestrally in the 1835 York Festival, Ponder, "arguably the most prominent player of the family of low brass instruments at that time", who also played serpent at Covent Garden in 1830, had notably swapped to ophicleide (McGrattan 2020, p. 125).

was dominated by German and Austrian composers, "most of whom were unaware of the ophicleide's existence" (Bevan 1997, p. 145), but a (keyed) ophicleide is recorded in the Hofkapelle in Darmstadt from 1819 (Reuter 2002, p. 470), and instruments built in Prussia, Bohemia, Austria, Bavaria, and Saxony exist to this day, with a notable example being a contrabass keyed ophicleide from Georg Saurle from 1835–40 (Heyde 1980, p. 68) (Fig. 7).[19] Saurle's ophicleides were of use to the Court Opera in Munich, who "between ca. 1825–45 […] could fall back on the ophicleide players of the Munich regimental bands to perform contrabassoon parts (Haydn's *The Creation* [1799] etc.) without any problems" (Tremmel 1993, p. 32).[20] Thus, while the instrument was indeed found in the Germanic states, England, and Italy, it was used as a 'modern' serpent, and once more as part of the bassoon section, and not, as in France, as an orchestral instrument in its own right. It took a new invention to enable development of orchestral tuba family practices outside of France: the valve.

1.3 Early valved instruments

While labrosone valves date from 1814 (see Annex, pp. 46–47), the earliest reference to a low-pitched valved labrosone is found in a Viennese advertisement from Wenzel Riedl in 1829 for "the newly invented bass bombardon with 12 keys, or with valves" (Riedl 1829, p. 718). This instrument was patented in 1833 (Riedl 1833; Fig. 8), by which time a "Bass Bombarton [*sic*] or Harmonie-Bass" (Fig. 9) potentially already existed,[21] which was described as "the strongest bass instrument" which "after improvement from J[oseph] F[elix] Riedl [possibly brother of Wenzel (Fastl 2001)], can be used in all keys with a tuning slide" (dated by Keyser to ca. 1830 (Keyser 2019, p. 72) and by Heyde to ca. 1832–35 (Heyde 2017, p. 39) or ca. 1833–35 (ibid., p. 19)). Following the double-reed pommer or bombard of the shawm family (described in 1795 as a "bombardo" (Baines 1976, p. 204)), bombardon, similarly onomatopoeically derived from

Figure 8: *Bassbombardon*. Riedl 1833, Appendix I.

19 Some Germanic keyed ophicleides are referred to as bombardons, see chapter 1.3.

20 Despite Haydn specifying contrabassoon in the score for *The Creation*, the fact that the instrument was "virtually unknown" in Vienna when the oratorio was premiered there in 1799 (Smither 2012 [1987], p. 498; see also footnote 8) has led to suggestions that a serpent was used instead (or as well) in early performances (Schreiber 1938, p. 136). The part noted at the work's German premiere in 1802 is for "contra-bassoon or serpent" (Günther 1996, pp. 57–58), and in performances in Berlin until 1810, it was cut altogether (Schreiber 1938, p. 135).

21 Similar to 'cimbasso' in Italian, 'bombardon' in German had multiple spellings, although the name used in W. Riedl's patent of a "Bass-Pumpathon" was "likely an error by the draftsman" (Heyde 2017, p. 18).

'booming' sounds,[22] was used to refer to keyed bass labrosones with a "vigorous tone" (Roy ca. 1825, p. 26). It was noted in 1833 that (Wenzel) Riedl "invented the Bombardon ten years ago in Warsaw […] at this time it had a different form and twelve keys" (Berndl 1833b, p. 291), and a keyed "bass signal horn known as a Bombardone" is illustrated in a method book from 1825 (Roy ca. 1825 (Fig. 10), presumably the same instrument as the contemporaneously cited "bass flugel horn known as a Bombardone with eight keys" ("Intelligenzblatt" 1825, pp. 58–59)). By 1833, it was also referred to in other sources as a "bombardon with 12 keys and bell" (cited in Keyser 2019, p. 70).[23]

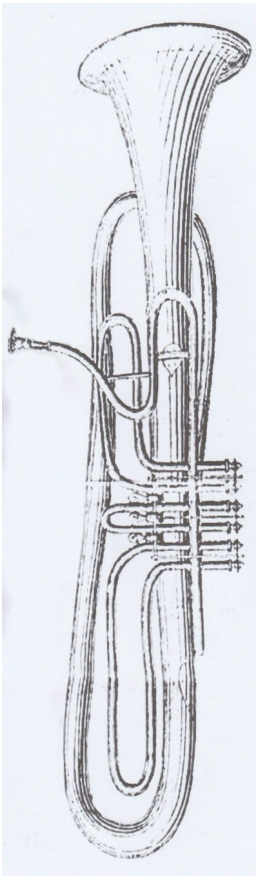

Figure 9: *Bass Bombarton oder Harmonie-Bass*. Josef Felix Riedl, Catalogue, ca. 1830–35. Reproduced in Keyser 2019, p. 79.

The keyed bombardons differentiated themselves from keyed ophicleides with their narrower bore and wider flared bell (Heyde 2017, p. 14–19). From the mid-1830s onwards, however, the name was used almost exclusively to refer to valved instruments.[24] As Berndl noted in 1833, "the bombardon, as it is now found, has no keys, but rather three valves" (Berndl 1833b, p. 291), with Wenzel Riedl's patent describing the "invention and development of the Bass-Bombardon, through use of chromatic valves" ("Wien" 1833, p. 1003), and including three double-piston valves, as invented by Christian Friedrich Sattler in Leipzig in 1821.[25] The illustrated instruments are in the now-recognisable 'tuba-form' design (see chapter 1.4), as opposed to the valved ophicleides from fellow Viennese manufacturer Leopold Uhlmann (Lannoy 1834, p. 451 (Fig. 11)),

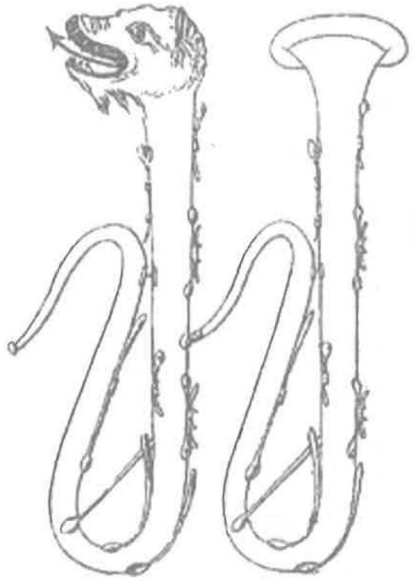

Figure 10: *Bombardon* (Roy ca. 1825, p. 26) or *Ophicléide* (Asioli 1825, p. 9). Reproduced in Heyde 2017, p. 15.

22 The name was also used for Italian and French military equipment (Bevan 1997, p. 148; Reuter 2002, p. 468).

23 This same instrument is is called an ophicleide in Asioli's *Metodo* (Asioli 1825, p. 9); Berndl writes that "Wenzel Riedl recognized in an ophicleide […] from Paris his beloved child, which, during its stay abroad, had lost three keys" (Berndl 1833a), although his dating of this invention is six years after Halary's first ophicleides (see chapter 1.2). Kastner refers to it as a "bass bugle with 11 keys (keyed bass horn)" (Kastner 1848, Pl. XIV No. 5), while Heyde also describes it as "[presumably Wenzel] Riedl's bombardon with 11 keys" (Heyde 2017, p. 15).

24 One of the few later historical examples of the word being used for a keyed instrument is V. F. Červený's "Serpent-Bombardon in F" from 1853 (reproduced in Heyde 2017, p. 24; see also chapter 2.1), but this instrument is also described contemporaneously as a "Baß-Ophicleide" in B-flat (Zamminer 1855, p. 321).

25 These valves are known today as 'Vienna valves' owing to their later development and popularity in Austria. By the mid-nineteenth century, they were generally superseded by the rotary valve, which was patented by Joseph Felix Riedl in Vienna in 1835.

which were later also referred to as bombardons (for example, Nemetz 1839, p. 95). In 1855, Karl von Schafhäutl wrote that the bombardon used to be known as a "corno basso" and had a narrow bore with the valves at a right-angle to the axis of the instrument (W. and J. F. Riedl's designs); the "valved ophicleide, later bombardon" had a wider bore with an upright valve mechanism (Uhlmann's design); and "today, they all are arranged like the bass horns" (perpendicular valves, see chapter 1.4) (Schafhäutl 1855, p. 199). Until around 1860, the terms ophicleide and bombardon were used interchangeably in the German-speaking world, with Schlotthauer failing to distinguish between "Ophieléide [*sic*], Corno Basso, Basso d'armonica, Bombardone" and "Contra-Basso" (Schlotthauer 1848, p. 13), and Julius Rühlmann writing that "one no longer makes any distinction between ophicleide and bombardon" (Rühlmann 1851, p. 10). Quantitative analysis reveals differentiations between the two instrument forms, but also concludes that "there is a clear overlapping" (Keyser 2019, p. 78).

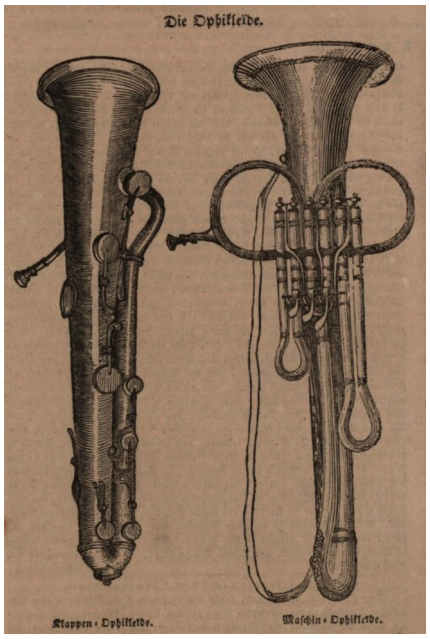

Figure 11: *Die Ophikleide*. Lannoy 1834, p. 451.

According to Eduard Freiherr von Lannoy's description of Uhlmann's instruments:

> Valved ophicleides have great advantages for military music […] the shape, setup [and] strap attached to the instrument make it easy to carry, both for infantry and cavalry. The keyed ophicleide, however, is preferred in every other respect, and in an orchestra it is far more useful, indeed certain passages, e.g. Act 3 of *Robert le diable* [Meyerbeer (1831)][…] could be played only with a lot of effort with a valved ophicleide. (Lannoy 1834, p. 452)

Figure 12: Valved ophicleide / bombardon. Anon., Italy, ca. 1845–60. MIMUL, 1765

Instruments which evolved from the various forms of valved ophicleide and bombardon have been used in military settings across Europe ever since, but it is difficult to ascertain their use in contemporaneous orchestral literature. Military bandsman Franz Fretzer was the "Bombardon-Bläser" with the Vienna Philharmonic from 1834 and was given a full-time position in 1845 (Zechmeister 2021b, p. 266). Gerhard Zechmeister presumes that Fretzer would have used a valved instrument, citing an earlier article from Lannoy which mentions *Robert le diable*, and, separately, Uhlmann's valved ophicleides (ibid.). However, it is quite possible that Fretzer used a valved instrument in

the band, and a keyed instrument in the orchestra. Ophicleide parts for works by German composers such as Robert Schumann (*Das Paradies und die Peri* (1843)), Felix Mendelssohn (*Musik zu Ein Sommernachtstraum* (1843)), and Friedrich von Flotow (*Martha* (1847)) could have been premiered using a valved instrument, although according to Lannoy's assessment above, a keyed ophicleide was perhaps more likely.[26] In my own practice, I have found a keyed ophicleide to function effectively when performing both *Musik zu Ein Sommernachtstraum* and *Martha* in ensemble, although these choices were made out of necessity given a widespread lack of valved ophicleides in playable condition (see chapter 4.1). In Italy, valved ophicleides were "an immediate success" (Meucci 1996, p. 149), and extant instruments (often built at Austrian military pitch owing to Austro-Hungarian control over Lombardy until 1859) include one similar to Uhlmann's from A. Apparuti in 1841 (ibid., p. 175), and a significantly wider-bore model from around 1850 (Heyde 1980, pp. 62–63) (Fig. 12). An Italian orchestral manager was instructed in 1845 that he "should find someone who can play bombardone or cimbasso to match the other brass instruments; the maestro [Verdi] also said this" (Garibaldi 1931, p. 184).[27] Terminology inconsistencies aside (see chapter 1.2), it is likely that a form of valved ophicleide was used in Verdi's Italian premieres of this period, such as *Luisa Miller* (1849), *Rigoletto* (1851) and *Il trovatore* (1853).[28]

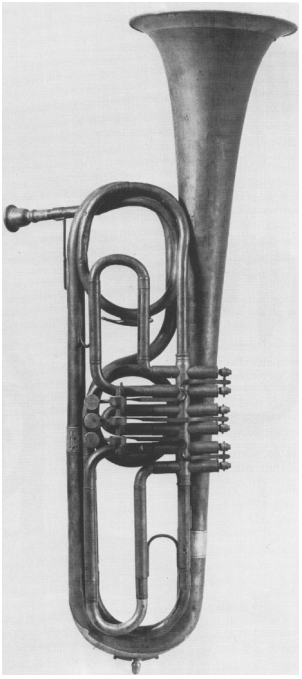

Figure 13: *Basstuba (3 Wiener Ventile)*. Franz Rehbock, Salzburg, ca. 1850. Germanisches Nationalmuseum, MI 224.

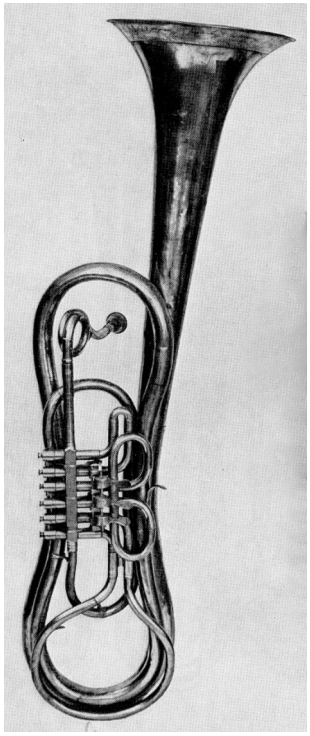

Figure 14: Valved ophicleide / bombardon. Michael Saurle, Munich, ca. 1830–55. MIMUL, 1767.

26 Mendelssohn wrote again for the English bass horn, but for the first printing in 1848 (in line with the publishing of the overture in 1832 (parts) and 1835 (score)), this was changed by the publishers to ophicleide (Mendelssohn 2001 (1843)), a decision seemingly approved of by the composer (Bevan 2000, p. 485). Twentieth-century editions of such Germanic music often substitute ophicleide with tuba, for example Flotow n.d. (ca. 1940) [1847].

27 Balbi equated the bombardon with the bass trombone, noting that "ophicleide or gimbasso" share the character of its deep voice with the bombardon and contrabassoon. (Balbi 1845, p. 143).

28 Meucci suggests that a valved ophicleide was in use as early as the premiere of *Oberto* in 1839 (Meucci 2015, p. 191), though this is several years earlier than any extant Italian instruments. He also notes that the first Italian translation of Berlioz's *Traité* from 1846–48 fails to mention the valved ophicleide, but does give reference to the new forms of bombardon which were being developed by Giuseppe Pelitti (see chapter 2.4) (Meucci 2020, pp. 32–33). In *Rigoletto*, the manuscript gives "serpan" (Verdi ca. 1860-95 [1851]), the printed score gives "cimbasso" (Verdi 1914 [1851]), the printed part gives "trombone basso" (Verdi n.d. [1851]) (see chapter 2.4), and the theatre (La Fenice, Venice), as well as a contemporaneous review, called it a "bombardone" ("Rigoletto…" 1852, p. 446).

As with Georg Saurle's keyed ophicleides (see chapter 1.2), valved ophicleides also were built at lower pitches, for example, Franz Rehbock's instrument in F from around 1850 (Fig. 13). Georg's father Michael Saurle built a C valved ophicleide (Heyde 1980, pp. 68–70) (Fig. 14) similar to that illustrating the *Ophikleïde monstre en Fa* which Kastner notes is "called a *Bombardon* in Germany […] formerly provided with 10 or 12 keys which were replaced with three pistons" (Kastner 1837, p. 57, emphasis in original). Berlioz used the French name in the original version of his *Grande Messe des morts* (1837), later calling the instrument "bombardon", noting that "[its] timbre differs slightly from that of the ophicleide" (Berlioz 1843, pp. 228–29).[29] Such lower Instruments in F would come to dominate orchestral performance practice in the German-speaking world, not via bombardon evolution, but rather as a result of the first valved low-pitched labrosone to be promoted for orchestral use and thus reach a wide audience of composers.

1.4 The bass tuba

It might be "inconceivable" that Johann Gottfried Moritz and Wilhelm Wieprecht developed their "Baß-Tuba" (Figs. 15, 16) without prior awareness of the bombardon (Heyde 1987, p. 229),[30] but the key innovation behind their instrument was the implementation of a wide bore and conical bell, which, coupled with their recently developed *Berliner-Pumpen* piston valves (see Annex, p. 47) enabled low frequency sound production with stronger low spectral content than other instruments of the time (see chapter 2.1). While organologists continue to debate such differences (see Heyde 2017, Myers 2019c), perhaps of equal significance is its description. As "the first valved bass instrument to be *called* the Baß-Tuba" (Bevan 2000, p. 203; emphasis added),[31] their choice of a Latin name conjures up Roman antiquity as opposed to the military-industrial image of the bombardon, attempting to distinguish it as musical

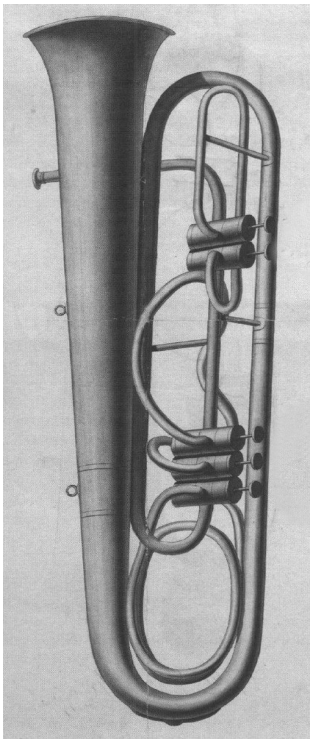

Figure 15: *Die Chromatische Baß-Tuba*. Wieprecht and Moritz 1835, Appendix I.

29 By 1863, François-Auguste Gevaert used "bombardon" and "ophicléide-monstre" interchangeably with "tuba-contrebasse" (Gevaert 1863, p. 98) (see chapters 2.1, 4.2).

30 The bombardon was noted in a concert in Berlin in 1837, described as "a newly developed instrument that should surpass the bass tuba in terms of sonority" ("Vermischtes" 1837, p. 182), although this could have been in reference to a keyed instrument (see chapter 1.2).

31 In the mid-nineteenth century, "bass tuba" was sometimes described separately from the "tuba" or "contrabass tuba" (Marx 1847, pp. 102–3; Lobe 1855, p. 388). Franz Ludwig Schubert clarified in 1866 that "the *Baßtuba* was also called a *Baßtrompete*, but this should not be confused with the actual tuba (Contrabaßtuba), which differs significantly from these in both form and bore diameter" (Schubert 1866, p. 27, emphasis in original). This has led to confusion between this 'contrabass tuba' (a Wieprecht-Moritz bass tuba, see below) and those given the same name more recently (for example, see Reuter 2002, p. 574; also chapters 2.1, 3.1).

instrument rather than a noise-generating machine.[32] Bevan asserts that "there is no evidence that he [Wieprecht] considered that his invention would enter orchestras" (Bevan 2019c, p. 455), yet as early as April 1836, a bass tuba was presented to Gaspare Spontini, director of the Staatskapelle in Berlin, with Wieprecht no doubt aware that the ophicleide had been introduced to the Opéra de Paris in Spontini's *Olimpie* in 1819 by virtue of similar claims of classical heritage (see chapter 1.2). It is speculated that Richard Wagner first heard the bass tuba while attending a performance of a revised (since lost) version of Spontini's *Ferdinand Cortez* (1809) in Berlin in 1836 (Aringer 2019, pp. 276–77),[33] although it would not be until his first season as Hofkapellmeister at the Königlich-sächsische musikalische Kapelle in Dresden in 1843–44 that he would first work with a tubist, Gottfried Hinke. It is suggested that a tuba was used for ophicleide parts Wagner composed in Paris, notably *Der fliegende Holländer* and *Rienzi* (ibid., p. 277), with the name on the part for *Holländer* being changed to bass tuba when the new edition of the end of the overture was printed in 1860 (Deathridge, Geck, and Voss 1986, p. 220). The tuba part for *Ein Faust-Overtüre* (1839–40) was not added in the revised 1855 version (as argued in Bevan 2019b, p. 423; Brinkmann 1990, p. 14; and others), but rather the manuscript shows that for the first performance in Dresden in 1844, when translating the instrument names from French to German, "Serpent" was changed to "Basstuba" (illustrated in Ahrens 1986, p. 45).[34] Duplicate performance material for *Tannhäuser* (1845) shows "Ophicl:" in pencil next to the printed "Tuba" (Aringer 2019, pp. 280, 287), with the part fitting the range of a valved or keyed ophicleide. This range is exceeded for the first time in *Lohengrin* (1850), though Aringer suggests that the first Munich performance in 1858 could have featured a bombardon (ibid., p. 283).[35] In 1846, Wagner wrote to the director of the opera in Dresden, suggesting that a tuba player who

Figure 16: Bass tuba. Johann Gottfried Moritz, Berlin, 1835–40. Scenkonst Museet, M478.

32 The name was adopted by French revolutionaries for similar reasons: the "tuba curva" (first heard in 1791) was a "crude wind instrument" that attempted to emulate the Roman *cornu* (Charlton 2001), propagated further by Adolph Sax with the development of his "Saxtuba" in the 1850s (Mitroulia 2011, pp. 169–175).

33 Wieprecht described himself as a daily guest in Spontini's house, and the military contexts of this work and Spontini's orchestrations (which date back to earlier Neapolitan repertoire, see chapter 1.2) suggest that the bass tuba could well have found its way into such a performance (Lattanzi 2020, pp. 27–28, 37–39).

34 This assumption was also made because the part goes lower than what seems possible on a serpent (see chapter 1.2).

35 By this time, 'bombardon' was being used across Europe for military band instruments of increasingly large proportions (see also footnote 86). Červený's wider-bore style of instruments (see chapter 2.1) was though to have reached Bavaria "at the latest after their great success at the Munich exhibition of 1854" (Tremmel 1993, p. 251).

could also play double bass be hired (cited in ibid., pp. 279–80), a practice first implemented in 1861 (Landmann 2019, p. 149). This is still exercised in some orchestras today; David LeClair retired as second principal tubist and tutti double bassist from the Sinfonieorchester Basel in 2021, though current pedagogical practice is dedicated to instrumental specialism rather than exploration and development of such additional skills (see chapter 4.2).

Figure 17: *Saxhorn contrabasse*. Adolph Sax, Paris, 1845. Music Instrument Museums Edinburgh [MIME], 5969.

Despite such a quick uptake from Wagner and other positive reactions to the bass tuba (described as having the potential to "find successful employment with regards to instrumental and dramatic music" (Schmidt 1840, col. 1041), and Berlioz stating that *"its low compass is the largest existing in the orchestra*" (Berlioz 1844, p. 229; emphasis in original)), Marx noted in 1847 that "both instruments [bombardon and tuba] have not become natives in the large orchestras" (Marx 1847, p. 206).[36] Nevertheless, the instrument was slowly spreading throughout the German states, with Darmstadt and Braunschweig both having acquired a tuba by 1850 (Reuter 2002, p. 543). However, in many cities, such as Weimar for Franz Liszt's tone poems of the 1840s–50s, and into the 1860s in Leipzig for Johannes Brahms's *Ein deutsches Requiem* (1869), performers were probably hired from local military bands. By 1865, Schubert noted that "the tuba […] is used in the latest orchestral works to support the string basses, especially in forte passages" (Schubert 1865, p. 305). The Hoforchester in Munich purchased a bass tuba from Carl Wilhelm Moritz (son of Johann Gottfried) for the premiere of *Tristan und Isolde* in 1865 (Hinrichsen 2015, p. 125), but the orchestral position was not filled until 1869 (Nösselt 1980, p. 241; see also chapter 2.1), a year after the premiere there of *Die Meistersinger von Nürnberg* (1868). Meanwhile, solo repertoire for the instrument was already being written and performed: in January 1843, a "Concertino für Baß-Tuba" from (perhaps Christian Gottlieb) Müller was performed in Nordhausen, accompanied by the Nordhäuser Musikverein (J. S. 1843, p. 177).[37]

36 Marx gave a rare negative contemporaneous appraisal of the bass tuba, praising the higher range, but stating that "in the lower pitches it does seem that the taming and smoothness of the original plumpness […] does not succeed evenly" (Marx 1847, p. 103).

37 This could refer to a bass trumpet (see footnote 31), and, lacking any other sources, possibly form a transcription of Müller's *Concertino* for bass trombone (1832) (Müller 2017 [1832]).

Beyond the 'Berliner' tuba

While this bass tuba, today known as a 'Berliner' tuba (Heyde 1987, p. 223), was beginning to appear more frequently in Germanic orchestras, and be produced by manufacturers beyond Wieprecht and Moritz (see examples from the 1850s reproduced in Weller, Arzig, and Weller 2015, pp. 109, 163), instruments intended explicitly for military bands were also undergoing rapid development. Adolph Sax's saxhorns (Fig. 17), patented in 1842, were instruments which may have been inspired by those from Moritz (see Breternitz 2019, pp. 285–92),[38] but contemporaneous orchestration works (Kastner 1848, pp. 380–81; Escudier 1854, p. 87; Berlioz 1855, pp. 234–35) do not suggest any deployment of them in the orchestra (see also chapter 2.5).[39] Meanwhile, in Bohemia, bombardon development was being spearheaded by Václav František Červený, who also founded his own company in 1842.[40] These forking paths would lead to separate organological developments in the German-, Russian-, Italian-, French-, and English-speaking worlds, and eventually come to define the working parameters of both tubists and composers throughout the second half of the nineteenth and early twentieth centuries. However, the extent to which the tuba family would be found in orchestras and opera houses at all would largely depend upon the only composer in the first half of the nineteenth century to have taken an active engagement with the bass tuba, Richard Wagner, and how he would employ it in his next work, *Der Ring des Nibelungen*.

38 Sax's patents from the 1840s that most closely resemble Wieprecht's are the *contrabass d'harmonie* in F and E-flat (illustrated in Klaus 2014, p. 31), and Eugenia Mitroulia asserts that these "were definitely not invented by Sax" (Mitroulia 2011, p. 110).

39 In French military bands, the saxhorn family did quickly supplant any remaining serpents, keyed ophicleides, or rare pre-existing French valved instruments such as A. G. Guichard's *Ophicléide à Pistons* from 1835 (Heyde 1987, p. 218) or Étienne François Périnet's *Piston basse* from 1841 (Reuter 2002, p. 468).

40 Manufacturers generally specialised in one market, but also made instruments exclusively for export, such as the saxhorns listed from Glier & Sohn in 1867 (Heyde 1987, pp. 277–78). Awareness of these multiple traditions is demonstrated by Schuster in ca. 1870, who noted the differences between the "Prussian system" the "Austrian [= also Bohemian] system" and the "Saxhorn system" (cited in Ahrens 1986, p. 41).

2: Tuba family diversification across Europe

2.1 *Der Ring des Nibelungen*

In 1865, Wagner wrote that "until now, I have used several instruments in the *Nibelungen* that I first discovered a long time ago from the instrument builder Sax in Paris" (Wagner 2009 [1865], p. 277), presumably referring to his visit to Paris in October 1853 (Westernhagen 1973, p. 46).[41] Given that Wagner mentioned "1 Saxhorn Contrabaß" in his sketches for *Das Rheingold* (1869) and wrote a part transposed to E-flat (Nitsche 1971, p. 231; Wagner 1854), it can be assumed that Wagner encountered an E-flat contrabass saxhorn (as opposed to those more rarely built at the time in F and B-flat), as depicted in contemporaneous advertising (Mitroulia 2011, pp. 163–64) (Fig. 17). Parts in the autograph scores of *Die Walküre* (1870) and *Siegfried* (1876) are also written in E-flat, with only *Götterdämmerung* (1876) written consistently in C (Deathridge, Geck, and Voss 1986, p. 419). By the time performances of excerpts from *Rheingold* and *Walküre* were being organised in Vienna in 1862, the instrument was referred to as a "contrabass tuba (in E-flat)", and Wagner noted that the instrument "could be found in the Austrian military bands, although perhaps under different names, maybe also in different tunings" (Wagner 2002 [1862], p. 296). The parts for these performances described the instrument as a "bombardon" (Deathridge, Geck, and Voss 1986, p. 414), and Franz Fretzer (see chapter 1.3) performed them using his new "Tuba /: Hellingkon [*sic*] :/ in C" (Fig. 18),[42] which was acquired in June 1862 when the orchestra adopted the new lower French pitch standard (cited in Zechmeister 2021b, p. 266).

The premieres of *Rheingold* and *Walküre* that took place in Munich in 1869 and 1870 respectively (against Wagner's wishes) were due to be conducted by Hans von Bülow, who was acquainted with Wilhelm Wieprecht from his time living in Berlin before joining the Hoforchester (Tremmel 1993, p. 202). Regarding acquisition of new instruments, Bülow wrote to Wieprecht in January 1866 that:

> It would be a possibility, perhaps, to spare [...] the contrabass tuba – if the one acquired from Berlin on the occasion of the rehearsals for "Tristan" [see chapter 1.4] can produce the specified low register. Since Tristan only reaches Contra-F [F1], I have not had the opportunity to examine whether the Contra-E-flat [E-flat 1] is possible [...] I would like first to suggest such an investigation, and note, incidentally, that this low E-flat in "Rheingold" is absolutely essential. (reproduced in Hofer and Schiwietz 2020 [1866], p. 176)

41 There is no primary source evidence to confirm this visit, leading some scholars to omit reference to this episode (Myers and Keyser 2021, pp. 152–63; email to author, 02.06.2021). There are competing theories as what influence the *saxhorn basse* and *saxhorn baritone* had on the instruments that came to be known as Wagner tubas (see Heyde 1987, pp. 190–91; Melton 2008, pp. 15–21; Norman et al. 2010, pp. 143–58).

42 A helicon is a circular-form tuba (see Annex, pp. 42–44), patented by Ignaz Stowasser in 1848, although it was potentially first developed several years earlier in Russia (see chapter 2.3).

In reply, Wieprecht questions the nature of such doubts, stating that "the well-known bass tuba in F with 5 valves completely covers the range prescribed in your letter" and suggests that the "wind players there have not properly recognised the meaning and value of this beautiful instrument" (ibid., p. 177). He details its range as compared with that of a "contrabass tuba in [contra] F-tube length (twice as long as the common bass tuba)," which "would constitute an instrumental colossus, exceeding even the so-called low B-flat basses commonly found in Austria" (ibid., p. 180; see also Fig. 22), even though he himself wrote multiple times for a "tuba contrabasso" (Wieprecht 1847; Breternitz 2019, pp. 85–86; Hofer and Schiwietz 2020, p. 212).[43] Nevertheless, while making Bülow aware that the original bass tuba would do the job, he also tried to sell him a new instrument:

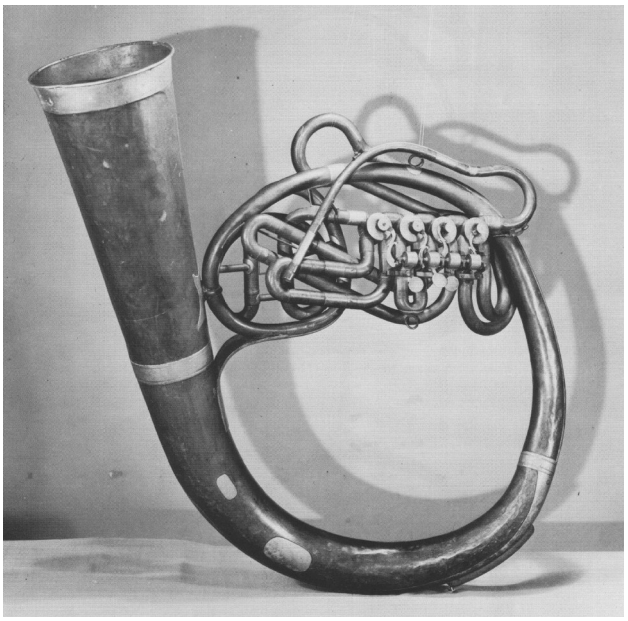

Figure 18: *Kontrabasstuba*. Ignaz Stowasser, Vienna, ca. 1850. Germanisches Nationalmuseum, MIR 71.

> I would suggest a bass tuba with 6 valves in E-flat […] which, to give the contrabass tuba even more fullness, could be given a slightly wider bell and bore construction, [and be] bent into a circle and arranged so that the bell rests on the left shoulder. As a result, it loses the snarling, pressed sound in the lower register, often a very uncomfortable result when the instrument is overblown. (ibid., pp. 177–78)

Bülow deemed Wieprecht's suggestion to be overly influenced by his military-music background and inappropriate for the opera house, yet he did eventually try to order this six-valved E-flat instrument (Breternitz 2019, p. 349). When this was deemed impractical on financial grounds, he suggested sending back the tuba they bought for *Tristan* so that an extra valve could be added (ibid.).[44] Moritz this time replied, explaining that this would not be satisfactory:

> [The five-valved F tuba] is not set up for this purpose; its tubes and bell construction were not made nearly wide enough to give room for development of the longer air passage enabled by the sixth valve. The tone would therefore always sound small and without definition. In order to produce a powerful tone that speaks easily, an instrument is required which I would send for inspection [...] in low B-flat, which contains all contrabass notes with an easy response at a powerful volume. (cited in Tremmel 1993, p. 204)

43 In this case, he was perhaps referring to the 1838 *Contra-Bombarde* of fellow Berliner J. Gabler, another inventor (alongside Sax) whom Wieprecht accused of plagiarism (Breternitz 2019, p. 202–6).

44 As was noted at the time, production of the G-flat 1 on five-valve F tubas can be difficult (Tremmel 1993, p. 204), although this "unstable" tone (Breternitz 2019, p. 349) can still be effectively produced (see chapter 4.2).

There is no further extant communication between the two parties—Bülow never actually conducted the premieres—nor records of instruments that might have been shipped to Munich, which makes it difficult to presume, as Tremmel does, that such an instrument in low B-flat was heard at these performances (ibid.).[45] Rudolf Strobl was engaged as "Ophikleidbläser / Barytonhornist / Baßtubabläser" from 1869 (Nösselt 1980, p. 241), but there is no indication as to whether this was before or after (or, indeed, specifically for) these performances, or whether a member of the Münchener Regimentskapelle was hired to play some form of bombardon (Tremmel 1993, p. 204), only that "evidently things were managed somehow" (Nösselt 1980, p. 171).[46] The instrument is not referenced in an article on "the new music instruments for Richard Wagner" (Franz 1884/85, p. 46), nor in the celebration of the centenary of the Moritz factory (Altenburg 1907/08, p. 635). Recent studies of these performances (Schmid 2015, p. 133) and Wagner's instrumentation (Heise and Gelloz n.d. (2013), p. 3) provide no further detail, while Egon Voss's seminal study confuses the "ordinary" tuba with the Wagner tuba (Voss 1970, p. 215).

Figure 19: Bombardon. "Blechinstrumente…" 1851, p. 484.

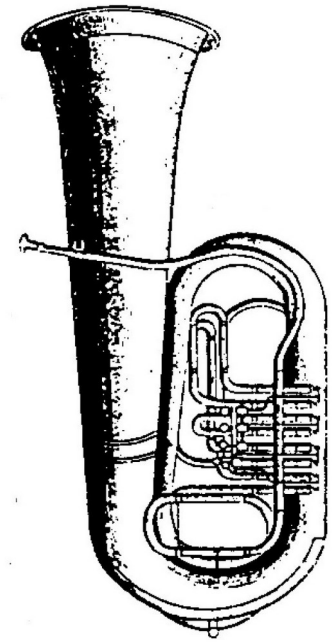

Figure 20: Bombardon in F. Advert, V. F. Červený, 1853. Reproduced in Joppig 1992, p. 215.

Given this lack of evidence, credit is commonly given to Červený for the supposed invention of the contrabass tuba in 1845. Bevan's assertion that "Wagner specified it [Červený's instrument] from *Das Rheingold* onwards" (Bevan 2000 p. 306) is widely accepted as fact (see, amongst others, Kunitz 1968, p. 868; Kuehn 1974, p. 83; Phillips and Winkle 1992, p. 10; Morgan 2006, pp. 78, 82; Slavický 2019, pp. 61–63; and Yeo 2021, pp. 38, 154). However, no contemporaneous commentators mention the creation of a contrabass tuba, with Červený himself describing his "Contrabaß" as an instrument "in the form of a Bombardon (Tuba) in Contra F [F0] and C [C1]" (Červený 1872, pp. 6–7). Červený crucially did adopt Moritz's model of building

45 Since Tremmel's publication, Bülow's original letters (Staatstheater 14682) have been removed from the public archive by the Bayerisches Hauptstaatsarchiv in Munich (email to library, 17.12.2019).

46 William Melton notes that for the horn/Wagner tuba section, two additional horn/bugle horn players were hired from the Infanterie-Leib-Regiment, the 1st Linien-Infanterie-Regiment and the Artillerieregiment, but does not suggest whether the (contrabass) tubist might have come from a similar source (Melton 2008, pp. 32, 146).

wide bore labrosones with conical bells, as can be seen in instruments illustrated from 1851 (Fig. 19) and 1853 (Fig. 20). At the time, narrower-bore instruments, such as the Bavarian and Austrian labrosones mentioned in chapter 1.3 (Figs. 14, 13) and those made in the Vogtland (Fig. 21) were often known as "Halbinstrumente" (Zamminer 1855, pp. 313–15, Schafhäutl 1855, pp. 170–73, Riemann 1882, p. 942; for a modern English-language equivalent see Miller 2015, pp. 107–8), as they could not produce low resonant frequencies with rich spectral content, thereby only effectively utilising half of their resonant length, in a similar manner to that of Sax's early contrabass saxhorns that Wagner might have heard in 1853 (Schafhäutl 1855, p. 170).[47] An illustration of Červený's *Contrabaß* from this era (Fig. 22) shows a *Halbinstrument* in F0 (no surviving examples in this pitch or form have been found, nor those illustrated in 1851 or 1853),[48] giving it the same effective range as Moritz's bass tuba (that is, a *Ganzinstrument* with half the length). Ever-increasing desires for low spectral content means that such narrow bore sizes are very rarely used in low labrosone construction today, even regarding broadly cylindrical-bore instruments such as valved contrabass trombones (see chapter 4.2). The wide bore of Moritz's instrument led it to also being known as a contrabass (see Schmidt 1840, col. 1041; Lobe 1855, p. 388; Bernsdorf 1861, p. 768; Schubert 1862, pp. 96–98; and Dommer 1865, pp. 196–97), with Wieprecht himself describing it as a "true contrabass wind instrument" (reproduced in Bevan 2000, p. 513), and by the time of the *Rheingold* and *Walküre* premieres in Munich, it was being found with increasing regularity in orchestras of the Germanic states (see

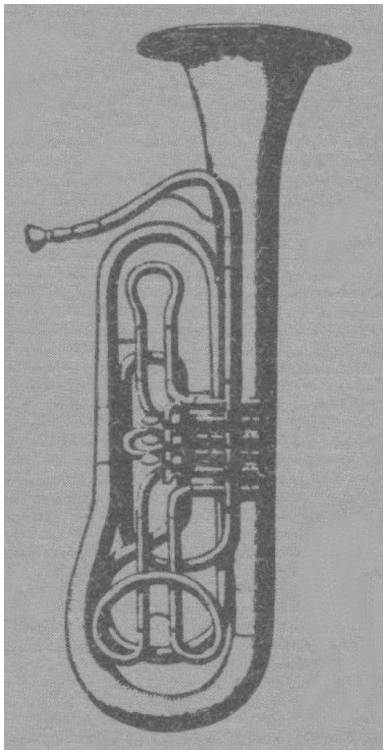

Figure 21: *Kontrabaß-Bombardon*. Catalogue, C. G. Herold, 1855. Reproduced in Heyde 1987, p. 275.

Figure 22: *Contra-Baß in F*. Catalogue, V. F. Červený, 1853. Reproduced in Heyde 2017, p. 24.

47 Munich instrument builder Johann Georg Ottensteiner obtained an (E-flat) contrabass saxhorn in around 1854, and began to make his own reproductions soon thereafter (Tremmel 1993, pp. 240–44). While parts were still being written in E-flat (see Wagner 2017 [1873] cited below), these instruments were unlikely to be of wide-enough bore to produce the range necessary in Wagner's scores with adequate volume and low spectral content.

48 This is likely the instrument to which Wieprecht was referring to in his letter quoted above: Červený and Wieprecht were in contact in 1864 and 1867, although without reference to these specific instruments (Hofer and Schiwietz 2020, pp. 170, 188–89). The *Contrabaß* is described elsewhere as an instrument "over-the-left-shoulder" (in helicon form), similar to military instruments from Prussia and Austria discussed earlier (Joppig 1991, p. 12).

chapter 1.4). On the other hand, there is no evidence to suggest contact between Červený and orchestral composers (the *Contrabaß* was developed upon the initiative of Kapellmeister Alscher of the Austro-Hungarian army (Červený 1872, pp. 6–7)), unlike, for example, Wagner's well-documented exchanges with both Sax (see above) and Wieprecht (Brixel 1985, pp. 177–88). Červený's wide-bore instruments gained him wide plaudits at the time,[49] and his later *Kaiser-Bass* instruments (Fig. 23) proved so popular that their design was soon copied across central Europe (Fig. 24) and is still mirrored closely in many instruments commonly used today (see chapters 3.1, 4.2). However, there is no evidence of any orchestral application of his instruments to the Munich performances of 1869 and 1870.

Figure 23: *Kaiser-Tuba*. Schafhäutl 1882, col. 878.

In preparation for the first *Ring* performances at Bayreuth, Wagner asked his protégé (and hornist) Hans Richter to organise the labrosones (Wagner 2012 [1870], p. 141–43),[50] but, by 1872, a tubist had not yet been hired (Sous 1988, p. 167). His request to his publishers in 1873 that "the contrabass tuba is to be transposed to C as it has been performed so far; C3 in the original score will sound as E-flat 2" (Wagner 2017 [1873], p. 216) shows awareness of the C helicon used by Fretzer in 1862, though Richter would hire a new tubist, Otto Waldemar Brucks, for the orchestra in Vienna in 1875, and also engage him to play at Bayreuth for the rehearsal period that summer (Zechmeister 2021b, pp. 268–69). In October that year, a tuba was ordered for Brucks from the Berlin instrument maker and former apprentice of Moritz, Ernst Leberecht Paulus (ibid.), and, it can be assumed, played by him at Bayreuth in 1876 ("Orchesterpersonal" 1876, p.

Figure 24: C bombardon. Anon, Bavaria, ca. 1880. Collection Louis Jake Klein.

49 Although overshadowed at the Great Exhibition in London in 1851 by Sax's instruments (Mactaggart 1986 [1851]), Červený's instruments received high commendation from commentators at subsequent exhibitions in Munich in 1854 (Schafhäutl 1855, p. 201), Paris in 1855 (Schebek 1858, pp. 26–29), London in 1862 (Hamm 1863, p. 133) and Vienna in 1873 (Paul 1874, p. 654; Schelle 1875, pp. 70–71), with particular mention of their "extraordinarily strong tone and very accurate tuning" (Schafhäutl 1855, p. 200).

50 Wagner asks for Richter's help in arranging the extra labrosones "just as you did in Munich" (ibid.), a process that has been documented for the Wagner tuba parts (Melton 2008 pp. 28, 34), but not for the contrabass tuba.

313).[51] Although this instrument has not survived, Paulus's tuba designs followed those of Moritz, and were retained by other Berlin manufacturers such as Julius Lemcke, Arthur Sprinz, and Albert Kley (Breternitz 2019, pp. 434–35, 493), and also copied by Leopold Uhlmann in Vienna, whose five-valved F-tuba eventually replaced that of Paulus in 1885 (Fig. 25).[52] In 1894, Wilhelm Jahn, then music director at the Wiener Staatsoper, explains the situation to Wilhelm Heckel thus:

Figure 25: *Wiener Tuba*. Leopold Uhlmann, Vienna, 1875–85. Sammlungen der Gesellschaft der Musikfreunde in Wien, IN 429.

> In the Wagnerian works there are two tenor tubas in B-flat, furthermore 2 bass tubas in F, and one five-valved contrabass tuba, tuned in F, with a register from C1 to C5, usable register as far as F4. (cited in Zechmeister 2021b, p. 270)

This range is identical to that described by Wieprecht in the original 1835 bass tuba patent, which raises questions as to why this five-valved F tuba was now being referred to as a contrabass tuba, with Wagner himself reverting to bass tuba in *Parsifal* (1882) (Wagner n.d. (ca. 1886) [1882]).[53] Perhaps it was a remnant of the original sketching for a contrabass saxhorn; perhaps it was maintained to avoid confusion with what later became known as Wagner tubas (see chapter 2.2); or perhaps it signified how Paulus's and Uhlmann's instruments had a significantly wider bore, bow and bell than Moritz's instruments of 40 years earlier, and also a conical lead pipe, which, together, aided in production of 'contrabass' spectral content (see also chapter 4.2). In any case, this form of tuba (Fig. 26) was used by Viennese musicians at Bayreuth until at least 1911 when Emil Hartmann (who also always referred to his now six-valved F tuba as a "contrabass tuba" (ibid., p. 271; see also chapter 2.2)) played there for

Figure 26: F tuba. Peter Emanuel Schmidt, Copenhagen, ca. 1880. Collection Louis Jake Klein.

51 Paulus wrote in 1879 that "very recently I delivered another tuba to His Majesty's Band, played at the last court hunt in Wusterhausen [near Berlin] by Brecks [Brucks]" (reproduced in Breternitz 2019, pp. 433–34), suggesting that Brucks also used Paulus's instruments after he returned to Prussia in late 1876 (Zechmeister 2021b, p. 269).

52 That this style of tuba continued to be made frequently in Berlin helps to explain why a significant proportion of Brucks's successors at the Vienna Philharmonic such as Emil Hartmann, Friedrich Knapke, and Max Blanckenburg had originally studied or worked in Berlin (Merlin 2017, pp. 23, 57, 84).

53 Wagner's only other reference to a "contrabasstuba" comes in his *Großer Festmarsch* (Wagner n.d. (1876)), written before the Bayreuth Festival in Spring 1876. However, by the time the score had reached Philadelphia, where it was to be premiered later that year, it was already being referred to as a part for "bass tuba" ("Wagner's Centennial March" 1876, p. 221).

the final time (Merlin 2017, p. 57). The difference between this tuba and those that other tubists or I would use in a modern orchestra today (which commonly descend from Červený's *Kaiser-Bass* designs, see chapter 3.1) and the resultant sonic effect is discussed in chapter 4.2.

2.2 After *Der Ring* in Germany and Austria

Continued use of this style of F tuba by the Vienna Philharmonic led to it being known as a 'Wiener' tuba (or "Wiener Konzerttuba" (Zechmeister 1997, pp. 50–55)),[54] and, following the premiere of *Der Ring*, other composers began to find use for it. It is argued that Johannes Brahms included the tuba in his Symphony No. 2 (1877) as a replacement for the originally sketched contrabass trombone in order to strengthen lower spectral content and better fit the sound character of the work (Brinkmann 1990, p. 15). This certainly had the desired effect, but is more pragmatically explained by Brucks's position in the orchestra that season (Merlin 2017, p. 30), moreover by the presence of the Paulus 'Wiener' tuba. Merlin provides a similar argument for the presence of a tuba in Anton Bruckner's Symphony No. 5 (ibid.); the instrument was only added in 1878, after Brucks had returned to Berlin (Carrigan 2007/08), but the instrumental practice had been established. Bruckner's Symphony No. 7 (1884) was the first work after *Der Ring* to specify contrabass tuba, with the manuscript (Bruckner 1881–83) giving contrabass tuba for movements two and four, and bass tuba for movements one and three.[55] With no consistent differentiation between the movements in scoring for the instrument(s), 'contrabass tuba' was most likely used in order to avoid confusion with the Wagner tubas, referred to as "Tenor-Tuben" and "Baß-Tuben", which are found only in movements two and four (Cohrs 2008/10, p. 3). His Symphony No. 8 (1892) specifies only contrabass tuba, and was presumably premiered using the newly-acquired Uhlmann tuba, especially given that it was conducted by Hans Richter. Cohrs argued that Bruckner's Symphony No. 9 (1903) requires a "Viennese contrabass tuba in B-flat" (Cohrs 2000, p. xx), but a B-flat tuba was used in Vienna only between 1908–13 (Zechmeister 2021b, pp. 272–74) (Cohrs corrects himself in Cohrs 2005/10, p. 5), and documentation showing that Emil Hartmann would have used his now six-valved 'Wiener' (F) tuba (Zechmeister 2021b p. 271).[56]

54 Five- and six-valved instruments are differentiated as 'early' and 'late' Wiener tubas respectively, although Daniel Fuchs first added a sixth valve to a bass tuba in Vienna as early as 1853 (Zechmeister 1987, p. 26).

55 This detail is overlooked by both the Nowak (Bruckner 1954 [1883]) and Haas (Bruckner 1944 [1883]) editions of the original version the score, although it is corrected in the Gutmann (Bruckner 1885), Breitkopf & Härtel (Bruckner n.d. [1885]), and Eulenburg (Bruckner n.d. (ca. 1925) [1885]) editions of the revised 1885 version.

56 Bernhard Rainer reproduced a photograph of the orchestra in 1901 that premiered the Ninth Symphony which shows a tubist holding an F tuba, and also noted that the Eighth Symphony would have used "a tuba in F", but inexplicably stated that the Seventh Symphony would have been premiered using "an instrument in BB-flat or CC" (Rainer 2016, pp. 153–55).

Gustav Mahler's use of "contrabasstuba" in his Symphony No. 2 (1895) (Mahler n.d. (ca. 1895)) perhaps indicates awareness of the 'Wiener' tuba tradition, as a consequence of his studies in Vienna from 1875–78, which aligned with Brucks's tenure. After writing "tuba" in his Symphony No. 1 in 1889 (Mahler 1906 [1893]) (at the time he was working for an orchestra in Leipzig that had first acquired a tuba two years earlier (Fontana 2007, p. 42)), he was also possibly 'updating' his orchestration for its second performance in Vienna in 1893, which presumably would have used an Uhlmann tuba. Friedrich Müller played with the Berlin Philharmonic when they premiered the work (Muck 1982, p. 954), though for the second performance in Vienna, Mahler engaged Emil Hartmann, who up until then had been working for the Königliche Oper in Berlin (Merlin 2017, p. 57) (Fig. 27),[57] and so it is possible that Mahler also hired Hartmann for the premiere.[58] In all of his subsequent symphonies, Mahler refers only to a bass tuba, although the first edition of his Symphony No. 3 (1902) gives "Contra–Basstuba" on the first page, but then abbreviates to "Btb." on subsequent pages (as shown in the overview) (Mahler 1898 [1902]), while Symphony No. 5 (1904) shows "tuba" in the autograph score (Mahler, 1903 [1904]), which is then changed to "Kontrabass-Tuba" in the first edition of the parts (Mahler n.d. (1904)).[59] Such details are often overlooked today; one contemporary analysis argues that "Mahler always writes 'bass tuba', but means contrabass tuba" (Kubik 2015, p. 144),[60] while another (Ünlü 2006, pp. 57–59) is based upon earlier uncritical research (Young 1980, pp. 89–95) and outdated technical descriptions (Kunitz 1968, p. 839).

Figure 27: F tuba. Augustus Kley, Berlin, ca. 1918. Collection Louis Jake Klein.

Richard Strauss specified "contrabass tuba" only in *Elektra* (1909), with Emil Teuchert, tubist with the Königlich-sächsische musikalische Kapelle in Dresden when the work was premiered, naming the part as for contrabass tuba, an instrument he says "differentiates itself from the bass tuba only

57 Hartmann also played in Bayreuth from 1896, where he presumably used the same instrument as in Berlin, and later, Vienna (Sous 1988, p. 197). Mahler created a second tuba position in Vienna from 1901, with receipts showing that the instruments were repaired and replaced in 1902 and 1907 (Darmstädter 2007, pp. 100–6).

58 It is possible that he wanted to ensure that he was working with a reliable tubist, given that, when editing the manuscript of his First Symphony (Mahler 1889), he felt it necessary to add next to an F1 that "if the tubist cannot produce this tone in *pianissimo*, it is to be taken over by the contrabassoon" (Mahler 1906 [1893], I: Fig, 13).

59 In a preface to a recent edition of the Fifth Symphony, Stephen Johnson does not ease the confusion by referring to the instrument as a "bombardon/bass tuba" (Mahler 2010 [1904], p. vi).

60 Kubik also mistakenly describes an image of modern six-valve 'Wiener' tuba as having eight valves, and later, somewhat mysteriously, describes instruments used today as "powertubas" (ibid.).

through its wider bore" but "is generally found in C or B-flat" (Teuchert 1911, pp. 124, 132).[61] Strauss, in fact, wrote "Baßtuba" in the autograph score, manuscript copy and galley proofs (1907–08), but for the first printing of the score and parts (1908–09), this was changed to "Contrabaßtuba" (Strauss 2020 [1909], pp. 387–95).[62] As before with Bruckner, this change may be due to the use of Wagner tubas. The galley proofs contain the first reference to these "Tuben", which, seen alongside the "Baßtuba", could explain the decision to change its name to "Contrabaßtuba" in order to avoid any confusion (the only difference in instrumentation between these two sources) (Strauss 2020 [1909], pp. 390–91).

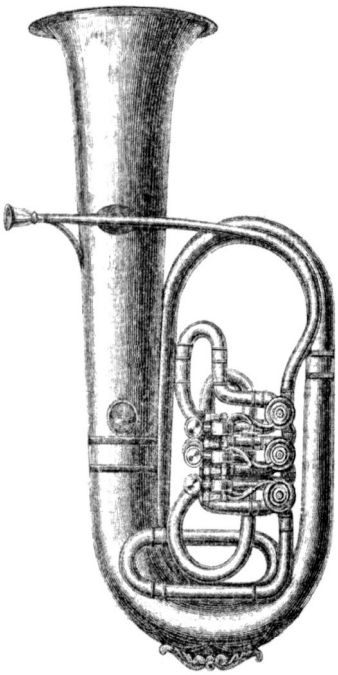

Figure 28: *Das Bombardon*. Hofmann 1890, p. 218.

Similar reasons could explain the "contrabass tuba (also bass tuba)" part in Arnold Schoenberg's *Gurre-Lieder* (1913) (Schoenberg 2005 [1913]). In what is perhaps a result of copyist error ("BsTa" used for bass tuba, and "BassTa" for bass Wagner tuba), "Baß Tuba" appears in reference to fewer than 2% of measures in the work, and only in sections orchestrated after his nine-year hiatus from working on the piece. In all of his instrumentation listings for the work, from sketches in 1901 ("1 CtrB. Tuba") to later orchestrations in 1903 ("1 Contra Baß Tuba") and the published score in 1920 ("1 Kontrabass Tuba"), he always includes only some spelling or abbreviation of contrabass tuba (Schoenberg 2008 [1913], pp. 82, 88, 128).[63] Bass tuba is mentioned in the parts produced for the 1920 and 2005 editions (Schoenberg 1920 [1913]; Schoenberg 2005a [1913]), while the 2005 edition of the score lists only "contrabass tuba" (Schoenberg 2005b [1913]).

Alban Berg specified contrabass tuba in his Three Pieces for Orchestra (1923), and also in *Wozzeck* (1925), although in the latter's score it is abbreviated to "Btb.", with the stated range reaching a (parenthetical) B0, the first incidence of Wieprecht's range being (tentatively) exceeded (Berg 1955 [1925], II: b. 344).[64] The on-stage band in Act II Scene IV, however, requires a "Bombardon in F […] possibly also a bass tuba instead […] possessing the range A1(G1)–F4" (ibid., II: b. 429). His request

61 The image used by Teuchert to depict the 'contrabass tuba' is of an instrument that was designed for the cavalry, given the low position of the valve block (ibid., p. 125; see also an F tuba in this design in Franz 1884, p. 70).

62 Discrepancies include how "Basstuba" is written above the staff at Fig. 177, without further indication in the part (Strauss 1908 [1909]), but reverts to "Contrabaßtuba" by the next entry in the score (Strauss 1916 [1909]).

63 This is in line with his earlier orchestral works that premiered in Vienna, notably *Pelleas und Melisande* (1905), which consistently state "Kontrabass-Tuba" (Schoenberg n.d. (1912?) [1905]).

64 Norman Del Mar erroneously asserts that Berg's use of this low register implies that he was writing for the "largest tubas" (contrabass tubas) (Del Mar 1981, p. 303), and thus disregards both Wieprecht's descriptions, and also the lack of correlation between such terminology and absolute pitch (see chapter 4.2; in particular, footnote 119).

for a military-issue bombardon (Fig. 28) could be attributed to the fact that these instruments were designed to be used while standing (or on horseback), as would be required here, although as Berg suggests, use of a 'Wiener' tuba is also a possible option.[65] In any case, a single performer is expected to play in the orchestra and on-stage, with Berg noting that, after the stage band leaves, the musician is to "rush to the orchestra and take the bass tuba" for the next entry (ibid., II: b. 662). Contemporary performances generally split the part between two tubists, with both musicians using very similar instruments (see also chapters 3.1, 3.2). Overall, despite common terminological issues (from which significant contemporary performance practice inconsistencies arise, see chapter 4.2), a form of 'Wiener' tuba was used consistently in orchestras in the German-speaking world from the premiere of *Der Ring* into the first decades of the twentieth century.

2.3 Russia

German labrosone musicians and performance traditions were encountered frequently in Russia in the mid-nineteenth century (Smith 1994b, p. 11; Lévachkine 1999?, p. 11). "Wurm brass choirs", which were military ensembles founded by German trumpeter and conductor Wilhelm Wurm (Lévachkine 1999?, p. 4), included helicon-like wearable tubas as early as 1845 according to Wilhelm Wieprecht (Wieprecht 1845, p. 3), who had delivered a tuba to Russia in 1838 (Heyde 1987, p. 256). Other German émigré musicians included Christoph Borck, who played ophicleide with the Moscow Bolshoi Theatre from 1859, and Wilhelm Schönekerl, who was engaged in St. Petersburg from 1861 as an ophicleidist (he likely played in the premiere of Verdi's *La forza del destino* in 1862), and from 1864 as a tubist (Lévachkine 1999?, pp. 9–11).[66] There is no evidence that these émigré musicians had previously worked in German orchestras, so it is unlikely that they would have encountered the orchestral tubas discussed in chapters 1.4, 2.1, and 2.2, and therefore they probably used military 'bombardons' in E-flat. Červený's wide-bore designs were the most popular in Germanic bands at the time (see chapter 2.1, also Reuter 2002, p. 470) (Fig. 29), as

65 'Wiener' tubas generally lack the rings for attaching a carrying strap commonly found on instruments intended for band usage ever since military serpents, bass horns, and valved ophicleides were in common use (see Lannoy 1834, p. 452; such a strap is visible in Fig. 11). While there was still a clear distinction between these instruments at the time (particularly those designed for use in the cavalry), as can be seen by comparing Figs. 27 and 28, the name 'bombardon' was used with increasing rarity in order to distinguish the two (see chapter 3.1, also footnote 61).

66 Mikhail Glinka included the ophicleide in *A Life for the Tsar* (1836), feasibly influenced by recent trips to Milan and Vienna where he possibly encountered a valved ophicleide (see chapter 1.3) (Green 2015, pp. 18–19). Keyed ophicleides have been documented in use in concert in Russia since at least 1846, while, as elsewhere in Europe (see chapter 1.3), the preferred instruments in military bands were valved ophicleides (Matvejčuk 2019, p. 97–99). Anton Rubinstein's Symphony No. 2 *Océan* (1851) contains a part playable using an ophicleide (see chapter 1.4), but nevertheless is one of the earliest symphonies with a part specifically designated for tuba (Rubinstein n.d. (1858) [1854]).

shown, for example, in an advertisement from Edmund Kruspe of Erfurt from ca. 1870 which shows a "bombardon in E-flat" next to a "tuba in F" (Heyde 1987, p. 278). Nikolai Rimsky-Korsakov was Inspector of the Russian Naval Music Bands from 1873, and presumably played a role in the reorganisation of the military orchestras in 1874–76 which replaced Wurm's instruments in C and F with new models in B-flat and E-flat (ibid., p. 4). Whether a similar reform was applied to orchestral practice is unclear, as Rimsky-Korsakov's own treatise on orchestration is incomplete and inconclusive.[67] The description of the instrument given in the published text ("*C*-bass") implies a tuba in C (in line with other instruments listed, for example, "Horn: *F, E*"), but the accompanying chart denotes an instrument in F (Rimsky-Korsakov 1922b, p. 25, emphasis in original).[68] Robert Kietzer writes in his *School for self-instruction on the E-flat tuba or helicon* that "only high E-flat and B-flat basses are used in mounted and hunting bands, while very rarely one can find F and C basses in infantry bands […] nowadays the E-flat is used most often" (as cited in Lévachkine 1999?, p. 5).[69]

Figure 29: E-flat bombardon. V. F. Červený, Hradec Králové, ca. 1919. Collection Louis Jake Klein.

There is no proof that E-flat instruments were in use orchestrally at the time, despite claims that works were orchestrated specifically with them in mind (Bevan 2000, pp. 332, 334; Lévachkine 1999?, p. 6).[70] In his late-nineteenth-century chamber music, Viktor Ewald did not specify the pitch of tuba in his quintets, but with two "*Cornetti* in B-flat", one "*Alto* in E-flat" and one "*Tenore* in B-flat", a tuba in E-flat would be "suitable" (Reed 1979, p. 125), and photographic evidence suggests that his own tuba was, indeed, likely to be in E-flat (reproduced in Smith 1994a, p. 5). The most

67 He noted that "in the group of brass wind-instruments [he] found some with three, four and five valves" and that "to describe all this was absolutely beyond [his] power," and ultimately describes the treatise as "the text-book that was never written" (Rimsky-Korsakov 1923, pp. 117–18). Nevertheless, he "came to see that all [he] had known of wind-instruments was wrong" and "began to apply this newly acquired information in [his] compositions, as well as impart it to [his] conservatory pupils [including Glazunov and Stravinsky]" (ibid., p. 117).

68 Unlike the English edition, which states simply "tuba" (Rimsky-Korsakov 1922b, p. 24), the German edition preserves the original Russian (Rimsky-Korsakov 1913, p. 30) and gives "Baßtuba oder Kontrabaßtuba (Tuba c-bassa)" (Rimsky-Korsakov 1922a, p. 28), implying that the two names can be treated synonymously.

69 Kietzer n.d. [1900] is a method book for "F or E-flat tuba or helicon" (other editions list only E-flat, as illustrated in Lévachkine 1999?, p. 6) although he later remarks that the work is "a method for the Saxtuba in E-flat" (ibid.). Curiously, he also suggests, without explanation, that Wagner employed for "his Nibelungen" an otherwise unheard of "low A-flat tuba" (ibid., p. 14).

70 As James Green notes (Green 2015, pp. 40–44), some Russian tuba parts are not playable with the three-valved Saxhorn-style E-flat tuba that Bevan refers to (Bevan 2000, p. 334), although such ranges are certainly possible with a four-valve Basstuba-style instrument as illustrated in Fig. 29 (see Annex, p. 40, also chapter 4.1).

convincing argument for use of the E-flat tuba in Russia perhaps comes from Emperor Alexander III, himself an enthusiastic amateur musician. According to his diaries:

> Wednesday 20.08[.1872]: [Franz] Turner [trombonist with the Imperial Theatre Orchestra in St. Petersburg from 1861, later trombone and tuba professor at the St. Petersburg Conservatory] brought me my new *Es Basso* [E-flat tuba], which I had ordered from Austria [from Červený of Königgrätz (today Hradec Králové)]. (cited in Lévachkine 1999?, p. 14)[71]

Russian composers pushed the technical limits of the tuba, both in terms of articulation and range: Rimsky-Korsakov's *Scheherazade* (1888) requires triple tonguing (Rimsky-Korsakov 1889 [1888], IV: Fig. M) (see Annex, p. 124), and Glazunov includes the first D1 in orchestral literature in his Symphony No. 5 (1896) (Glazunov 1896 [1895], I: b. 1). The extent to which this experimentation was influenced by contemporaneous developments in Austro-Germanic tuba writing (see chapter 2.2) is unclear, though Tchaikovsky's tuba parts written after he attended the first Bayreuth Festival and praised Wagner's "instrumentation of unprecedented beauty" (Tchaikovsky 1876), are notably more detailed than those written before, for example in his Symphony No. 4 (Tchaikovsky n.d. [1888] (1878)). The technical challenges provided by this repertoire are exacerbated today by the wide-bore bombardon-style instruments in C and B-flat which are commonly used for this music (see chapter 4.2). A propagation of wide-bore military instruments in Russia from the 1890s onwards (Lévachkine 1999?, p. 4) led to claims that "the Russians often took a very large tuba for granted" (Del Mar 1981, p. 303),[72] however, much as in Austria and Germany, there is no evidence to suggest that larger tubas were regularly employed in Russian orchestras until the mid-twentieth century (see chapter 3.1).[73]

2.4 Italy

Much as the 'early' cimbasso made way for the ophicleide (both keyed and valved, see chapters 1.2, 1.3) in Italy in the 1840s, these instruments were found with increasing rarity as the nineteenth century progressed. Military bombardons were rapidly gaining in popularity, most notably Giuseppe Pelitti's *pelittone*, which was patented in Austria in 1846 as an alternative to narrow-bore valved ophicleides (as shown in his patent illustration next to a "Pombartone [*sic*]

71 Červený set up a factory in Kiev in 1867 (Bevan 2000, p. 327). The exact type and origin of the Emperor's tuba requires detailed study of said instrument, which is currently held in the Sheremetev Palace in St. Petersburg.

72 Despite his previously noted research to the contrary, Clifford Bevan wrote in 2019 that "The tuba in 16-ft C with five or six valves is widely used as an orchestral instrument capable of doing justice to the lowest tuba parts, such as those of Russian composers" (Bevan 2019b, p. 423).

73 Sergei Rachmaninoff's Symphony No. 2 (1908) contains an E1 that would be difficult to create on a three- or four-valve E-flat bombardon (Rachmaninoff 1908, III: Fig. 50) (see also footnote 120). This work was composed in Dresden, and so perhaps under the influence of the F tuba played by Emil Teuchert in the Sächsische Staatskapelle (see chapter 2.2, illustrated in Teuchert 1911, p. 119).

basso di Vienna", Fig. 30).[74] By 1851, Pelitti had developed the *generale pelittone* (Fig. 31), an even larger form of bombardon, which continued to grow in both size and popularity over subsequent decades, and by 1881 was "found in every orchestra" (Pazini 1881, p. 111). With regard to the premiere of *Aida* in 1871, Verdi made his opinions on these instruments clear:

> I would like a fourth trombone […] preferably a bass trombone, but if this is too difficult, then the normal *oficleide* that can play down to B1. In other words: whatever you want, but just not any devilish *bombardone* that doesn't mix with the others. (Verdi 1871, emphasis in original)

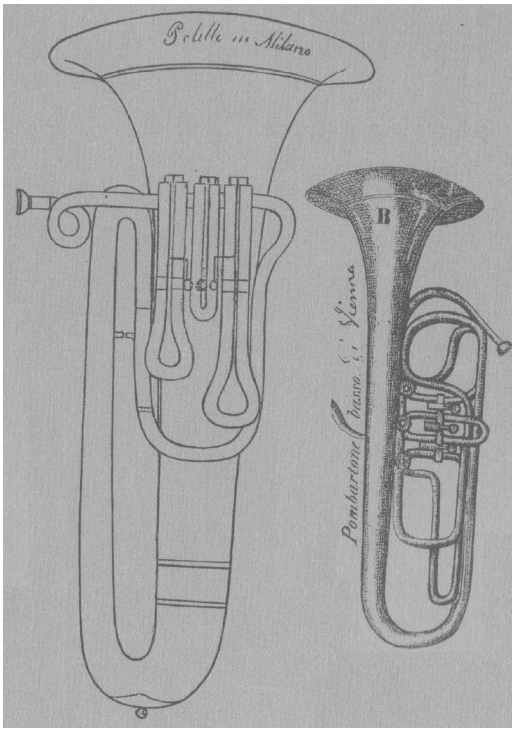

Figure 30: *Pelittone*. Patent, Giuseppe Pelitti, 1846. Reproduced in Heyde 1987, p. 281.

Figure 31: *Generale pelittone*. Giuseppe Pelitti, Milan, ca. 1855. Collection Andrew Kershaw.

His clear differentiation between *oficleide* and *bombardone* (*bombardone* in Italian was not used to refer to valved ophicleides (Meucci 2015, pp. 193–94)), and his pragmatic use of instrumental range (the *generale pelittone* could reach below B1 to notes Verdi had always carefully avoided) confirms that the *bombardone* referred to here was a *pelittone*, most likely a *generale pelittone*.

In 1881, the same year in which the musicians' congress met in order to recommend that the bass tuba be used in Italian orchestras,[75] Verdi discovered Giuseppe Pelitti Jr.'s new instrument, a "bass trombone in B-flat, one octave lower than the tenor trombone" (Fig. 32), which "shows excellent results in terms of range, timbre, volume, power, softness, and ease of execution, and it mixes perfectly with the other trombones" ("Visita di Verdi..." 1881, p. 319).[76] Verdi proclaimed that "adopting two B-flat trombones, a bass trombone in F, and the new bass trombone in B-flat would be necessary" (ibid.), and it is this combination that Verdi

74 In this same year (presumably prior to knowledge of the *pelittone*), Giuseppe Fahrbach wrote that "no perfect instrument exists for the bass parts" in the Italian military band, nevertheless stating preference for the ophicleide (Fahrbach 1846, p. 397).

75 Regarding the implications of this decision, see chapter 3.1. Verdi himself reacted by saying that "instead of correcting past wrongs, [they] have only added new ones" (cited in Meucci 1996, p. 161).

76 Orchestral trombones of the period were commonly found with valves rather than a slide (particularly frequently in Italy, although not exclusively); for further details, see Rainer 2016, Webb 1996, and Zechmeister 1998a.

would use in his final operas, *Otello* (1887) and *Falstaff* (1893). Given that "the 'Verdi-Trombones' suddenly found themselves granted entrance into all Italian opera houses" (Meucci 2015, p. 196), such instruments were likely used for the first performances of Pietro Mascagni's *Cavalleria rusticana* (1890) in Rome, and Ruggero Leoncavallo's *Pagliacci* (1892) in Milan, despite the parts calling for a "basso tuba" (Mascagni 1890; Leoncavallo n.d. (1892)) (see also chapter 4.2).[77] In *Tosca* (1900), Giacomo Puccini called the instrument a "trombone basso" (Puccini 1900),[78] much as Verdi did himself in *Otello* and *Falstaff* (Verdi n.d. (ca. 1913) [1887]; Verdi n.d. (1893)). Ettore Panizza called it a "trombone basso Verdi" (Berlioz 1912, p. 132), while in Puccini's *Turandot* (1926), it is a "trombone contrabbasso [*sic*]", presumably the result of Franco Alfano's completion (Puccini 1926).[79] Following a mid-century hiatus, instruments in this form are again in common use (although now built at a higher pitch and with a wider bore, which reflects the modern desire for ever lower spectral content, see chapter 4.2) and have reverted to the name cimbasso, or, for clarity's sake in this document, a 'Verdi' cimbasso.

Figure 32: 'Verdi' cimbasso. Romeo Orsi, Milan, ca. 1902–18. MIME 6608.

2.5 France

The ophicleide was found in French orchestras late into the nineteenth century; despite François-Auguste Gevaert writing in 1863 that "it could be advantageous to replace the ophicleide [with a saxhorn]" (Gevaert 1863, p. 98), he noted, twenty-two years later, that "even today its use has not completely ceased" (Gevaert 1885, p. 265). Earlier treatises mentioned the saxhorn only in the context of military bands (see chapter 1.4), but in 1853, Camille Saint-Saëns wrote for one "saxhorn basse in B-flat" and one "sax-horn c-basse in E-flat" in his Symphony No. 1 (Saint-Saëns n.d. [1855], p. 114). Operatic composers employed the ophicleide into the 1860s (for example, Meyerbeer, in *L'africaine* (1865)), as did Saint-Saëns, it can be assumed, while composing his first opera, *Le timbre d'argent* (1864), although it is unlikely such an instrument was used when the

77 *Pagliacci*, like *Otello* and *Falstaff*, takes advantage of the new potential low register of this instrument, reaching as low as E1 (for example, Verdi n.d. (1893), III:I, Fig. 14), but *Cavalleria rusticana* does not (Leoncavallo, n.d. (1892)), so perhaps, by this time, the instrument had not, in fact, reached as far as Rome.

78 In his early *Manon Lescaut* (1893), Puccini wrote for a "Bass-Tuba (*Pelittone in B-flat*)" (Puccini, 1893), but all of his works thereafter include a *trombone basso*.

79 Simon Wills suggests that this part was played using a tuba (Wills 1997a, p. 172), which, although lacking primary source evidence, is plausible in the context of contemporaneous performance practice (see chapter 3.1).

work was premiered in 1877.[80] Léo Delibes's *Coppélia* from 1870 included an ophicleide (Delibes, n.d. (1869–71) [1870], p. 5), but Joseph Brousse notes that, in 1874, "a tuba [in C] with four valves was introduced at the opera" (Brousse 1925, p. 1675), and in the same year, Saint-Saëns's *Danse Macabre* was written, and included a part specifically for "tuba" (Saint-Saëns 1874, p. 3).[81]

Figure 33: *Saxhorn basse*. Adolph Sax, Paris, 1868. Collection J. C. Verdié.

Brousse does not provide further detail, but this tuba was most likely based on a saxhorn design, as Sax's four-valve bass saxhorns already appeared in "some dance orchestras from the mid-1840s" (Bevan 1997, p. 152). By the late 1860s, bass saxhorns were built with a significantly wider bore and bell (Fig. 33) (Mitroulia 2011, p. 163), and also in C and F (alongside the usual B-flat and E-flat), but these were not manufactured by Sax, who was focused on his *nouveau* saxhorn design (Fig. 34) with six independent valves (Mitroulia, pp. 166–67; see also Annex, p. 54). This system never found broad appeal, owing to the extra cost and weight involved (ibid.), however, this process of adding more valves to bass saxhorn-shaped instruments in order to improve intonation (much like Daniel Fuchs did to 'Wiener' tubas, see chapter 2.2) culminated in what is known today as the French C tuba (Fig. 35). Émile Barat designed a system for five-valve "C/B-flat" tubas in 1894 (Grenot 2016, p. 78), while Brousse notes that "in 1880, a five-valve instrument appeared which was considered the definitive tuba, until the final instrument appeared from Courtois in 1892 with a supplementary transposing valve" (Brousse 1925, p. 1675).[82] Such

Figure 34: *Nouveau saxhorn basse*. Adolph Sax, Paris, 1870. MIME, 3115.

80 The libretto was passed to Saint-Saëns after the death of Fromental Halévy, "France's most eminent musician" (MacDonald 2017), and composer of notable ophicleide parts, for example, in *La Juive* (1835). The work would eventually be revised six times; the instrument used in a recording of the 1914 version is listed as "trombone contrabasse", although evidence for this choice is not given (Saint-Saëns 2020).

81 Saint-Saëns continued to experiment with Sax's instruments, notably in *Le Déluge* (1875) which includes three contrabass saxhorns, as well as pairs of trumpets and trombones which used the six-valved independent system (see below) (Saint-Saëns n.d. [1878], p. 48).

82 Brousse separately refers to the introduction of the contrabass trombone at the Opéra de Paris in 1893 for their first performance of *Der Ring des Nibelungen*, which would have also necessitated Courtois's six-valve tuba (thus negating Douglas Yeo's suggestion that Courtois first introduced this tuba in 1898 (Yeo 2021, p. 154)). He also notes that the lower range enabled by the fourth, fifth and sixth valves "at first was mainly used by Wagner, but

descriptions clarify that manufacturers were using the extra valves to accommodate the more traditional B-flat tuning within their C instruments.[83] As such, Sax's *nouveau* models, commended at the time for their "magnificent" and "magisterial" sound ("Nouvelles" 1863, p. 118), left an important legacy in orchestral performance practice, even if the additional valves were ultimately used for alternate tuning options (as with Basstuba-style instruments, see Annex, p. 53), rather than as part of a complete overhaul of the valve system.[84]

Figure 35: French C tuba. Couesnon, Paris, after 1882. MIME, 2925.

In 1885, Geveart stated that composers were now writing for a "tuba in C", but he described it as having a low range that reaches only A1, deeming as high as G2 to be "poor" (Gevaert 1885, p. 291).[85] Charles Widor similarly claims that the lowest register of the "bass saxhorn = tuba" in C or B-flat is "unfortunately the weakest" (Widor 1904, p. 94), despite examples to the contrary in the low writing found in contemporaneous compositions, such as César Franck's Symphony in D (1889) (Franck n.d. (ca. 1890) [1889], III: Fig. O) and Claude Debussy's *La mer* (1905) (Debussy 1909 [1905], III: Fig. 60), while my own practice experience suggests that this low register is indeed well matched by a contemporary contrabass tuba (see chapter 4.2; in particular, 4.2.33). Widor described the middle register as having "full tone-power", which is notably exploited by Igor Stravinsky in *Petrushka* (1911) (Stravinsky, n.d. (1912) [1911], Fig. 100) and *The Rite of Spring* (1913) (Stravinsky, 1922 [1913], Fig. 64), although both works also exploit the low register, as far as E-flat 1 (ibid., Fig. 53). These registers are also used by Maurice Ravel in his orchestration of Modest Mussorgsky's *Pictures at an Exhibition* (1922), though he also makes use of the "remarkably intense and rich" higher register (Widor 1905, p. 94), which results in a part for which modern practice commonly demands the use of two instruments, although my own practice suggests that neither are suitable substitutions (see chapter 4.2; in particular, 4.2.39).

since then many composers have followed his example, making the tuba with six dependent pistons [as opposed to Sax's *nouveau* independent valves] essential in the orchestra" (Brousse 1925, p. 1676).

83 Swappable tunings require significant valve slide adjustment, which compromise the overall acoustic design, and lead some resonant frequencies to diverge significantly from their theoretical positions (see Myers and Parks 1997).

84 Sax's early *Contrabass d'harmonie en fa*, patented in 1843, also had six valves (see chapter 1.4), but due to a lack of extant examples, it is difficult to verify any particular tuning system he may have intended for them.

85 Gevaert suggests that the "bombardon or low saxhorn-basse in F […] has the dimensions necessary for providing the solid fundamental to the modern brass" (ibid., p. 292), but again, the instrument described only reaches A-flat 1, almost an octave higher than that described by Berlioz for the bass tuba forty-two years earlier (Berlioz 1843, p. 229).

Nevertheless, the French C tuba's reputation for having a seemingly weak lower register and "lightweight tone" (Bevan 2000, p. 345)—Charles Koechlin wrote in 1930 that it had a smaller range than Debussy used in *La mer* twenty-five years earlier (Koechlin 1930, pp. 102–3; Debussy 1909 [1905], III: Fig. 8)—would eventually lead to its demise later in the century (see chapter 3.1).

2.6 England

Figure 36: E-flat bombardon. F. Besson, London, 1883. MIME, 2097.

The ophicleide was found in the Philharmonic Society in London from 1843 (Bevan 2000, p. 502), and made an appearance in the opening concert of the Hallé Orchestra in Manchester in 1858, while professorial positions at music colleges were appointed in 1888 (Morley-Pegge et al. 2001), and existed until at least 1901 (Palmer 1990, p. 182)). However, reflecting a Germanic rather than French influence on English concert programming (Bevan 2000, p. 371; Zechmeister 1987, p. 13), the instrument was never a regular orchestral member (Bevan 2000, p. 374). In 1855, when Wagner conducted the Philharmonic Society in a concert of his music (the programme included selections from *Tannhäuser* and *Lohengrin*), Bevan argues that "it is certain that [the tubist] will have been a military bandsman […] and equally certain that he will have played his E-flat bombardon" (Bevan 2000, pp. 372–74), this despite the parts being playable on some forms of ophicleide (which may well have been used in Munich in 1858, see chapter 1.4).[86] A military bandsman may well have been engaged, yet it was noted at the time that "neither an F bass […] an instrument serving to represent […] the orchestral ophicleide or bass-bombardon […], nor an E-flat bombardon [(Fig. 36)] [...] possesses, as the stringed double-bass does, a so-called sixteen-feet tone in the bass" (Mandel 1860, pp. 24, 39). This suggests that the instruments did not have a wide-enough bore to create sufficient low-frequency resonance, much like Sax's instruments and others from Bavaria at the time (see chapter 2.1). The "B-flat euphonion" (Fig. 37), on the

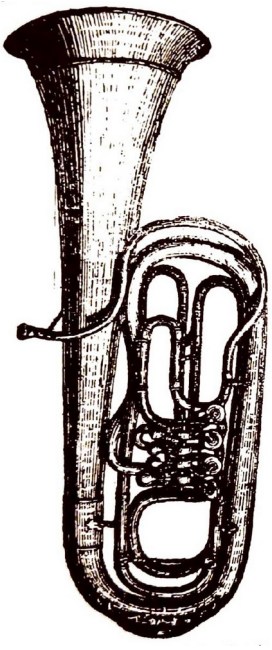

Figure 37: *Euphonion*. Advert, Ferdinand Sommer, 1844. Reproduced in Krones 2019, p. 200.

86 A contemporaneous Bavarian text describes the bombardon as "existing in F, E-flat and C, most of which are in C" (Streck 1860–61, p. 146), and so the name was being used for instruments in tuba- rather than ophicleide-shaped design (see also Schafhäutl 1855, pp. 165–70; Schebek 1858, pp. 28–31). 'Ophicleide' was rarely applied to valved instruments in English, and so 'bombardon' here always refers to tuba-shaped instruments, (Bevan 2000, p. 218).

other hand, is “the most important of all the low brass instruments, […] [it] is of wide calibre, [possesses] both the contra pedal notes and, also, the high notes, [...] and therefore, can be very variously employed (ibid., pp. 38–39).[87] This instrument, later known as a euphonium (Fig. 38), found widespread use in nineteenth-century British orchestras, and was still being found in 1890 at the Norwich Festival, and in the Hallé Orchestra in 1895 (Bevan 2000, pp. 371–72). Therefore, it may well have been used in Wagner’s 1855 concert, as the instrument’s range as described at the time easily encompasses Wagner’s writing (Mandel 1860, p. 38). As late as 1912, it was thought that “for orchestral purposes, the four-valved euphonium in B-flat is extremely useful [...] the player is competent to deal with the F-Tuba parts favoured by the composers of a century ago” (Miller 1912, p. 56).

Figure 38: Euphonium. Joseph Higham, Manchester, ca. 1882. MIME, 2776.

Tubas were observed in the Philharmonic Society in 1870, and in the Hallé from 1878 (Bevan 2000, pp. 503, 505), although the bombardon, tuba, euphonium, and ophicleide were written of ambivalently that year, as opposed to the serpent, which “could still be made to form a most valuable addition to the orchestra of the present day” (Bonavia Hunt 1878, pp. 147–48).[88] It is therefore surprising to read, less than two decades later, that “the tuba plays so important a part in many modern works”, but it was still “not a *regular* constituent of the orchestra (Prout 1897, pp. 234–40; emphasis in original). Such a transformation of opinion can be seen as emerging from Wagner’s visit to London with Hans Richter in 1877 (Cummings 2015, pp. 396–97). Charles Villiers Stanford noted that Richter “taught [the orchestra] by example […] the spectacle of a conductor who could play passages on the Bass Tuba was a new experience for the old stagers” (Stanford 1914, pp. 178–79).[89] Richter commissioned from William Hillyard a new tuba in F (Bevan 2000, pp. 376–77), presumably inspired by that ordered for Brucks in 1875 (see chapter 2.1), but, given the British bombardon tradition, in Saxhorn-form (Sax’s instruments were abundant in British bands

87 The euphonion was patented by Franz Bock and Ferdinand Hell in Vienna in 1844, and at the Great Exhibition of 1851, Hell and F. Sommer presented their “euphonic horn” (Heyde 1987, p. 217) or “sommerophone […] a kind of ophicleide with much power and capability” (MacTaggart 1986 [1851], p. 71). At the time, a “Bass-Euphonium” was a form of a keyed bass horn (see chapter 1.2) from Heinrich Johann Haseneier (Heyde 1982, pp. 96–98).

88 In response to Berlioz’s negative assessment of the serpent (see chapter 1.2), Schubert similarly wrote that “if he [Berlioz] had actually heard a good serpent player in Germany, he would probably have formed a very different opinion” (Schubert 1865, p. 304).

89 Stanford also noted Richter’s role in improving standards of playing across the whole orchestra, in particular the labrosones: “It was not until the advent of Hans Richter (himself an excellent horn-player) that this department of the band [labrosones] reached the same level of excellence as the strings and woodwind” (ibid., p. 175).

after being introduced in 1844 (Mitroulia 2011, pp. 237–39)) (Fig. 39). This instrument, likely based on a euphonium rather than an E-flat bombardon (Bevan 2000 p. 377; note the similarities between Figs. 38 and 39 as opposed to Fig. 36),[90] may not have been ready for the 1877 concerts in London, but was used from 1879 after Richter began conducting regularly in England (Cummings 2015, p. 395). Richter himself described it as a "magnificent instrument", and that "the intonation, considering the extraordinary compass, is so perfect that I with pleasure testify to the great excellence of the instrument" (The British Bandsman 1887, rear cover).

Figure 39: English F tuba. Joseph Higham, Manchester, ca. 1904. MIME, 4048.

This wide compass was tested in two works premiered in England soon thereafter; Antonín Dvořák's Requiem (1891) regularly uses F1 and G1 (Dvořák 1892 [1891], IX: Fig. O), and Arnold Schoenberg's Five Pieces for Orchestra (1912) reaches from D1 to G4 (Schoenberg 1912, I: Fig. 16; IV: Fig. 9). It was Edward Elgar who would be the first English composer to embrace the F tuba, doubtless owing to his encounters, through Richter, with the tubist Harry Barlow, who had joined the Hallé in 1894, and switched instruments in 1896–97 from euphonium to an F tuba from Joseph Higham (Myers et al. 1999).[91] Bevan suggests that "Barlow is reputed to have advised the composer on his tuba parts" (Bevan 2000, p. 38), and so it is likely that he was invited by Richter to play in the premiere of Elgar's *Variations on an Original Theme 'Enigma'* in London in 1899 (the same year that Richter became chief conductor of the Hallé), as well as in subsequent works from Elgar which were premiered by the orchestra, such as his Symphony No. 1 (1908).[92]

The English F tuba was adopted by other English composers, notably Ralph Vaughan Williams and Gustav Holst, although, as with the orchestral tuba traditions elsewhere in Europe, criticism of the instrument from the perspective of military traditions was common, for example, that "an acquaintance with the orchestral tuba in F gives but a very poor idea of the present magnificent

90 A "contrabass tuba in F" built by Victor-Charles Mahillon in ca. 1890–1910 (Myers and Keyser 2021, pp. 160–61) has, perhaps due to its size and bass saxhorn form, been mislabelled as an instrument in (high) B-flat (Sisto et al. 2010, pp. 284–85).

91 None of Hillyard's instruments have survived, but Higham's model and subsequent promotion by Barlow led to its reproduction by the manufacturer Besson, and these are known today as "Barlow tubas" (Bevan 2000, p. 384).

92 It was reported in Barlow's obituary that "his genius as a tuba-player is further witnessed to by the fact that he was invited [presumably by Richter] to play on several occasions at the Bayreuth Festivals" (The Radio Times 1932, p. 6), although there is no evidence that this invitation was accepted, as the only tuba player listed playing at Bayreuth under Richter's direction was Emil Hartmann (see chapter 2.2) (Sous 1988, pp. 197, 202).

tubas, or basses, of the military band" (Miller 1912, p. 57). William Forsyth describes "our present rather unsatisfactory makeshift [or] midway instrument" as unable to recreate the "beautiful" sounds "which the conductor of a first-class military band exacts from his Brass Basses". Nevertheless, he does add in a footnote that "one of our most artistic Tuba-players, Mr. Barlow, plays on a large-bore five-valved Tuba-in-F [and] his results are extraordinarily fine" (Forsyth 1914, pp. 151–59), acknowledging the distinct value of the F tuba, with the right instrument in the right hands. The English F tuba was perhaps the longest-lasting of the European orchestral tuba traditions, and was commonly found until the early 1960s, owing, in part, to an embargo on import of instruments to the UK (see chapter 3.1). It was most famously employed in Vaughan Williams's Concerto for Bass Tuba (1955), which was commissioned by John Barbirolli, conductor of the London Symphony Orchestra, and later one of Richter's successors at the Hallé. However, my own pedagogical training in the UK for this work and all others by British composers, was focussed on the E-flat tuba, which is commonly used in all forms of tuba performance practice in Britain today (see chapter 3.1). As in the German-, Russian-, Italian- and French-speaking lands, Forsyth's wish that the tubist be "free to adopt [...] the finest of military instruments" (Forsyth 1914, p. 157) would soon be realised and lead to the forging of new orchestral practice traditions.

The end of the long nineteenth century and the age of nationalist tuba traditions

By the outbreak of World War One, distinct orchestral tuba practices were evident across Europe: instruments that had evolved from 'Berliner' tubas were used in Germany and Austria, those influenced by the saxhorn were found in France, a hybrid of the two was utilised in England, the Bohemian-style bombardon was the instrument of choice in Russia, and a bass valved trombone was typically played in Italy. Composers and performers engaged with these instruments to varying extents—in some cases establishing strong working relationships, and in others being willing to make do with what was available—but all resulted in the repertoire which defines orchestral tuba practice today.[93] However, what could also be observed by this point, was the proliferation of ever-larger military band instruments; while bombardons were already in use in Russian orchestras, those in Italy, France and England were regularly compared with, and, in some cases, recommended over their orchestral counterparts. As the twentieth century progressed, these band instruments would infiltrate and come to dominate orchestral performance practice.

93 Of 109 standardised excerpts for European tuba orchestral auditions, 97 were composed before 1923, and all, apart from one, are from German, Austrian, Russian, French, or Italian composers (Evans and Pröpper 2002).

3: Contemporary practice

The accepted historical narrative of tuba family development presents the fairly short, linear process since the invention of the bass tuba in 1835. Larger instruments, such as the saxhorn (1842) and contrabass tuba (1845), followed soon thereafter, various forms of these instruments found their way into the orchestra, and have remained largely unchanged ever since: "in the 1850s, after fewer than twenty years, the bass tuba became practically the instrument it is today" (Bevan 2000, p. 302). While, in the broadest sense, this is true (with the exception of the contrabass tuba, see chapter 2.1), it does not explain how the specific types, pitches, and sizes of instruments found today came into common orchestral usage, particularly the largest tubas in B-flat and C. If I were taking an orchestral audition today, I would be obliged to play one of these instruments in the first round,[94] yet they are not featured in any of the orchestral tuba traditions noted in chapters one and two. Bevan's chapter on "the contemporary tuba" mentions how "national preferences […] are now giving way to a much more universal concept of tuba practice" (Bevan 2000, p. 276), but does not comprehensively explain how and why such preferences gave way. An examination of this process will address the transitions that took place, arguing that the resultant disconnect from pre-existing practices had a significant role in shaping contemporary performer- and composer-tuba relationships.

3.1 Internationalisation, militarisation, and homogenisation

Between 1910–30, after helping to establish and spread European orchestral tuba practices, several of the rare tubists who had had direct contact with notable composers and conductors of their generation retired. Emil Hartmann left the Vienna Philharmonic in 1918, having worked with Mahler, Bruckner, and Strauss (Merlin 2017, p. 57), Joseph Brousse, the inaugural tubist of the Société des Concerts in Paris, retired in 1924 (Holoman 2004, p. 65; see also Brousse 1925, pp. 1674–80), and Harry Barlow left the Hallé Orchestra in 1930, having worked intimately with Richter and Elgar (Bevan 2000, p. 505). Meanwhile, military band instruments were being introduced to the USA by émigré musicians (John Philip Sousa's first band of 1892 included German tubas from Rudolf Sander (Bevan 2000, p. 355)), and, given a lack of indigenous practices, were assimilated into local orchestras. Danish-Norwegian military musician August Helleberg immigrated in 1878 and began playing with the New York Philharmonic in 1879 (Arnsted 2022). A generation later,

94 At time of writing, tuba auditions that demand performance on a tuba in C or B flat in the first round include those for the Orchestre national d'Île-de-France, the Philharmonisches Staatsorchester Hamburg, Göteborgs Symfoniker, and the Tonhalle-Orchester Zürich (accessed 29.03.2022, https://www.muvac.com/en/vacancies/tuba).

when conducting the Philadelphia Orchestra in 1933, Leopold Stokowski "suggested the tuba player Mr. Philip Donatelli [who had immigrated in 1905 ("The Billboard" 1954, p. 34)] obtain an instrument more pipe organ-like in scope and breadth" ("CSO York Tubas" 2022). This led to the acquisition of tubas from the York Band Instruments Company (Fig. 40), which were described in their 1938–39 catalogue as "America's standard symphonic bass" (York Band Instrument Company 1938, p. 15), and were similar to those in use by Fred Geib, Helleberg's successor at the New York Philharmonic (Johnston 1917, p. 47; Fig. 41) (Geib immigrated from Germany in 1888 (Arnsted 2022)).

Figure 40: *Symphony CC Bass, Model 692*. York Band Instrument Company 1938, p. 15.

Donatelli's pupil in Philadelphia was Arnold Jacobs, "rightfully called the father of modern orchestral tuba playing" (Taylor 1999, p. 6), whose own pupils included Roger Bobo, who played with the Royal Concertgebouw Orchestra from 1962. Both Jacobs and Bobo went on to teach Mel Culbertson, who played for Orchestre Philharmonique de Radio France, and who in turn taught many orchestral tubists and pedagogues still active across Europe today, such as Anne Jeller Visser (Oper Zürich), Stefan Heimann (Staatsoper Stuttgart) and Stephane Labeyrie (Orchestre de Paris). Culbertson is credited with standardising "universal [that is, American] tuba practice" in France in the early 1970s (Bevan 2000, p. 351), thereby also signalling the demise of the French C tuba.[95] The English F tuba fell out of common usage once a British trade embargo on foreign instruments was lifted in 1958 (Yeo 2021, p. 57). John Fletcher used his E-flat band instrument with the BBC Symphony Orchestra in 1964 (see chapter 2.6), although upon joining the London Symphony Orchestra in 1970, he added a (modern) C tuba (Bevan 2000, p. 386), an instrument described in 1981 as "a relative newcomer, that, at the time of writing, has ousted the F tuba and become the favourite orchestral instrument" (Del Mar 1981, p. 280).[96] American tubists active in Austria and Germany from the 1960s onwards, such as Mark Evans (Deutsche Oper Berlin), Tom Walsh (Münchner Philharmoniker), and Robert Tucci (Wiener Symphoniker, Bayerische Staatsoper),

95 By 1993, Gérard Buquet wrote regarding contemporaneous practice in France that the French C tuba "is now abandoned in favour of the much more appropriate bass and contrabass tuba" (Buquet 1993, p. 5).

96 The modern C tuba has a tube length double that of the French C tuba, and is hence often referred to as a "CC tuba" (Bevan 2000, p. 42). This double-letter naming convention is not used consistently between various pitches, bores and nominal lengths, and thus is not useful for critical reflection (see also Annex, p. 36). Modern tubas are often given a 'quarter size' (3/4, 4/4, 5/4 or 6/4) (ibid.), a system which is also "not standardized in the industry" and is "both a bit misleading and generally not definitive in discerning the size of an instrument" (Yeo 2021, p. 7).

would initially lead the C tuba to be welcomed into their orchestras, though German and Austrian institutions would eventually standardise the use of B-flat tubas from their own band traditions.[97] There are isolated examples of earlier employments of military band instruments in European orchestras, for example, a B-flat tuba from Červený was acquired by the Leipzig Gewandhausorchester in 1894 ("Lieferung…" 1894–95, p. 121), and Karl Essmann used a B-flat tuba with the Wiener Philharmoniker from 1907–13 (Zechmeister 2021b, pp. 271–74). Nevertheless, it took the "sudden introduction of the 'big sound' […] after World War II" (Bevan 2000, p. 507) for these practices to spread more widely in the German-speaking world; for example, it was not until 1971 that the Wiener Philharmoniker would hire their first tubist who did not play the 'Wiener' tuba (Zechmeister 1987, p. 78). Meanwhile, such military instruments were already in common use in Russia. J. H. Zimmermann of St. Petersburg made band instruments from 1883, but soon after the turn of the century, notably after the death of Franz Turner (see chapter 2.3) in 1909, they began to attract orchestral custom for their larger tubas, and are "still to this day […] the go-to instruments for Russian tuba players" (Lévachkine 1999?, pp. 4, 7, 11).[98] The tuba was accepted into Italian orchestras in 1881 (see chapter 2.4; in particular, footnote 75), yet a newspaper report from that year said that "the new bass trombone ['Verdi' cimbasso] is a substitute for the bombardon" ("Un' importante notizia" 1881, p. 458). In 1912 "almost all the parts for ophicleide or tuba [were] played on the Trombone Verdi" (Berlioz 1912, p. 132), but by around 1920, the bass tuba was "finally accepted in Italy" (Meucci 1996, p. 160),[99] and "until the 1980s … [it was] being used for cimbasso parts, ophicleide parts and serpent parts indiscriminately" (Bevan 2000, p. 419; see also chapter 4.2).

Figure 41: *Tuba* [with Fred Geib]. Johnston 1917, p. 47.

Instruments designed for European military bands were adopted into American ensembles, and then returned to Europe via subsequent generations of tubists, where, following a post-war

97 The F tuba is also still commonly used for higher tuba parts in Germany, though now mirroring the bombardon design initially seen in E-flat instruments (see Fig. 28 in F and Fig. 29 in E-flat) as opposed to the 'Wiener' tubas in F (Fig. 27).

98 As a result of the relatively early adoption of larger bombardon-style tubas in Russia, the only common practice orchestral repertoire for tuba likely to have been originally performed with large military-issue instruments are the early- to mid-twentieth century works of Sergei Rachmaninoff, Sergei Prokofiev, and Dmitri Shostakovich.

99 Meucci notes that the 1881 commission found the tuba more suitable "to orchestral needs" than the bombardon (ibid.). Ottorini Respighi's parts for *basso tuba*, for example in *Pini di Roma* (1924), may have been premiered using a 'Wiener'-style F tuba, but today are universally performed using a modern (bombardon-derived) B-flat or C tuba.

generational disconnect, they had overwhelming influence on orchestral performance practice. Consequently, what can be observed between roughly 1920–70 is a subsumption of the tuba by instruments that, for the half-century prior, had been referred to as bombardons. Terminological distinctions between tubas and bombardons are nowadays no longer critically observed; after initially referring to bass reed aerophones, then keyed bass horns, and later, forms of valved ophicleide (see chapter 1.2), "between about 1875 and 1910 the name 'bombardon' was gradually dropped in favour of the name 'tuba'" (Heyde 2017, p. 37).[100] Turn of the century publications generally still included both names, but, rather than trying to differentiate between them, they were seen as essentially synonymous. For example, distinct entries for bombardon and tuba were given by Hofmann in 1890 (Hofmann 1890, pp. 217–19, 224–29), whereas the 1911 *Encyclopædia Britannica* has one entry for "bombardon, or bass tuba, the name given to the bass and contrabass of the brass wind in military bands, called in the orchestra bass tuba" (Schlesinger 1911), and another for "the tubas — bombardon […] in the orchestra these instruments are called tubas; in military bands [...] bombardon" ("Tuba" 1911). By mid-century, all such references had vanished, 'bombardon' mentioned in neither Koechlin 1930 (in French) (pp. 101–3), nor Schillinger 1941 (in English) (pp. 1534–35), nor Erpf 1959 (in German) (p. 211). Nevertheless, orchestral instruments used from this point onwards can all be traced back to forms of bombardon: Červený's instruments of the 1880s (Fig. 23) are still most popular in the German-, Slavic-, and Russian-speaking worlds; Sax's wider-bore contrabass saxhorns of the 1880s (Fig. 36) (commonly referred to in English at the time as bombardons) maintain popularity in France and England,[101] and American instruments that themselves evolved around the turn of the century from a combination of the aforementioned instruments (Figs. 40 and 41) are popular across the world. This is evident in how closely common instruments in use today resemble those illustrated above (for example, compare Figs. 23 and 40 with Figs. 2.4.6,1 (Annex, p. 42) and 2.4.5,2 (Annex, p. 41) respectively).

The impact on performance practice which resulted from this instrumental transition can be observed by comparing the various generations of bass horns, tubas, and bombardons illustrated thus far. By substituting the diverse instruments that had previously found use in orchestras with those designed in the late-nineteenth century, which have a large bell and bore size in order to create the volume and low spectral content required for military service, there was an inescapable

100 This is the case in English, German, French (where bombardons were generally referred to as saxhorns) and Italian. While *bombardón* is rarely used today in Spanish, a euphonium is still known in that language by the diminutive *bombardino*.

101 Eugenia Mitroulia noted that, over the nineteenth century, of any of Sax's instruments, the bass and contrabass saxhorns "probably show the most profound changes with time" (Mitroulia 2011, pp. 364). A dramatic comparison between a contemporaneous *Saxhorn bourdon* in E-flat and French C tuba is illustrated in Brousse 1925, p. 1675.

loss in the ability to recreate the level of nuance which was achievable with earlier instruments. When preparing Brahms's Second Symphony for a performance with a 'Wiener' tuba, I had to invest significant effort in producing a level of the timbral control I had previously taken for granted when performing the work using a modern F, E-flat, or C tuba. However, as a result, I was able to alter my sound, for example, between blending with the double basses in the opening of the second movement (Brahms 1878 [1877], II: opening), and with the trombone section towards the end of the fourth movement (ibid., IV: Fig. O), to an extent that is impossible to create with modern instruments (see chapter 4.2).

As the orchestra became more homogenised, the loss of control regarding which instrument best fit each individual purpose led to significant repercussions for composers writing new music for the tuba. Instrumental choice today is firmly in the hand of the performer; this is independent not only of the particular instrument of the tuba family a historical composer may have composed for and the national or local practices that may have been in place when and where the music was written (the tubist likely to be aware of neither),[102] but also of any instrument that a composer today might desire. Alfred Blatter wrote that "the composer need not specify the tuba on which a given part is to be performed […] the choice of instrument is usually a decision made by the performer" (Blatter 1997, p. 182); in my experience, the choice of instrument is, in fact, almost *always* a decision made by the performer, and will almost *always* override any specification that the composer may have made. When composers ask me as to whether their tuba writing is effective or even playable, I can only answer with regard to my own practice, as there is no way of guaranteeing what instrument(s) any other tubist may be willing or able to offer for any particular performance. As the twentieth century progressed, this self-determined practice prevented the initiation and development of significant relationships between tubists and composers, as will be discussed in more detail with regard to specialist literature in chapter 5.1.

3.2 Approximation, assumption, and underestimation

Orchestration manuals published since 1945 refer to the tuba family in terms which vary from generic to misleading. For example, Stiller misjudges both the playing and dynamic range of the instruments (Stiller 1985, p. 92), while many authors, including Gieseler, Lombardi, and Weyer,

102 This is often still the case when concerning orchestras and ensembles otherwise devoted to historically informed performance. A 2016 performance of Verdi's Requiem from The Orchestra of the Age of Enlightenment used a modern 'Verdi' cimbasso (Proms 2016) (see chapter 4.2), and Concerto Köln's performance of *Das Rheingold* in 2021 used a bombardon-style instrument of common mid-twentieth-century design (illustrated in Apthorp 2021).

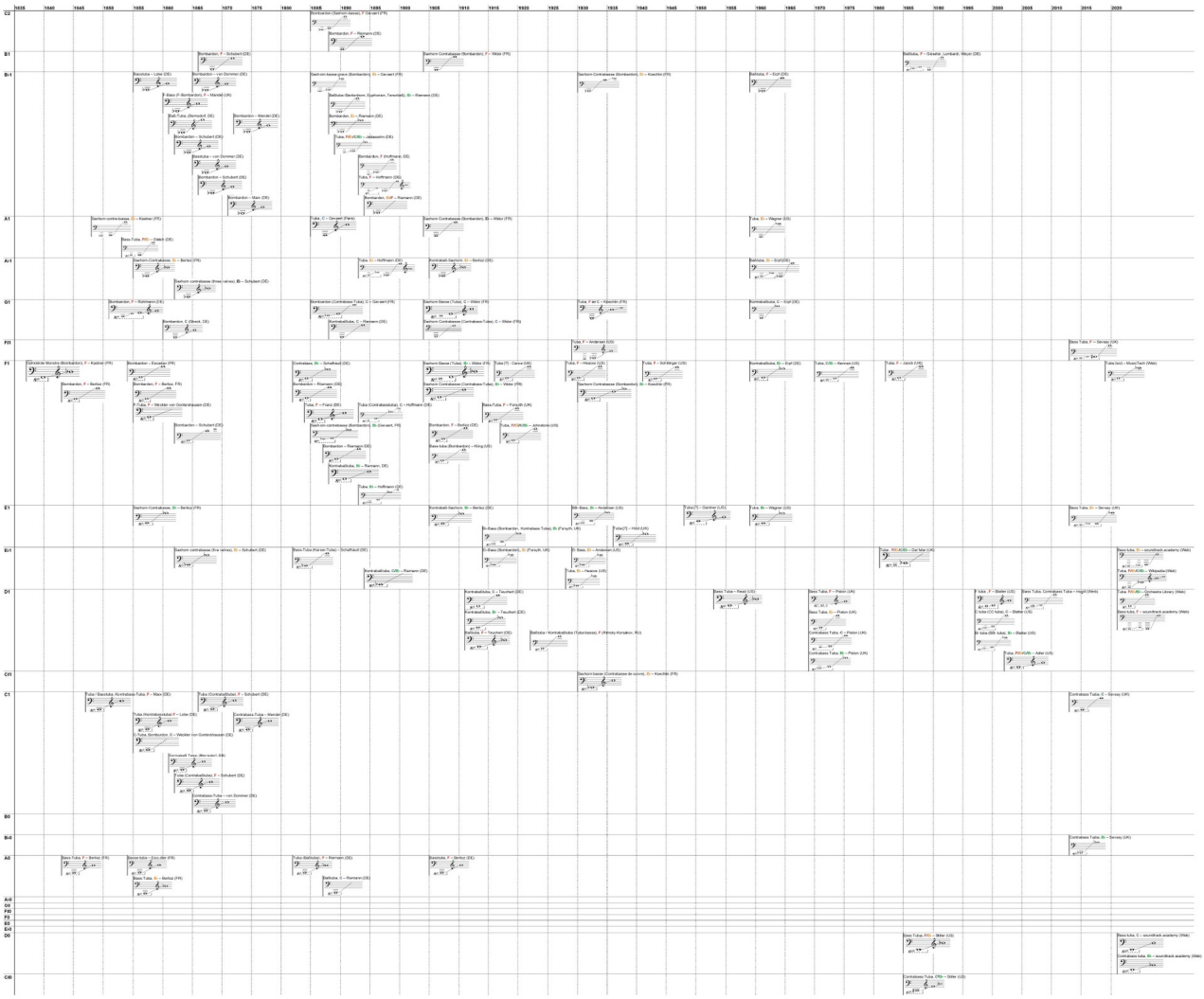

Figure 42: Valved low-pitch labrosone instrument ranges according to primary sources (the full-size image is available here).

Kennan, Blatter, and Miller, underestimate the range of the F tuba by almost an octave in both directions (Gieseler, Lombardi, and Weyer 1985, p. 78; Kennan 1970, p. 145; Blatter 1997, p. 180; Miller 2015, p. 128). This trend of misinformation is depicted in Fig. 42, which plots instrument ranges (by lowest stated pitch) against date of publication. The left-hand side of this chart (up to ca. 1945) shows the wide diversity of instrument names, descriptions, and pitches of instruments given by authors, depending on the instrumental traditions to which they had been exposed. What follows illustrates how such writings converged upon a middle ground, not because of any codification or propagation of knowledge (they are in no consistent manner more accurate or thorough than their predecessors, and indeed the outliers to this trend represent remarkably misleading modern descriptions), but rather owing to their assumptions that contemporaneous practices accurately reflect the organological and acoustic properties of the instruments they are describing without consulting primary sources. Walter Piston believes that the tuba has only been in use since 1875 (Piston 1969, p. 282), a theory repeated by Samuel Adler (Adler 2002, p. 350).

Sevsay makes greater attempts than most to describe the diversity of the tuba family, but entries of the "double (contrabass) tuba", "helicone [*sic*]", cimbasso, and ophicleide are lacking in detail and accuracy (Sevsay 2013, pp. 110, 113, 116). Value judgements are also frequently encountered: with regard to tuba mutes (which, in a previous generation, were regularly employed by composers such as Richard Strauss in *Ein Heldenleben* (1899) (Strauss 1899), Arnold Schoenberg in *Gurre-Lieder* (1913) (Schoenberg 1920 [1913]), and Igor Stravinsky in *Le sacre du printemps* (1913) (Stravinsky 1922 [1913])), it has been written that they are "clumsy affairs and may well be out of tune" (Del Mar 1981, p. 314), that they "render the timbre thin, nasal and distant" (Stiller 1985, p. 92), and that they produce "a dry, empty tone of little attraction" (Campbell, Greated, and Myers 2004, p. 185). The first publication to specifically address contemporaneous tuba performance practice is volume nine of Hans Kunitz's *Die Instrumentation*, which provides broadly accurate organological and acoustic fundamentals, but overlooks most instrumental practice and repertoire outside of the German-speaking world, and also states many assumptions as fact without providing sources, notably Červený's 'invention' of the 'contrabass tuba' in 1843 (see chapter 2.1) (Kunitz 1968, pp. 862–71).[103] Today, this work today is outdated in terms of methodology and level of rigour, and yet, its continued existence as the only reference work dedicated to orchestral tuba performance practice means that it is still cited in recent publications (see chapter 2.2).[104]

Such texts are in stark contrast to earlier generations' thorough, pan-traditional writings on the tuba family, from Berlioz's initial assessments in French (Berlioz 1844, Berlioz 1858) through Schubert's multiple texts in German (Schubert 1862, Schubert 1865, Schubert 1866) to Prout's extensive descriptions in English (Prout 1914), amongst many others. One cannot assert causal connection between these texts and the instrument-specific writing produced by composers of the time (as described in chapters one and two), but it is possible to observe a similar correlation between the manner of writings on the tuba family from the second half of the twentieth century noted above, and the employment of the instruments by composers of the same era. The post-war modernist generation pushed the aesthetic and technical boundaries of labrosones beyond those of the mid- to late nineteenth century for the first time, but utilisation of the tuba suffered from fundamental misunderstandings with regard to the diversity of the instruments and their individual technical capabilities, even from composers otherwise known for their skill in orchestration and astute handling of lesser-known instruments. In *Prometeo* (1981–85), Luigi Nono

103 Kunitz's text is dominated by the author's discussion regarding tuba and bass trombone orchestration by Strauss and Wagner, commentary which itself has been subject to significant criticism (Ahrens 2019, pp. 247–74).

104 Bevan 2000 is a more extensive and musicologically rigorous guide to tuba organology, but is not intended to be used as a practical guidebook for performers or composers.

demands pitched air sounds (Nono 1985, I: b. 149), and Gérard Grisey's *Quatre chants pour franchir le seuil* (1998–99) includes microtonal tuning (Grisey 1999, IV: b. 53), both of which are impossible to create in the manner they desire, not because of performance practice limitations, but owing to the fundamental acoustic properties of the tuba (see Annex, pp. 86–97, 98–103). They also demand doubling instruments (both require euphonium, while Nono also requires alto trombone) that are not commonly played by tubists. Other composers, wary of the unknown, limit their scope: Pierre Boulez's 37-note tuba part in *Cummings ist der Dichter* (1986) (Boulez 1986) is not anomalous in his writing for the instrument, while at the other extreme, Wolfgang Rihm wrote a significant tuba part in *Jagden und Formen* (1995/2008), but it is remarkably simple in comparison with the extreme demands made on every other instrument in the ensemble (Rihm 2008).[105] Helmut Lachenmann's concerto *Harmonica* (1981/83) demonstrates a more nuanced and thorough awareness of the tuba than observed in any work before or since (Lachenmann 1983), but in his more recent ensemble work *Concertini* (2005), even he assumes that the tuba has the same harmonic structure as the trombone, and thus writes multiphonics that cannot be produced (Lachenmann 2005, b. 373–76; see also Annex, p. 116). Logistical oversights are also commonplace: Rebecca Saunders in *Nether* (2016–17) demands the insertion of a mute, a process which is generally neither quiet nor unnoticeable, in a bar of otherwise almost complete silence (Saunders 2017, b. 167), as did Igor Stravinsky in *Symphonies of Wind Instruments* (1920) almost a century earlier (Stravinsky 1952 [1920], 1 bar before Fig. 74). Such parts generally only exist in the first place because a tubist was present in the ensemble for which the music was being written. When performing such works today, while thankful that there is a part for tuba at all, I am also disappointed that the respective tubists' relationships with their instrument was not developed sufficiently in order to allow the composer to fully utilise its sonic potential.

Conclusion: The role of the tubist

In these and countless other instances of the tuba being acoustically misunderstood or otherwise technically mishandled, one could reasonably argue that a significant responsibility ought to be borne by the performer who premiered the work. Some nineteenth and early-twentieth-century tubists could, on occasion, directly engage with and even influence composers in their writing for

105 Many nineteenth-century composers were also limited in their awareness and understanding of the tuba family, though commonly-cited examples are often lacking in rigour. Most infamously, Antonín Dvořák's Symphony No. 9 *From the New World* (1893) has a tuba part with only fourteen notes (Dvořák 1894 [1893]) (see anecdotal commentary in Del Mar 1981, p. 308 and Bevan 2000, p. 335), but examination of the manuscript shows a considerably more extensive part that was either removed or missed by a copyist when making the first edition (Dvořák n.d. (1893)).

their instrument, but these were very much exceptional cases. Wagner's desire in 1846 to hire a tubist that could also play double bass (see chapter 1.4) was born out of his frustration from working with military bandsmen that were untrained in orchestral performance practice (cited in Aringer 2019, pp. 279–80), yet such bandsmen were frequently used by orchestras up until the mid-twentieth century. Bevan notes that "tubists at the time [he] began [his] career in the late 1950s consist[ed] principally of a series of ex-military bandsmen who were very agreeable, who turned up at rehearsal dressed like bank clerks, who rarely talked, and whose playing was mainly inaudible", later describing a teacher as "the last of the non-playing tuba players" (Bevan 2000, p. 391). Over the last half century, however, following the rapid introduction of military instruments into the previously rarefied realm of orchestral labrosone practice, this situation has changed dramatically. The majority of symphony and opera orchestras have at least one full-time tubist, and tuba professors can be found at pedagogical institutions across the world. Unlike most of their nineteenth- and early-twentieth-century predecessors, tubists today are in privileged positions of being able to work directly with composers and aid them in their writing; a recent study showed that 69% of composers surveyed who had written for the tuba family had consulted an instrumentalist directly (Hynds 2019b, p. 41). In order to provide composers with the information required for them to fully utilise the tuba within their sound-worlds, the tubist needs to be able to answer questions regarding their instruments' organological development (Why are your tubas in these pitches? What do these valves and slides do?), acoustic properties (How are sounds made? How can you control them?), and technical capabilities (Can you make this sound? If not, is it physically impossible, or does it require more practice?). However, owing to contemporary universal non-historically-apprised performance practice, the assumption of such responsibilities cannot be relied upon. Composers often work with specific musicians, but collaborations can result in idiosyncratic parts that are designed to fit the capabilities of a certain instrumentalist rather than an instrument, with results ranging from Nono's unique combination of instruments for *Prometeo*, as noted above, to Vaughan Williams's concerto (see chapter 2.6), where the original soloist convinced the composer to remove the highest notes from the cadenza that he was struggling to produce (Gourlay 2008, p. 6). Contexts are also often missing: Vinko Globokar writes fingering combinations for air sounds through removed valve slides in *Juriritubaïoka* (1997) that, owing to the instrument's mechanics (see Annex, p. 148) are only possible on the model of tuba for which the piece was written, but the model is not specified (Globokar 1997, pp. 4–6). Similar consequences can be observed through the tubist-composers who have specialised in writing music for themselves, notably Melvyn Poore, Robin Hayward, Aaron Hynds and Gérard Buquet. In

any case, when working with an instrument where contemporary practice is as self-determined as witnessed with the tuba family, knowledge of organological and acoustic contexts is essential in order to prevent works only ever being performable by that single, individual tubist.

In 2017, Herbert Heyde wrote that:

> The modern tuba shares characteristics of Wieprecht's tuba (the generally wide bore) and the bombardon (conical bore, wide flaring bell), but the sound qualities follow more the line of the bombardon. It remains the task of organology to fill the history of both instruments with measurements and bore profiles, to reject or verify this hypothesis. (Heyde 2017, p. 23)

While such organological work has yet to be comprehensively undertaken,[106] it also remains the task of performance-practice research to examine this hypothesis. A quantitative approach can provide data to support such an argument, but does little to inform the contexts in which this debate arises, namely the practice of using instruments based on mid-to-late-twentieth-century traditions with little to no awareness of, or relation to their historical predecessors, while fundamental flaws and value judgements still persist in commonly found literature, and composers are unable to define the capabilities of the instrument (or even *which* instrument) they are writing for. If numerical acoustic data, such as bore profiles, are not supported by either an awareness of which type of instrument is associated with what repertoire, or knowledge of the impact these measurements can have on the employment of said instruments, such research will be largely irrelevant for both performers and composers. Some may use such data to attempt to prove that a certain instrument was a 'success' or a 'failure' (or, for example, that the valved ophicleide is a "broken promise" (Keyser 2019, p. 85)); while perhaps a valid form of organological inquiry, such pursuits are not helpful when aiming to understand how performers and composers can clearly and constructively interact and engage with said instrument. Quantitative analysis provides important empirical evidence to enlighten such discussions, but in order to foster critical awareness in performance practice studies, I propose additional means of analysis in order to provide contextualisations and translations that can be applied to practical, qualitative circumstances.

106 At the time of writing, measurements and bore profiles of tuba family members are being taken, notably by Arnold Myers, who also co-developed a unified quantification of such measurements in order to compare relative timbral possibilities of labrosones, the Brassiness Potential Parameter (Campbell, Gilbert, and Myers 2021, p. 280). Some initial results, with particular regard to tuba predecessors, have been published (ibid., also Keyser 2019, pp. 86–87), but have yet to be comprehensively measured, collated, and published in reference to modern or historical tubas.

PART TWO: Methods of (re)connecting instruments, performers, and composers

The tuba performance practice revolution of the mid-twentieth century had the effect of both limiting interpretative methods of older music, and stifling possibilities for creation of new music. Through my practice, I have created new resources which can aid in developing both reflexive, critical evaluation methods from performers, and active, creative modes of engagement from composers. As the developments described in chapter three have become institutionalised over the last fifty years, opportunities today to encounter instruments from previous eras vary from rare to non-existent. I have therefore produced audio-visual recordings to provide tubists with practical demonstrations of instruments that were employed when earlier repertoire was first performed, as well as examples of how they differ from the tubas used today. The modern self-determined approach to instrumental choice has contributed to a lack of incentive for tubists to fully understand the workings of their own tubas. My guidebook presents the instruments to performers in clear, universal terms, and is also of use to composers for the facilitation of deeper musical connections with tubas and tubists. Finally, I have also made recordings of excerpts from existing literature alongside newly commissioned works, which illustrate the techniques and technologies available from the modern tuba family, and demonstrate the extent to which performer-composer collaboration can be built upon by the presence of such a guidebook.

4: Resources for interpretation of historical repertoire

4.1 Recordings of orchestral repertoire on historical instruments

Despite a lack of consistent organological developments or regular interactions between tubists and composers, the history of tuba family orchestral practice presents a series of distinct time- and location-specific instrumental employments. Historically and geographically sensitive application of the instruments to appropriate repertoire can illuminate connections that may help inform tubists with regard to their own interpretations. These connections are not claims of ‘right’ or ‘wrong’ methods of interpretation; my methodologies employed here are not designed to engage directly with arguments regarding authenticity, but rather to establish the contexts and knowledge bases upon which such debates can be grounded. This perspective is particularly important in the context of modern self-determined orchestral tuba performance practice, which often leads to conclusions that an analysis of instrumental choice is of little relevance. It is indeed logistically unfeasible to have all the possible instruments available for every piece, even if one was trained in

playing them all. Phillips and Winkle describe a typical contemporary attitude to employment of the tuba family:

> The lack of a common nomenclature or definitive identification of the many designs, bore sizes, and configurations of low brass instruments produced by the different manufacturers between 1830 and 1900 has caused considerable confusion among both composers and performers. To this day, there are often differing opinions as to precisely what specific instrument any given composers may have intended for a particular composition. Fortunately, today's tubist, with the modern instruments available to him [*sic*], is capable of meeting the challenges presented by the various compositions of the period. (Phillips and Winkle 1992, p. 8)

Even Clifford Bevan, himself an ophicleide and serpent player, wrote that "the transition from ophicleide to Small C Tuba in French orchestras or ophicleide to euphonium to compact F tuba in England was probably the result of the pursuit of secure intonation" (Bevan 2000, p. 507). Meanwhile, Jennifer Higdon, while writing a tuba concerto in 2017, noted that she saw in the orchestra "improvements in some instruments", expressing that "we now have multiple-size tubas, and that makes a big difference in the repertory, whether you've got the low end or the high end of the tuba" (Tibbetts 2018, p. 277), a statement contrary to the history described in Part One. An alternative perspective is proposed by Bruce Haynes:

> The instruments of one period are not "better" in some absolute sense than their counterparts in other periods. The traverso […] is not "better" than the Boehm flute except in one way: it is much easier to play eighteenth-century music in eighteenth-century style on an eighteenth-century instrument. (Haynes 2007, p. 152)

Thus, rather than viewing new instruments as superior substitutes for weaker predecessors, older instruments can be viewed as stronger than their modern successors at playing the music written for them in a stylistically appropriate way. This approach requires recognition of the specific connections between instruments and repertoire, an awareness which is commonly found and applied practically by many flautists, and indeed many other instrumentalists, but, as outlined above by Phillips and Winkle, is clearly lacking in tubists. To address this situation, I have recorded a broad selection of common practice orchestral repertoire featuring members of the tuba family using a selection of historically and practically appropriate instruments, the choices of which were informed by my research as detailed in Part One.

In making assessments of these connections, I needed to consider many parameters, not least the widely varying extent to which relationships existed between an instrument and a particular location, composer, or work. Some are clear: the Opéra de Paris between 1819–75 exclusively used

a keyed ophicleide (see chapter 2.5); Verdi only wrote two operas following the invention of the 'Verdi' cimbasso (see chapter 2.4); the 'Wiener' tubas used in Bayreuth and Vienna have been well documented (see chapter 2.1). Other links are, at best, nebulous: Italian works of the 1830s could have featured a keyed or valved ophicleide, or an 'early' cimbasso (see chapters 1.2, 1.3); German premieres of the 1840s could have featured a keyed or valved ophicleide, or a 'Berliner' tuba (see chapter 1.4). The availability and playability of relevant instruments was also unpredictable. An historically accurate English bass horn, late 'Wiener' tuba, 'Verdi' cimbasso, French C tuba, and English F tuba were sourced,[107] but the use of modern reproductions of keyed and valved ophicleides, serpent, and 'early' cimbasso were necessary, owing to the scarcity of fully functioning originals. The 'Berliner' and early 'Wiener' tubas used were later models, as earlier instruments rest in inaccessible collections, while authoritative documentation regarding the E-flat or C bombardons that might have been used orchestrally, if at all, is lacking (see chapters 2.1, 2.3). Such inconsistencies do not negate the function of this investigation, as these resources demonstrate a general type of historically and geographically appropriate instrument, as well as the variety and diversity of such instruments as compared with today's broadly homogeneous family of tubas (see chapter 3.1). For example, the early 'Wiener' tuba used in Table 7 (Fig. 26) is of a slightly wider bore and bell size than Leopold Uhlmann's instrument built a few years earlier (Fig. 25), but such differences are minor in comparison to those between both of these instruments and the bombardons of that time (Fig. 24), and in comparison with instruments in use today (see chapter 4.2).[108] I also needed to make compromises with respect to acoustic constraints, which made it impossible to record all of the instruments in the same space. Regarding subjective assessment of trumpet recordings, Gunter Ziegenhals concluded that "it is necessary to keep the influencing factors of the room, test piece, and musician constant in order to distinguish between the instruments […] the influence of the musician dominates over the instrument" (Ziegenhals 2010, pp. 148), later describing the order of influence (most to least) as "test piece, musician = room [at an equal level], instrument" (ibid., p. 153).[109] Therefore, by keeping the performer constant and

107 The English F tuba I used was likely played by Harry Barlow in the Hallé Orchestra (including premieres of music from Elgar (see chapter 2.6)), and the late 'Wiener' tuba used was built for use in Berlin in ca. 1918, and so was plausibly used in early performances of Berg's music (see chapter 2.2).

108 A similar principle was required with regard to mouthpiece selection. Few direct associations exist between mouthpieces and specific instruments, and so a pragmatic approach was necessary, including using some original mouthpieces (for example, with the 'Verdi' cimbasso), some copies of originals (for example, with the serpent and keyed ophicleide), and some modern mouthpieces selected according to historical sources (for example, Zamminer 1855, p. 310) and contemporary research (for example, Campbell 2019, pp. 280–84).

109 While the order of dominating factors changed between the other instruments included in his survey (guitar, violin and clarinet), in all cases, the instrument itself had the least noticeable effect on the subjective assessment of the performance (ibid.).

selecting appropriate repertoire, it was possible to overcome acoustic compromises in order to make fair assessments. I chose representative repertoire written between 1817–1922 and recorded excerpts from them using thirteen types of instrument (Tables 1–13).

Table 1: Serpent

Composed	Premiered	Location	Composer	Work	Instrument details[110]
1824	1825	Paris	Berlioz	*Messe solennelle*	Built by Pierre Ribo in Brussels (2018) after anon. (ca. 1801). Nominal pitch: C2. Interfaces: 6 holes; 3 keys: B, F-sharp, C-sharp. Source: Private ownership.
1830	1830	Paris	Berlioz	*Symphonie fantastique*	
1830	1832	Berlin	Mendelssohn	Symphony No. 5 *Reformation*	
1834	1836	Düsseldorf	Mendelssohn	*Paulus*	
1837–40	1842	Dresden	Wagner	*Rienzi*	

Table 2: English bass horn

Composed	Premiered	Location	Composer	Work	Instrument details
1826	1826	Bad Doberan	Mendelssohn	*Nocturno*	Built by Griesling & Schlott in Berlin in ca. 1830. Nominal pitch: C2. Interfaces: 6 holes; 4 keys: B, F-sharp, D, C-sharp. Source: Collection Günter Hett.
1826	1827	Stettin [Szczecin]	Mendelssohn	*Ein Sommernachtstraum* (overture)	

Table 3: 'Early' cimbasso

Composed	Premiered	Location	Composer	Work	Instrument details
1817	1817	Naples	Rossini	*Armida*	Built by Nicholas Perry in St. Albans (1998) after Ubaldo Luvoni (ca. 1826). Nominal pitch: C2. Interfaces: 6 holes; 3 keys: B, F-sharp, C-sharp. Source: Manufacturer.
1820	1820	Naples	Rossini	*Maometto II*	
1831	1831	Milan	Bellini	*Norma*	
1833	1833	Florence	Donizetti	*Parisina*	
1840	1840	Milan	Verdi	*Un giorno di regno*	

Table 4: Keyed ophicleide

Composed	Premiered	Location	Composer	Work	Instrument details
1826	1826	Paris	Rossini	*Le siège de Corinthe*	Built by Wessex in China (ca. 2015) after Gautrot aîné (ca. 1840). Nominal pitch: B-flat 1. Interfaces: 11 keys: G-sharp, G, F-sharp, F, E, D-sharp, D, C-sharp, C, B, A. Source: Private ownership.
1845 (rev.)	1845	Paris	Berlioz	*Symphonie fantastique*	
1836	1836	Paris	Meyerbeer	*Les Huguenots*	
1840–41	1843	Dresden	Wagner	*Der fliegende Holländer*	
1845–46	1846	Paris	Berlioz	*La damnation de Faust*	
1855	1855	Paris	Verdi	*Les vêpres siciliennes*	
1867	1867	Paris	Verdi	*Don Carlos*	
1874	1874	Venice	Verdi	*Requiem*	

110 Keys and valves are listed in order from mouthpiece to bell. Valve lengths are given in approximate semitone displacements from nominal pitch, and decimal point values are approximate and variable. For further details, see Annex, pp. 46–55.

Table 5: Valved ophicleide

Composed	Premiered	Location	Composer	Work	Instrument details
1842	1843	Potsdam	Mendelssohn	*Musik zu Ein Sommernachtstraum*	Built by Friedbert Syhre and Takao Nakagawa in Leipzig (2007). Nominal pitch: F1. Interfaces: 5 valves (rotary): 2.6, 2, 1, 3, 5. Source: Manufacturer.
1843	1843	Leipzig	Schumann	*Das Paradies und die Peri*	
1840–41	1843	Dresden	Wagner	*Der fliegende Holländer*	
1844–47	1847	Vienna	Flotow	*Martha*	
1849	1849	Naples	Verdi	*Luisa Miller*	
1851	1851	Venice	Verdi	*Rigoletto*	
1853	1853	Rome	Verdi	*Il trovatore*	
1862	1862	St. Petersburg	Verdi	*La forza del destino*	
1870–71	1871	Cairo	Verdi	*Aida*	

Table 6: 'Berliner' tuba

Composed	Premiered	Location	Composer	Work	Instrument details
1843–45	1845	Dresden	Wagner	*Tannhäuser*	Built by Ahlberg & Ohlsson in Stockholm (ca. 1860). Nominal pitch: F1. Interfaces: 5 valves (*Berliner-Pumpen*): 2.6, 5, 2, 1, 4. Source: Collection Louis Jake Klein.
1848/54	1849	Weimar	Liszt	*Ce qu'on entend sur la montagne*	
1846–48	1850	Weimar	Wagner	*Lohengrin*	
1857–58	1858	Prague [?]	Smetana	*Richard III*	
1868	1868	Munich	Wagner	*Die Meistersinger von Nürnberg*	
1865–68	1869	Leipzig	Brahms	*Ein deutsches Requiem*	

Table 7: Early 'Wiener' tuba

Composed	Premiered	Location	Composer	Work	Instrument details
1853–54	1876	Bayreuth	Wagner	*Das Rheingold*	Built by Peter Emanuel Schmidt in Copenhagen (ca. 1880). Nominal pitch: F1. Interfaces: 5 valves (rotary): 2, 1, 2.7, 1.3, 5. Source: Collection Louis Jake Klein.
1854–56	1876	Bayreuth	Wagner	*Die Walküre*	
1877	1877	Vienna	Brahms	Symphony No. 2	
1880	1881	Breslau [Wrocław]	Brahms	*Akademische Festouvertüre*	
1883	1884	Leipzig	Bruckner	Symphony No. 7	
1884–88	1889	Budapest	Mahler	Symphony No. 1	
1888–89	1890	Eisenach	Strauss	*Tod und Verklärung*	
1884–92	1892	Vienna	Bruckner	Symphony No. 8	

Table 8: Bavarian C bombardon

Composed	Premiered	Location	Composer	Work	Instrument details
1853–54	1869	Munich	Wagner	*Das Rheingold*	Built by an anonymous Bavarian manufacturer (ca. 1880). Nominal pitch: C1. Interfaces: 4 valves (rotary): 1, 2, 3, 4. Source: Collection Louis Jake Klein.
1854–56	1870	Munich	Wagner	*Die Walküre*	
1856–71	1876	Bayreuth	Wagner	*Siegfried*	
1869	1876	Bayreuth	Wagner	*Götterdämmerung*	

Table 9: Late 'Wiener' tuba

Composed	Premiered	Location	Composer	Work	Instrument details
1888–94	1895	Berlin	Mahler	Symphony No. 2	Built by Augustus Kley in Berlin (ca. 1918). Nominal pitch: F1. Interfaces: 6 valves (rotary): 2, 1, 1.6, 2.7, 1.3, 5. Source: Collection Louis Jake Klein.
1897–98	1899	Frankfurt	Strauss	*Ein Heldenleben*	
1894–96	1903	Vienna	Bruckner	Symphony No. 9	
1903–04	1906	Essen	Mahler	Symphony No. 6	
1906–08	1909	Dresden	Strauss	*Elektra*	
1900–10	1913	Vienna	Schoenberg	*Gurre-Lieder*	
1914–22	1925	Berlin	Berg	*Wozzeck*	

Table 10: Bohemian E-flat bombardon

Composed	Premiered	Location	Composer	Work	Instrument details
1869–76	1877	St. Petersburg	Borodin	Symphony No. 2	Built by V. F. Červený & Synové in Hradec Králové (ca. 1919). Nominal pitch: E-flat 1. Interfaces: 4 valves (rotary): 2, 1, 3, 5. Source: Collection Louis Jake Klein.
1877	1878	Moscow	Tchaikovsky	Symphony No. 4	
1880	1882	Moscow	Tchaikovsky	*1812 Overture*	
1867	1886	St. Petersburg	Mussorgsky	*Night on a Bare Mountain*	
1888	1888	St. Petersburg	Rimsky-Korsakov	*Scheherazade*	
1893	1893	St. Petersburg	Tchaikovsky	Symphony No. 6	
1895	1896	St. Petersburg	Glazunov	Symphony No. 5	
1906–08	1908	St. Petersburg	Rachmaninoff	Symphony No. 2	

Table 11: 'Verdi' cimbasso

Composed	Premiered	Location	Composer	Work	Instrument
1887	1887	Milan	Verdi	*Otello*	Built by Romeo Orsi in Milan (1902–18). Nominal pitch: B-flat 0. Interfaces: 3 valves (rotary): 2, 1, 3. Source: Music Instrument Museums Edinburgh.
1890	1890	Rome	Mascagni	*Cavalleria rusticana*	
1892	1892	Milan	Leoncavallo	*Pagliacci*	
1893	1893	Milan	Verdi	*Falstaff*	
1899	1900	Rome	Puccini	*Tosca*	

Table 12: French C tuba

Composed	Premiered	Location	Composer	Work	Instrument details
1886–88	1889	Paris	Franck	Symphony in D	Built by Couesnon in Paris (after 1882). Nominal pitch: C2. Interfaces: 6 valves (Périnet): 2, 1, 3, 5, 1.3, 6. Source: Music Instrument Museums Edinburgh.
1903–05	1905	Paris	Debussy	*La mer*	
1910–11	1911	Paris	Stravinsky	*Petrushka*	
1910–13	1913	Paris	Stravinsky	*The Rite of Spring*	
1922	1922	Paris	Mussorgsky/Ravel	*Pictures at an Exhibition*	

Table 13: English F tuba

Composed	Premiered	Location	Composer	Work	Instrument details
1890	1891	Birmingham	Dvořák	*Requiem*	Built by Joseph Higham in Manchester (ca. 1904). Nominal pitch: F1. Interfaces: 5 valves (Périnet): 2, 1, 3, 1.3, 5. Source: Music Instrument Museums Edinburgh.
1899	1899	London	Elgar	*Variations*	
1909–11	1911	London	Elgar	Symphony No. 2	
1909	1912	London	Schoenberg	Five Orchestral Pieces	
1913–14	1914	London	Vaughan Williams	Symphony No. 2 *London*	
1914–16	1918	London	Holst	*The Planets*	

These instruments are inaccessible to tubists at large—those used in Tables 2 and 6–13 are part of public or private instrument collections, while those in Tables 3 and 5 were sourced directly from the manufacturer—and so, contemporary assessments often rely upon second- or third-hand judgements, which tend to treat the instruments as dead artefacts (Morgan 2006, Green 2015). Despite a lack of first-hand experience, many argue for their substitution with modern instruments (Demy 2014, Kleinsteuber 2017, Peterson 2018, Gourlay 2022), in a similar fashion to derogatory descriptions written of the serpent after it had fallen out of common use (Hofmann 1893, p. 51; Prout 1897, p. 242; Teuchert 1911, p. 116; Westrup 1927, pp. 635–37). Adam Carse, however, also writing before the late-twentieth-century serpent "revival" (Bevan 2000, p. 119) noted that:

> When anyone now picks up an old serpent […] the sounds issuing from it will most likely provoke either laughter or else amazement that such a contrivance could ever have been used for musical purposes; when the player is not used to the instrument, does not understand the necessary lip technique, knows nothing about its tone-character, and perhaps expects it to sound like a tuba or trombone, the serpent is all the less likely to do itself justice. (Carse 1965, p. 274)

As tuba predecessors become increasingly accessible, this perspective is spreading, but is yet to become universal. Modern serpents and keyed ophicleides are made in Europe, Asia and North America, and prominent soloists range from Patrick Wilbart (serpent) in France to Nick Byrne (ophicleide) in Australia, yet almost all orchestras still require all repertoire be performed exclusively on the tuba.[111] Critical reflection on 'tuba' parts remains non-existent outside of a few specialist ensembles such as Les Siècles (Saint-Saëns 2020), Les Dissonances ("Bruckner …" 2020), and MusicaAeterna ("Tchaikovsky …" 2018), though these ensembles often make significant uncritical compromises (see footnote 102).[112] These recordings, therefore, provide a means of

111 33 of 109 standardised excerpts for tuba orchestral auditions were either composed for or first performed using a serpent, bass horn, ophicleide, or 'Verdi' cimbasso (Evans and Pröpper 2002) (see also footnote 93).

112 Notably, one article on "the informed approach" covers serpent and ophicleide performance practice in detail, yet makes no attempt at all to comment on historically informed *tuba* performance practice (Bevan 1998, pp. 34–35).

broadening the reach of critical approaches to the tuba family, and also, when practical access is lacking, to demonstrate how these instruments compare with those used today (see chapter 4.2).

Even in the context of organological study, practical advice can resort to uncritical assumptions. Arnold Myers, in an otherwise analytically rigorous article, states that "the ideal tuba for ensemble playing would have the widest practicable bore and the lowest Brassiness value" (see footnote 106) (Myers 2019c, p. 173), without describing what sort of tuba is in question, or indeed why such an "ideal" tuba should, or even could be sought-after. Herbert Heyde's pioneering research includes references to "the typical dullness of the serpent's sound" (Heyde 2015, p. 26), describes the sound of one valved ophicleide as "dull, covered, and a bit musty" (Heyde 1980, p. 63), and another as "not having the sound of a tuba" (ibid., p. 69). Renato Meucci's groundbreaking study on the cimbasso concludes, in a one-page reflection on "the performance of cimbasso parts", that a modern F tuba should be used for almost all works, and that ultimately "we should trust […] the good sense of the performer" (Meucci 1996, pp. 161–62).[113] By providing audio-visual resources to supplement such historical and quantitative research, I am aiming to provide contexts in order to aid fellow performers in strengthening their development of this 'good sense'. In combination with the instrument-, time-period-, location-, and composer-specific connections of the tuba family as detailed in chapters one and two, these recordings offer a level of rigour that can practically contextualise organological research projects. In relation to contemporary tuba performance practice as outlined in chapter three, they can also enable questioning of how such practices arose, how they relate to the practices customary when this music was first heard, and how they can evolve in the future, as demonstrated via comparative examples.

4.2 Comparisons between historical and modern instruments

Limitations on contemporary orchestral tuba performance practice are imposed by a combination of pedagogical background and the retention of post-war tradition. Students learn to play instruments determined by geographic or linguistic boundaries (see chapter 3.1), and new orchestral players are selected largely for their ability to emulate their predecessor. Other constraints are minimal, given that tubas are relatively inexpensive (especially for state-supported music colleges, symphony orchestras, and opera houses), yet ventures beyond one's surroundings

113 This situation is commonly encountered across broader areas of labrosone musicology: the *Cambridge Encyclopedia of Brass Instruments* (Herbert, Myers, and Wallace 2019) provides comprehensive lists of instrument collections, manufacturers, and early didactic works, but not, for example, living composers who have written for labrosones, renowned places of study, or notable orchestral section members (see Adler-McKean 2019, p. 759).

are made close-to impossible; current practice dictates that, for example, to work in a German orchestra, one *must* play a five- or six-valved F tuba and a four valve B-flat tuba, and in the UK one *must* play a four-valved E-flat tuba and a five-valved C tuba. This, despite the fact that the basic technical principles are transferable with a minimum of effort, even with regard to older tuning systems such as the French *doigté ministériel* (Myers 2019b, p. 150) (see Fig. 35, also Table 12) and Bavarian *katholische Griffe* (Myers 2019a, p. 97) (see Fig. 24, also Table 8). Instruments with holes and/or keys require additional practice, but twentieth-century pedagogy has rather encouraged tubists to invest their time mastering music using only the instruments that happen to be to hand.[114] Not only do these instruments often bear little relation to those upon which the music was originally played, but are also often more technically challenging. Arnold Jacobs famously played 'Bydlo' from Ravel's orchestration of *Pictures at an Exhibition* on a B-flat tuba (Taylor 1999, p. 6), an instrument whose fundamental pitch is over an octave lower than the French C tuba for which it was written. While the work is playable with this tuba, it requires significantly greater technical skill as one is forced to exceed the bell cut-off frequency, which significantly lowers pitch stability (see chapter 5.1). This is not an isolated incident; for example, Alexei Lévachkine writes:

> Amongst the Russian tuba players, it became a tradition to always strive to perform all parts that are written for various types of tuba on a B-flat contrabass instrument. Many, with varying success, managed these "acrobatic" stunts, which were often provoked by conductors. (Lévachkine 1999?, p. 9)

Jacobs himself, meanwhile, said that:

> Intelligence should not be diverted inwards (in the terms of analysis): put the priority on the musical idea. There must be many well-defined sounds in the brain in order to produce musical sounds. (Reproduced in Little 1999, p. 14)

By suggesting that there is no worth in prioritising the 'inward' analytical contexts that surround a piece of music, any influences on the processes of interpretation are limited to the immediate experiences that surround any particular performance. Such dedication to 'acrobatic stunts' is rooted in pursuits of technical virtuosity that arose in labrosone performance practice following the invention of the valve, which enabled previously unattainable speeds of articulation and levels of security in tonal control. While military movements grew in influence and encouraged competition between the various families of the valved instruments that they had adopted, these pursuits only increased in popularity. As ever-larger band instruments began entering the orchestra (see chapter 3.1), a crossover in practice was inevitable, despite the contrast with instruments

114 In an early advertisement for the (valved) bombardon, Othmar Berndl argued that it had "greater worth" than the (keyed) ophicleide "because an instrument with multiple keys is always a deterrent to the learner" (Berndl 1833a, p. 689).

used by orchestral musicians one or two generations earlier. As early as 1882, Schafhäutl likened the difference between the serpent and Červený's *Kaiser-Tuba* (see chapter 2.1) to that between Mozart's keyboard instruments and "our modern giants" (Schafhäutl 1882, col. 879). Fast-forward to today, an "historical perspective" discussion on Wagner's *Ein Faust-Overtüre* disregards the fact that the lower labrosone part was written for a serpent, knowledge which has been widely available since 1986 (see chapter 1.4) (Kelsick 2021, pp. 78–83).[115] The effect of modern labrosones on contemporary practice is under discussion by some (Willis 1997a, pp. 175–76; Bevan 2000, pp. 488–89), but the impact of such debates can only be supported and deepened via comparative audio-visual material. I have therefore provided thirty-nine recordings of repertoire performed using one or more instruments that may have been used for early performances of each work, juxtaposed with performances on instruments that could plausibly be employed for the respective parts today (Table 14). While individually forming demonstrations of the extent to which modern instruments can recreate the sound of their predecessors, taken as a whole, these examples show how concepts of timbre, dynamic, and articulation have evolved since these works were first performed, and the extent to which this evolution varies, depending on a variety of factors, including geographical location, contemporaneous nomenclature, and pedagogical tradition.

Table 14: Comparative examples

Ref.	Prem.	Location	Composer	Work	Historical Instrument	Modern instrument
4.2.1	1817	Naples	Rossini	*Armida*	'Early' cimbasso	Euphonium
4.2.2	1826	Paris	Rossini	*Le siège de Corinthe*	Keyed ophicleide	Euphonium
4.2.3	1827	Stettin [Szczecin]	Mendelssohn	*Ein Sommernachtstraum* (overture)	English bass horn; Keyed ophicleide	Euphonium
4.2.4	1830/ 1845	Paris	Berlioz	*Symphonie fantastique*	Serpent	Euphonium
4.2.5	1831	Milan	Bellini	*Norma*	'Early' cimbasso	'Verdi' cimbasso [new]
4.2.6	1836	Düsseldorf	Mendelssohn	*Paulus*	Serpent	Basstuba-style F tuba
4.2.7	1836	Paris	Meyerbeer	*Les Huguenots*	Keyed ophicleide	Euphonium
4.2.8	1840	Milan	Verdi	*Un giorno di regno*	'Early' cimbasso	'Verdi' cimbasso [new]
4.2.9	1842	Dresden	Wagner	*Rienzi*	Serpent	Basstuba-style F tuba
4.2.10	1843	Dresden	Wagner	*Der fliegende Holländer*	Keyed ophicleide; Valved ophicleide	Basstuba-style F tuba
4.2.11	1843	Leipzig	Schumann	*Das Paradies und die Peri*	Valved ophicleide	Euphonium
4.2.12	1846	Paris	Berlioz	*La damnation de Faust*	Keyed ophicleide	Basstuba-style F tuba
4.2.13	1847	Vienna	Flotow	*Martha*	Valved ophicleide	Basstuba-style F tuba

115 This is despite a significant article in the same publication regarding the serpent itself (Hostiou 2021, pp. 55–65). Another article in this edition, on the topic of performance practice regarding Mahler's Second Symphony makes no attempt to provide any historical context (McCourt 2021, pp. 84–87).

Ref.	Prem.	Location	Composer	Work	Historical Instrument	Modern instrument
4.2.14	1850	Weimar	Wagner	*Lohengrin*	'Berliner' tuba	Basstuba-style F tuba
4.2.15	1862	St. Petersburg	Verdi	*La forza del destino*	Valved ophicleide	'Verdi' cimbasso [new]
4.2.16	1868	Munich	Wagner	*Die Meistersinger von Nürnberg*	'Berliner' tuba	Saxhorn-style E-flat tuba
4.2.17	1869/ 1876	Munich/ Bayreuth	Wagner	*Das Rheingold*	Bavarian C bombardon; Early 'Wiener' tuba	Saxhorn-style C tuba
4.2.18	1870/ 1876	Munich/ Bayreuth	Wagner	*Die Walküre*	Bavarian C bombardon; Early 'Wiener' tuba	Basstuba-style B-flat tuba
4.2.19	1874	Venice	Verdi	*Requiem*	Keyed ophicleide	'Verdi' cimbasso [new]
4.2.20	1877	St. Petersburg	Borodin	Symphony No. 2	Bohemian E-flat bombardon	Basstuba-style F tuba
4.2.21	1877	Vienna	Brahms	Symphony No. 2	Early 'Wiener' tuba	Saxhorn-style E-flat tuba
4.2.22	1878	Moscow	Tchaikovsky	Symphony No. 4	Bohemian E-flat bombardon	Saxhorn-style E-flat tuba
4.2.23	1884	Leipzig	Bruckner	Symphony No. 7	Early 'Wiener' tuba	Basstuba-style B-flat tuba
4.2.24	1890	Eisenach	Strauss	*Tod und Verklärung*	Early 'Wiener' tuba	Saxhorn-style C tuba
4.2.25	1892	Rome	Leoncavallo	*Pagliacci*	'Verdi' cimbasso [old]	'Verdi' cimbasso [new]
4.2.26	1893	Milan	Verdi	*Falstaff*	'Verdi' cimbasso [old]	'Verdi' cimbasso [new]
4.2.27	1893	St. Petersburg	Tchaikovsky	Symphony No. 6	Bohemian E-flat bombardon	Saxhorn-style C tuba
4.2.28	1895	Berlin	Mahler	Symphony No. 2	Late 'Wiener' tuba	Saxhorn-style C tuba
4.2.29	1896	St. Petersburg	Glazunov	Symphony No. 5	Bohemian E-flat bombardon	Basstuba-style B-flat tuba
4.2.30	1899	Frankfurt	Strauss	*Ein Heldenleben*	Late 'Wiener' tuba	Basstuba-style F tuba
4.2.31	1899	London	Elgar	*Variations*	English F tuba	Saxhorn-style E-flat tuba
4.2.32	1900	Rome	Puccini	*Tosca*	'Verdi' cimbasso [old]	'Verdi' cimbasso [new]
4.2.33	1905	Paris	Debussy	*La mer*	French C tuba	Saxhorn-style C tuba
4.2.34	1911	Paris	Stravinsky	*Petrushka*	French C tuba	Saxhorn-style E-flat tuba
4.2.35	1912	London	Schoenberg	Five Orchestral Pieces	English F tuba	Basstuba-style F tuba
4.2.36	1913	Vienna	Schoenberg	*Gurre-Lieder*	Late 'Wiener' tuba	Basstuba-style B-flat tuba
4.2.37	1914	London	Vaughan Williams	Symphony No. 2 *London*	English F tuba	Saxhorn-style C tuba
4.2.38	1918	London	Holst	*The Planets*	English F tuba	Saxhorn-style E-flat tuba
4.2.39	1922	Paris	Mussorgsky/Ravel	*Pictures at an Exhibition*	French C tuba	Euphonium

The self-determined nature of contemporary practice limits the universality of such comparative recordings. For example, I have performed Stravinsky's *Petrushka* using an E-flat tuba in the UK, an F tuba in Germany, and a C tuba in Scandinavia, while a B-flat tuba would probably be used in Russian orchestras. Parts for tuba predecessors are also performed using a wide variety of instruments, with some parts even being split between two musicians (see 4.2.39 discussed below). This comparative material, therefore, needed to reflect choices that could conceivably be made by professional tubists today, as well as an appropriate range of repertoire, given that choice of music is a parameter of primary importance when differentiating between labrosone recordings

(Ziegenhals 2010, p. 153). By demonstrating the fundamental differences between modern instruments and those of the nineteenth and early twentieth centuries, such audio-visual examples can enable tubists to look beyond uncritical practice traditions

The euphonium is seldom found in orchestras, as it is rarely played by tubists, and thus, generally requires contracting of a guest musician. However, it does have a role in orchestral performance practice, particularly in countries where smaller tubas are not often used, notably Russia and the UK. The narrow bore and resulting limited spectral content in low registers is well suited to recreating the timbre present in similar ranges from bass horns, such as those found in writing from Mendelssohn (4.2.3) and Meyerbeer (4.2.7), but its wide conical bell section fails to mimic a bass horn's bright higher registers, as required by Rossini (4.2.2) and Schumann (4.2.11). Strong articulation highlights differences in dynamic compass, particularly in comparison with the serpent, as demanded by Berlioz (4.2.4). This difference is even clearer when bass horns are substituted with an F tuba, as in later writing from Berlioz (4.2.12), and Flotow (4.2.13). The difference between bass horns and modern tubas is less noticeable at lower dynamics, as required by Wagner (4.2.10), but in comparison with his louder serpent writing (4.2.9), and also that from Mendelssohn (4.2.6), the F tuba's generation of strong, low spectral content above the lowest dynamics overpowers nuances in phrasing and articulation (although the difference in tonal and technical stability is also significant (see chapter 1.2)).[116] The euphonium's physical similarity to the French C tuba has led to it being used often for Ravel's high writing in 'Bydlo' (4.2.39), however, the modern instrument's wide conical bell form fails to emulate the French tuba's high spectral content which results from its shorter cone length and narrower taper, thus calling into question suggestions that this and similar repertoire is "suitable for euphonium" (Yeo 2021, p. 59). The 'Promenade' excerpt also demonstrates how ill-suited the euphonium is for recreating the strong, resonant low register demanded in Ravel's writing, and so, this excerpt (and, indeed, the whole work apart from 'Bydlo') is always performed today using a larger instrument.[117]

F tubas can effectively recreate the low register of 'Berliner' tubas, as demonstrated in *Lohengrin* (1850), the first labrosone part to go below the range of an ophicleide (4.2.14; see also chapter 1.4). However, as with the euphonium, the wide bore of modern F tubas results in significantly

116 The instrument is sometimes not used at all for Mendelssohn's serpent parts which double the more commonly-found contrabassoon (an inversion of early nineteenth-century practice, see chapter 1.2) and has been removed from the score of some non-critical modern editions of his music (Mendelssohn 2018 [1828]). I have performed Symphony No. 5 *Reformation* (1832) and *Paulus* (1836) on a variety of instruments (for example, see Mendelssohn 2017), and found that, for these parts, a keyed ophicleide blends effectively with a modern contrabassoon.

117 For a more detailed comparison of the euphonium and French C tuba, see Kleinstuber 2017, pp. 20–24. For a full recording of Ravel's orchestration of *Pictures at an Exhibition* using a French C tuba, see "Mussorgsky…" 2014.

more powerful spectral content at higher pitches and dynamics, and is particularly noticeable from the wide-tapered bell of a Saxhorn-style E-flat tuba (4.2.16). The narrower bore of the English F tuba (closer to that of a euphonium, see chapter 2.6) also creates a brightness and clarity, as demanded by Elgar (4.2.31) and Holst (4.2.38), that cannot be reproduced with a modern E-flat tuba. This timbre also cannot be emulated on a modern F tuba, as demonstrated by Schoenberg's music premiered in England (4.2.35), and even less so on a modern C tuba, which is often used today in Vaughan Williams's works (4.2.37), although in both cases, as with earlier comparisons with bass horns, differences in timbre are less evident at lower dynamic levels. The French C tuba's piercing upper register, which was demanded by Stravinsky (4.2.34), is also impossible to reproduce on modern tuba family instruments, yet the lower register is well-imitated by the modern C tuba, with Debussy's employment of the French instrument (4.2.33) well-suited to the modern definition of a 'contrabass' tuba (see below). Bohemian E-flat bombardons were designed for use in bands before being appropriated by Russian orchestras (see chapter 2.3), and their accurate substitution by modern instruments in music from Borodin (4.2.20), Tchaikovsky (4.2.22, 4.2.27) and Glazunov (4.2.29) exemplifies a similar genealogy.[118] Nevertheless, the latter of these works in particular, also demonstrates, as discussed earlier with regard to 'Bydlo', how the largest modern tubas struggle to securely produce the higher register demanded by these composers (cf. Del Mar 1981, p. 303). This variety of success in substitutions between works demonstrates the consequences of instrumental choice based on pedagogical training without reflection upon the instrument for which the music was originally written.

Since the earliest tubas were built, various labrosones have been described as 'contrabass' instruments (see chapter 2.1), with traditional pitch notation suggesting its application to instruments which play in the "contra octave" (Helmholtz 1877, p. 30) (C1–B2). However, ever since the equivocation of the serpent and contrabassoon (see chapter 1.2), the term has been applied to spectral content rather than absolute pitch. Analysis of the term 'contrabass tuba' can therefore aid in distinguishing between differing concepts of timbre via employment of various instruments. This can primarily be observed by comparing the term's use by Wieprecht, Wagner, and those that followed in Austria and Germany through to the early twentieth century (see chapter 2.2), and its application to instruments today, which descend either from Červený's *Kaiser-Tuba* (primarily in B-flat), or from American saxhorns (primarily in C) (Yeo 2021, p. 38, see chapter

118 The B-flat tuba used in these recordings was built a few decades after the E-flat bombardon, with the E-flat instrument design not having changed significantly since the 1880s (see the E-flat tuba in Heyde 1987, p. 174), and the B-flat model closely resembling those used in orchestras today (see the Melton 195 "Fafner" (Melton 2022a)).

3.1).[119] Differences between these styles of instruments can be immediately heard in *Der Ring des Nibelungen* (4.2.17, 4.2.18), with the bright sound of the early 'Wiener' tuba contrasted against the dark resonances of both a contemporaneous Bavarian C bombardon that could have been used for the Munich premieres (see chapter 2.1), and of modern C and B-flat tubas. In making these specific recordings, through a combination of valve slide manipulation and pitch bending, I was also able to disprove the theory that a larger instrument and/or a sixth valve is required in order to create the G-flat 1 and other low pitches demanded by Wagner in these works (see chapter 2.1; in particular, footnote 44).[120]

Terminological confusion has led to contradictory implementation of instruments today for other works written for or premiered using one form of 'Wiener' tuba. Brahms's music was premiered by Otto Brucks with the same instrument used in Bayreuth (see chapter 2.2), but the composer referred to it as a bass tuba, and so the work is played today using an F or E-flat instrument (4.2.21). Bruckner and Schoenberg wrote for both bass and contrabass tuba, and their works today commonly use a tuba in C or B-flat (4.2.23, 4.2.36), whereas Strauss and Mahler usually indicated bass tuba, though these could be interchanged in printed materials (see chapter 2.2). Today, Mahler's symphonies are often played with a C or B-flat tuba (4.2.28), while an F or E-flat tuba tends to be used for Strauss's tone poems and operas (4.2.24, 4.2.30); *Elektra* states contrabass tuba (see chapter 2.2), yet the work's name is given to a modern model of F tuba, the Miraphone 481 "Elektra" (Miraphone 2022b).[121] The concept of a 'contrabass' timbre was thus greatly influenced by the introduction of military band instruments to the orchestra, once more exposing the significant inconsistencies that result from uncritical appropriation of instruments without reflection upon historical sources.

'Verdi' cimbassos were substituted with tubas in Italy from the 1920s onwards (see chapter 3.1), but by mid-century, new instruments were developed in Germany, first in 1959 as hybrid

119 The discrepancy between timbre and range is also demonstrated in an early advertisement for a B-flat *Kaiser-Tuba* that only reaches as low as F1 (Červený 1883, p. 8), in a manner similar to early American descriptions of a C tuba (Johnstone 1917, p. 46). In comparison, the earliest 'Berliner' tubas were described by their inventors as reaching C1 (Wieprecht and Moritz 1835, Fig. III), and by Berlioz shortly thereafter as reaching A0 (Berlioz 1843, p. 229).

120 Notes one semitone above the fundamental pitch of an instrument are the most difficult to produce with reliable intonation, owing to the nature of valve tuning systems (see Annex, pp. 51–55). I also encountered this situation with regard to an E1 in Rachmaninoff's Second Symphony (see footnote 73); in this case, the larger bore of the E-flat bombardon made intonation harder to correct through valve slide manipulation than with the early 'Wiener' tuba, and the significant pitch bending required resulted in a noticeable timbral modulation (see Table 10).

121 Miraphone's other tubas named after works with parts written for different instruments include the 281 "Firebird" (Miraphone 2022a) and 1281 "Petruschka" (Miraphone 2022c) F tubas. Melton similarly offers B-flat tubas named the 195 "Fafner" (Melton 2022a), and 196 "Fasolt" (Melton 2022b).

instruments with a slide and two valves, and by 1985 with only valves (Bevan 2000, pp. 419–20).[122] These modern 'Verdi' cimbassos are used indiscriminately today for performance of parts indicating *serpentone*, *cimbasso*, *oficleide*, *trombone basso*, and, in some cases, *basso tuba* (see chapter 2.4). The difference between these and older 'Verdi' cimbassos is analogous to that between nineteenth-century *Halb-* and *Ganzinstrumente* (see chapter 2.1): the old instruments were in narrow-bore (low) B-flat with three valves, whereas modern instruments are in wide-bore F with five or six valves.[123] This gives them the same effective range, but while the old instruments blend with contemporaneous Italian trombones, modern 'Verdi' cimbassos are built with a bore similar to modern 'contrabass' tubas (Bevan 2000, p. 420). Played quietly, the differences are negligible, as exhibited in Verdi's *Falstaff* (4.2.26), but at louder dynamics, the narrow-bore old instruments create the strong volume demanded in the lower register from Puccini (4.2.32) and in the upper register from Leoncavallo (4.2.25), but without the powerful lower spectral content inherent in modern instruments. The differences between the modern cimbasso and Italian instruments which predate the invention of the 'Verdi' cimbasso (see chapters 1.2, 1.3) are more significant. The modern 'Verdi' cimbasso's bright spectral content, omnipresent above the lowest volume levels, is in stark contrast to the darker, more malleable timbre of both the keyed and valved ophicleide, which were likely used in Verdi's Requiem (4.2.19) and *La forza del destino* (4.2.15), and contrasts even further when compared with the 'early' cimbasso, for example, in *Un giorno di regno* (4.2.8) and Bellini's *Norma* (4.2.5). This calls into question any suggestions that the modern 'Verdi' cimbasso is a "suitable substitute" for parts "that originally called for serpent or ophicleide" (Miller 2015, p. 124). Use of a euphonium for Italian bass horn parts has been recommended by others (Gourlay 2022, pp. 8–9), in, for example, Rossini's *Armida* (4.2.1). While forming a well-suited substitution to the narrow bore of bass horns in the low register, the euphonium produces much stronger low spectral content, and its wider implementation is limited by contemporary performance practice (see above). Verdi's desire for a fourth trombone in *Aida* (1871) (see chapter 2.4) has led to presumptions that a 'Verdi' cimbasso should be used in all of the composer's earlier operas (see, for example, Peterson 2018, p. 7; Gourlay 2022, p. 8), and this is, indeed, the most common approach taken by performers today. However, my practice here demonstrates how this approach does not do justice to the diversity of instruments used in Italy in

122 The lack of reference to any modern 'Verdi' cimbassos in Meucci 1989 (translated to English as Meucci 1996) suggests that re-adoption of the instrument was slower in the instrument's homeland than elsewhere in Europe.

123 Miller refers to "low cimbassos" (in C or B-flat) (Miller 2015, p. 124), however, there are no current manufacturers of cimbassos in the original low B-flat, and they have never been built commercially in C.

the nineteenth century, and how the sound they produce differs demonstrably from modern 'Verdi' cimbassos.[124]

New perspectives and reassessing practices

These recordings demonstrate the effect uncritical choices of instrument can have on potential timbre and dynamic range, and the variability between modern instruments in their effectiveness at assuming the role enacted by their historical predecessors. They also display the dramatic pedagogical and performance transformations that can result from relatively minor changes in terminology or technology, notably between narrow and wide bore tubing, between conical and flared bell forms, and between descriptions of instruments as 'bass' or 'contrabass'. Rather than basing decisions on dogmatic traditions, these resources present how repertoire may have sounded when it was first performed, and how this compares with contemporary practices, thus providing options for interpretation that allow for the possibility of experimentation, and a basis for musicological debate regarding the nature of historically informed performance practice. One cannot fail to notice how similar the modern instruments sound to each other, in contrast to the diversity of timbres encountered with earlier instruments, and the tuba family is not alone in this situation. The conglomeration of multi-national manufacturing companies, combined with the internationalisation of performance practice has led to an ever-more homogenised range of instruments; as Simon Wills writes in relation to all orchestral labrosones, "in the late twentieth century, sameness is triumphant" (Wills 1997a, p. 175). My approach demonstrated here (an approach which, as Wills also notes, is becoming more commonplace amongst some trombonists and trumpeters (ibid., p. 176)) shows that this need not be the case, and presents what alternative tuba family sound-worlds existed before bombardon-derived tubas became so ubiquitous. This process of creating a means for removing unchecked biases from interpretative choices is important, not only for music of the past, but also for that of the future. By breaking down sonic resources into their technical components, I aim to form new, better-informed perspectives on the processes of music creation and performance, perspectives that can be beneficial for both performers and composers.

124 Meucci makes similar conclusions, but his assertion that the name should only "refer to a contrabass trombone in B-flat, and not a valved bass trombone in F" (Meucci 2015, p. 198) seems to contradict his earlier description of the word's historic employment as "everyday musicians' jargon" (Meucci 1996, p. 145) (see also chapter 1.2).

5: Resources for interpretation and creation of contemporary repertoire

5.1 Guidebook

Recognition of the diversity of spectral content available from older members of the tuba family necessitates a critical approach to sound production and modulation using modern instruments. Pedagogical practices evolve as instruments are "constantly changing in small ways to make it easier for musicians to perform the music currently in fashion" (Haynes 2007, p. 170), but contemporaneous descriptions rely heavily upon haptic analysis rather than the study of historical-critical practice or acoustic phenomena. Awareness of sensory feedback is of significant importance, yet, by prioritising this approach above all others, value judgements easily become commonplace, such as false dichotomies of "conventional" and "alternative" methods of sound production (Burba and Hübner 2019, pp. 19, 55), deeming certain techniques to be "extended" (Herbert 2019b, p. 165), and categorising some "sound effects" as "special" (Svoboda and Roth 2017, pp. 65–68). While undoubtedly a broader issue in Western instrumental practice, labrosone pedagogy is particularly entrenched in tradition; much as double stopping, *sul ponticello*, and *col legno* are not string 'extended techniques', neither are multiphonics, air sounds, or vocalisations for labrosones. The tuba family, as the youngest member of this grouping (see chapter 1.1), is both under-explored (see chapter 3.2) and ill-defined (see chapter 3.1), which places it in a particularly extreme position.[125] By means of codification and classification of the sonic resources presented by the modern tuba family, my guidebook to the playing techniques of the tuba (see Annex) employs developmentally constructive language that can be used to assess the specific techniques and technologies demanded by both contemporary and historical repertoire, and to ascertain how they can be put into practice effectively by performers and composers.

Since Hans Kunitz's writings on the tuba (see chapter 3.2), some attempts to codify performance practice have been undertaken, though often, those who tackle the subject are tubists who focus primarily on their own individual practice. This approach can lead to creation of works which are effective at describing the author's practice, but of limited relevance to others. Following a brief organological guide to the tuba family and a methodology for performance of music with live electronics, Gérard Buquet devotes almost a third of his book *Le Tuba Contemporain* to analysis of one of his own compositions (Buquet 1993, pp. 39–53). Barton Cummings's text *The Contemporary*

125 The serpent was first used in the orchestra several generations after horns, trumpets and trombones were commonplace, while the tuba is the only orchestral labrosone that was created as a direct result of the invention of the valve (see chapter 1.3), which marks it as organologically distinct from those with 'natural' valveless predecessors.

Tuba is written solely with reference to works written for him; he "fervently hope[s] that [it] will spur others into action", but he is also aware of its limitations, accepting that "obviously there will be criticism of [his] 'Yankee Isolationist' approach" (Cummings 2004 [1984], p. iii). Addressing collaborative and self-composed works is not in and of itself problematic—my text also includes both—but does inevitably reduce the scope of such a text, and so I decided that it was important to also include references to music of multiple generations of composers, as well as representing, where possible, diverse creative backgrounds.[126]

With regard to more recent theses devoted to the tuba, Andrew Brian Larson's text *Investigating "experimentalism"* includes "changes in tempo" and "extreme range changes" under "extended techniques", as well as glissando (found in tuba repertoire since at least 1895 (Mahler 1898 [1902], I: Fig. 7) and flutter tongue (used since at least 1909 (Schoenberg 1912, I: Fig. 9)) (Larson 2013, pp. 36–38). Narrow contextual awareness risks prevention of any future 'experimentalism' by not explaining developments in such techniques over the intervening time period, be they glissandos in the context of lip resonant frequency modulation (see Annex, pp. 107–8), or flutter-tongue in the context of formant modulation (see Annex, pp. 129–31). Aaron Hynds's work contains more up-to-date technical information (including audio examples, see chapter 5.2), but historical contexts are based on secondary sources, and thus do not address the performance implications of modern instrumental practice (Hynds 2019b, pp. 51–79). These contexts may be beyond the scope of such a text, but by perpetuating a narrative that modern instruments are the direct linear successors to those of the early nineteenth century (see chapter 4.1), contemporary exploration can appear disassociated from 'traditional' instrumental employment, and thus create a divide between those who feel comfortable experimenting with their instrument, thanks to knowledge of how and why it is employed, and those who do not. My text presents a brief overview of tuba family history and development in order to provide a basic knowledge of how contemporary practice emerged, although in light of publications released since it was printed, this section is already in need of updating and further clarification (see conclusions below).

Douglas Yeo's *An Illustrated Dictionary for the Modern Trombone, Tuba, and Euphonium Player* contains thorough organological research,[127] but does not carry this rigour across to acoustic

126 In the opposite extreme, Douglas Hill's *Extended Techniques for the Horn* does not include any excerpts of extant scores, which allows him to describe techniques as being "like a subtle laugh", "a musical wink", or "good for a rough and wild character" (Hill 1996, pp. 47, 48, 56).

127 Some questionable assumptions are still made, notably when discussing contrabass instruments (Yeo 2021, pp. 36–38, cf. chapters 2.1, 4.2) and the bombardon (ibid., pp. 24–25), where the instrument illustrated in Fig. 14 is mislabelled as being half its actual size (with a fundamental of C2 rather than C1), a result of a lack of discussion regarding the difference between *Halb-* and *Ganzinstrumente* (see chapter 2.1).

phenomena. He states that “the science of acoustics is complex and beyond the scope of this volume”, and that he does not wish to engage with “detailed scientific description[s]” (Yeo 2021, pp. 102, 68), instead favouring entries on vernacular descriptions of haptic processes, such as “back pressure”, “false note” and “natural slur” (ibid., pp. 15, 56, 95). This approach, frequently seen in recent literature, limits the text’s ability to comprehensively describe acoustic functions. It is common knowledge that a labrosone’s high register is defined by the musician and musical context rather than the instrument: “the *actual* possible playing range […] varies greatly from player to player and according to the dynamic” (Svoboda and Roth 2017, p. 28; emphasis in original), and the upper register requires “a certain amount of pressure against the lips” (Miller 2015, p. 111). However, acoustic studies show that each instrument has a bell cut-off frequency, beyond which the harmonic structure of the instrument no longer functions. Passing this threshold makes extreme demands on embouchure stamina, which destabilises pitch accuracy and limits control of dynamic and timbre (see Annex, p. 60). Loud *cuivré* dynamics are also commonly discussed, described by Hill as “more a colour than a technique” (Hill 1996, p. 55). However, once again, awareness of the underlying acoustic phenomenon, non-linear sound propagation, is required in order to explain why these sounds have their particular characteristics, how they relate to other sounds, and how they can be controlled in manners that allow for a wide variety of musical applications (see Annex, pp. 66–67) rather than the prevailing non-critical implementation, that is, to be played as loud as possible.[128] Incomplete descriptions of these functions limit the potential employment of these techniques by composers, and also has significant pedagogical implications. A tangible recognition as to why one note is more difficult to play than another a semitone lower, or why, for the same pitch, one valve combination produces a different timbre than another, can greatly enhance the processes involved in being able to create these sounds confidently and reliably.

An example of a situation that can arise when acoustic properties are not fully considered can be observed in the case of Just Intonation. A 2006 paper outlined how “tunable intervals” can be created with labrosones by means of valves tunings, and notated using valve combinations and the Extended Helmholtz-Ellis JI Pitch Notation (Sabat and Hayward 2006). However, this paper did not consider the inherent “inharmonicity” of labrosones, owing to the curvature and varying bore of the tubing, and the nature of tube resonances such that they occur over bands of frequencies

128 These acoustic phenomena have detailed entries in recent scientific and reference publications (Campbell, Gilbert, and Myers 2021; Herbert, Myers, and Wallace 2019), which can hopefully soon be distributed more widely through texts aimed directly at aiding performer- and composer-instrument relationships.

rather than at specific modal points, meaning that pitches can deviate significantly from their theoretical locations (Campbell, Greated, and Myers 2004, p. 151). It is therefore neither possible to define a valve combination and harmonic and expect a microtonally accurate pitch to be produced, as in Stefan Pohlit's *M/S "Barış Manço"* (2018), which includes a cent deviation next to every pitch (Pohlit 2018, b. 1f), nor to prescribe attempts at *scordatura* through valve tuning, as in Wolfgang von Schweinitz's *Plainsound-Sinfonie* (2003–5), which requires that the solo tuba be detuned by a pure quarter-tone (ca. 53.3 cents) (Schweinitz 2005, b. 502f).[129] The microtonal tuba system can alleviate such difficulties (see Annex, pp. 92–95), but research on the topic so far has approached its implementation from primarily theoretical perspectives (Hayward 2011, pp. 125–77). In my practice, I have emphasised how this system can be applied to microtonal music of any tuning system, what its limitations are, and, moreover, when it need not be employed. Many standard valve tunings can make fair approximations of a quarter-tone scale (Wallace 2019a, p. 331; see also Annex, pp. 183–84), and if pitch deviations smaller than these or absolute accuracy of microtonal articulation are not compositional parameters, specification of the microtonal system can hinder the reach of new compositions beyond the few tubists with access to this instrument, an issue which is already widespread in tuba repertoire (see chapter 3.2).

The performance and compositional implications of basing analyses on haptic feedback stretch across many techniques which are defined by the harmonic structure of the instrument. When describing how multiphonics (referred to as "split tones", see below) are created, Hynds writes:

> Split tones are generated by modifying the lips in a way that allows for multiple harmonic partials to be activated through the buzz. This is primarily achieved by allowing the buzz to be loosened to the point of moving to the lower partial of a particular harmonic series However, instead of allowing the lips to settle on the lower note, the performer instead holds the lips at the "break point" between the two partials. (Hynds 2019b, p. 140)

From the perspective of the performer, this description may accurately reflect how the process of creating multiphonics *feels*, but this approach can lead to misunderstandings. There is no "'break point' between the two partials", but rather the lip resonance frequency is destabilised to a point where the lips attempt to "occupy two or more resonance nodes at the same time" (Svoboda and Roth 2017, p. 111). Rather than being produced at a point between two notes where they can sound simultaneously (or, in other words, where the sound is "split"), what is audible is the rapid oscillation between said notes (see Annex, p. 113), which creates the effect of a dyad. This explains why the timbre of different multiphonics can vary dramatically, as well as the ease with which they

129 Even if this were acoustically logical, Schweinitz notes that this requires a "main slide prolonged by circa 12 cm" (Schweinitz 2005, p. vii), which is physically impossible on almost all models of tuba.

can be modified. Moreover, the second note is not the "lower partial of a particular harmonic series", but rather the highest possible frequency of the lower resonance node of a set of spectral content, which may differ significantly from any theoretical pitch as a result of bending or factitious pitches (see Annex, pp. 105–7). This difference has a significant effect on the resultant audible pitch content, and limits the practical applicability of the data provided by Hynds (Hynds 2019b p. 145).[130] Despite being first demanded by composers almost 40 years ago (see Xenakis 1986, b. 9f), this technique is yet to reach widespread pedagogical implementation, for which a plausible explanation is a hitherto incomplete functional awareness of the acoustic phenomena involved. By being able to visualise an oscillation between two pitches and understand why those pitches sound the way they do, someone approaching this technique for the first time may have significantly greater confidence than if they were told only to loosen the lips in order to find a "break point". Several authors, meanwhile, refer to simultaneous singing and playing as "humming and playing" (Svoboda and Roth 2017, p. 101; Cummings 2004 [1984], p. 9; Wallace 2019b, p. 286), which, once more, may reflect how vocalisations *feel* whilst playing, given that they resonate significantly in the mouth and vocal cavities (see Annex, p. 153).[131] However, humming requires the lips to be shut or the rear of the tongue to be raised to the soft palate, with vocalisations emerging solely through the nostrils, and therefore cannot be executed while playing a labrosone (excluding some exceptional circumstances, see Annex, pp. 78, 152). Air sound resonances, meanwhile, are described as "sibilant" sounds (Svoboda and Roth 2017, p. 120) which "create the sound of rushing air" (Szlavnics 2004, p. 36). Formant modulation can control these sounds with the requisite air flow, but these descriptions lack recognition of how modal resonances function in the first place. Knowledge of the processes involved, which result in these background resonances being continually present (if not always audible) during lip buzzing, is key to understanding the manner and extent to which they can be combined with buzzed sounds, and controlled in terms of absolute pitch (see Annex, pp. 97–99, 101–2).

Many of these misunderstandings owe to a lack of realisation that labrosone resonances are created not by blowing air through the instrument, but rather by blowing air to vibrate the lips, which in turn resonate the air that is already inside the instrument. An active consciousness of this process can have significant pedagogical effects. A focus on blowing air has led to a physiological

130 The information he provides is useful in describing theoretical rather than practical or audible resultant spectral content from tuba multiphonics. However, given that this distinction is not made, and that the work is titled *The Composer's Guide to the Tuba*, it can be assumed that it is intended to fulfil the latter.

131 Near-universal description of this technique as "multiphonics" has also hindered the widespread understanding and pedagogical application of actual multiphonics as noted above, with contemporary texts still often altogether failing to address the existence of the latter (Yeo 2021, p. 93).

approach to labrosone teaching, which is often lacking in critical self-reflection; according to Simon Wills, “many conservatoire teachers use the language of the sports field: the race is to the swift and the battle to the strong, though it is doubtful whether, in these circumstances, bread is to the wise” (Wills 1997a, pp. 175–76). On the other hand, an approach which considers the resonant structure as a whole, as an air-containing body which can be controlled and manipulated in various ways, allows for nuance and experimentation with sound generation and manipulation possibilities that can shape how both the performer and composer can most fully utilise the instrument. My text describes these resonant structures and how they can be notated, the sonic resources that they enable, the possibilities for modifying these sounds, and additional sounds that can be added from external sources. It was also important that the work remain as accessible as possible, and has therefore been written using terminology considerate of non-academics, has been made available in three languages,[132] and also contains 39 instrument and equipment graphics, 28 tables (based on data collected through my own practice in order to improve reliability, see chapter 4.1, also Ziegenhals 2010), and 221 score excerpts and descriptions (uniformly typeset except where hand-written notation was itself a parameter). In addition to this written information, it was important for me to be able to demonstrate how these techniques can be realised through my own practice, as well as to present examples of performer-composer collaborations that can be enabled with such a text. These goals were realised by means of two forms of supporting audio material.

5.2 Audio resources: score excerpts and recent works for solo tuba

Some of the score excerpts for the guidebook were selected to demonstrate notational practices by displaying a range of options for techniques that lack codified notation systems, or to present uses of technology or equipment as case studies in employment of sound generation or modification devices. However, the majority form contextual illustrations of specific techniques. These provide composers with examples of options for their implementation, and performers with an awareness of how and where such notations and techniques might be encountered and further explored. The chosen excerpts can also demonstrate unsuccessful application of techniques or technologies, displaying impractical implementations or impossible combinations, and offering suggestions of alternatives to or pragmatic solutions for creating similar sounds. In both cases, such illustrations can be aided by sonic resources, not as substitutes for performer-composer

132 The English- and German-language texts are included in the Annex, the French-language text has been produced and is awaiting digital publication.

interactions or live performances, but rather to provide reproducible evidence of how the implementation of these techniques can be realised under various circumstances.

Contextual employment is crucial; abstract examples can be of use when practising a technique, but without a range of examples to represent technically and stylistically diverse material, there is a risk of imbalance between sounds currently in common use amongst composers and performers, and others encountered more rarely. Svoboda and Roth include 92 audio excerpts, where 40 are abstract examples or improvisations, and 12 are not provided with any accompanying notation (Svoboda and Roth 2017, pp. 141–43). Several techniques have score examples but lack audio references, for example "half-valve articulation" (ibid., pp. 42–43) and "trills using the F valve" (ibid., p. 70).[133] Douglas Hill only refers to abstract examples of techniques (see chapter 5.1), but the accompanying recordings of these are all precisely notated (Hill 1996, p. 2). Aaron Hynds's recordings are of abstract examples (in part compromised by performance mistakes); he also provides hyperlinks to recordings of complete pieces, but these lack references to the scores (Hynds 2019a). He also frequently refers to works by name only, stating that they are "particularly representative examples of [a] technique" but without further identification (ibid.). These inconsistencies risk creating subconscious biases towards techniques practically demonstrated with more thorough or consistent audio references than others, and also risk propagating misuse of techniques due to a lack of contextual awareness. For example, the audio examples of "breath sounds" provided by Hynds (Hynds 2019a) do not correspond with the absolute pitches notated, and so do not effectively portray the differences between pitched and non-pitched air sounds, and the various associated means of execution and modulation (cf. Annex, pp. 97–102).

In order to aid performer- and composer-instrument relationships, such resources ideally need to show how such techniques have been put into practice without bias towards any particular aesthetic or time period, and also to demonstrate how they might be encountered in scores today. These resources are listed in Table 15, and are also available online via the publisher's website. Compromises were sometimes inevitable; in two cases (Nos. 34 and 45) improvisations were necessary, owing to a lack of existing repertoire that demonstrates how these techniques can be effectively utilised.[134] My choice of instruments was also largely self-determined, in accordance with current performance practice (see chapter 3.1), although bias towards the F tuba is reflected in the fact that this instrument is most-frequently used across the world today for solo and

133 The audio examples were also made by six different trombonists, which is problematic regarding the variability between musicians when comparing brass instrument recordings (see chapter 4.1, also Ziegenhals 2010).

134 Since publication, a new contextual example of one of these techniques could now be provided (see conclusion).

chamber music repertoire.[135] I have also provided eight examples (Nos. 1–8) of repertoire which showcases older instruments, and these feature video excerpts largely taken from the resources listed in Tables 1–13. This selection can also be updated and extended to better reflect current research into historical performer- and composer-tuba relationships (see conclusions). These examples illustrate selected score excerpts used in the guidebook, and provide them with further contexts alongside the written captions, as well as practical evidence of the sonic results created by each of the individual techniques described in the text.

Table 15: Score excerpts

No.[136]	Composer	Title	Instrument	Excerpt(s)
01	Felix Mendelssohn	*Paulus*	Serpent	Overture: b. 119–28
02	Vincenzo Bellini	*Norma*	'Early' cimbasso	II: *Mira, o Norma*, b. 103–16
03	Hector Berlioz	*Symphonie fantastique*	Ophicleide	V: Fig. 86–end
04	Richard Wagner	*Lohengrin*	'Berliner' tuba	III: Fig. 51
05	Richard Wagner	*Das Rheingold*	Bavarian C bombardon	III: b. 2664–78
06	Modest Mussorgsky / Maurice Ravel	*Pictures at an Exhibition*	French C tuba	I: Fig. 5; IV: Opening
07	Giuseppi Verdi	*Falstaff*	'Verdi' cimbasso	I: b. 186–92
08	Ralph Vaughan Williams	Concerto for Bass Tuba	English F tuba	I: cadenza (opening)
09	Heiner Goebbels	*Herakles 2*	Basstuba-style F tuba	b. 124–31; b. 143–49
10	Anton Wasiliev	*threesome*	Basstuba-style B-flat tuba	b. 43–44
11	Franco Donatoni	*CHE*	Basstuba-style F tuba	p. 3
12	Helmut Lachenmann	*Harmonica* (1)[137]	Basstuba-style F tuba	b. 352–56
13	Claude Ballif	*Solfeggietto VII*	Saxhorn-style C tuba	V: p. 11
14	Kalevi Aho	Solo VIII	Euphonium	p. 2
15	Bernd Alois Zimmermann	*Musique pour les soupers du Roi Ubu*	Saxhorn-style C tuba	*Pile, Cotice et l'ours*, b. 23–28
16	Michael Tippett	Symphony No. 4	Basstuba-style F tuba	2 before Fig. 38
17	Luigi Nono	*Post-prae-Ludium No. 1*	Basstuba-style F tuba	p. 2
18	Patrick Friel	*Ezra's Telescope* (1)	Microtonal tuba	p. 1
19	Richard Wagner	*Siegfried*	Saxhorn-style C tuba	II: b. 18–42
20	Mauricio Kagel	*Mirum*	Basstuba-style F tuba	p. 4
21	Haukur Þór Harðarson	*Air and Blood* (1)	Microtonal tuba	p. 1
22	Samuel Penderbayne	*Die Schneekönigin*	Basstuba-style F tuba	IIIb: b. 1–4
23	Malcolm Arnold	*Fantasy for Tuba*	Basstuba-style F tuba	Fig. D–E

135 Specific instruments were used when explicitly demanded by composers, for example No. 10 on B-flat tuba, No. 49 on E-flat tuba, and No. 52 on C tuba.

136 Numbers correspond to the listing of video and audio examples in the published guidebook (see Annex, pp. 207–9).

137 Parenthetical numbers are used to distinguish between multiple excerpts from the same piece.

24	Georg Friedrich Haas	*…aus freier Lust…verbunden* (1)	Basstuba-style F tuba	b. 49–53
25	Wolfgang von Schweinitz	*Plainsound-Sinfonie*	Microtonal tuba	b. 562–73
26	Roland Pfrengle	*Projektionen*	Microtonal tuba	b. 398–99
27	Asia Ahmetjanova	*א [Aleph]* (1)	Microtonal tuba	p. 1
28	Georges Aperghis	*RUINEN* (1)	Microtonal tuba	p. 4
29	Luigi Nono	*Omaggio A György Kurtág*	Basstuba-style F tuba	b. 18–20
30	Mark Andre / Jack Adler-McKean	*iv 16*	Basstuba-style F tuba	b. 37–43
31	Eric Egan	*of her Skin* (1)	Microtonal tuba	b. 3
32	Edo Frenkel	*Megaphone* (1)	Microtonal tuba	p. 209–12
33	Haukur Þór Harðarson	*Air and Blood* (2)	Microtonal tuba	p. 2
34	*Improvisation*	Factitious notes	Basstuba-style F tuba	N/A
35	Athena Corcoran-Tadd	*SCWBA* (1)	Basstuba-style F tuba	p. 9
36	Barney Childs	*A Question of Summer*	Basstuba-style F tuba	p. 4
37	Georg Friedrich Haas	*Das kleine ICH BIN ICH*	Basstuba-style F tuba	b. 276–81
38	Karlheinz Stockhausen	*IN FREUNDSCHAFT* (1)	Basstuba-style F tuba	p. 2
39	Jack Adler-McKean	*Engführung* (1)	Basstuba-style F tuba	p. 6–7
40	Patrick Friel	*Ezra's Telescope* (2)	Microtonal tuba	p. 7
41	Jesse Ronneau	*, aber es werden Geister…*	Microtonal tuba	b. 107
42	Helmut Lachenmann	*Concertini*	Basstuba-style F tuba	b. 373–76
43	Priscilla McLean	*Beneath the Horizon*	Basstuba-style F tuba	p. 3
44	Evan Johnson	*Rückenfigur* (1)	Microtonal tuba	IV: opening
45	*Improvisation*	Ingressive pitches	Basstuba-style F tuba	N/A
46	Sylvain Marty	*Discreet 2* (1)	Basstuba-style F tuba	b. 72–74
47	Athena Corcoran-Tadd	*SCWBA* (2)	Basstuba-style F tuba	p. 5
48	Helmut Lachenmann	*Harmonica* (2)	Basstuba-style F tuba	b. 120–23
49	Nicolaus A. Huber	*Solo mit Koonstück*	Saxhorn-style E-flat tuba	Line 5
50	Sophie Pope	*Something Sacred* (1)	Basstuba-style F tuba	b. 16–17
51	Saim Gülay	*Today, the Eternity*	Basstuba-style F tuba	Opening
52	Cort Lippe	*Solo Tuba Music* (1)	Saxhorn-style C tuba	Fig. G
53	Dmitri Kourliandski	*Tube Space* (1)	Basstuba-style F tuba	b. 83–86
54	Edo Frenkel	*Megaphone* (2)	Microtonal tuba	b. 85–86
55	Arnold Schoenberg	Five Orchestral Pieces	Basstuba-style F tuba	I. 9–10
56	Nigel McBride	*come, from nothing* (1)	Microtonal tuba	p. 1
57	Cort Lippe	*Solo Tuba Music* (2)	Saxhorn-style C tuba	1 before Fig. E
58	Jesse Ronneau	*Carthage* (1)	Microtonal tuba	b. 119
59	Georg Friedrich Haas	*…aus freier Lust…verbunden…* (2)	Microtonal tuba	b. 66–70
60	Jack Adler-McKean	*Engführung* (2)	Basstuba-style F tuba	p. 3
61	Rainer Rubbert	*depth* (1)	Basstuba-style F tuba	Opening
62	Nigel McBride	*come, from nothing* (2)	Microtonal tuba	p. 2

63	Evan Johnson	*Rückenfigur* (2)	Microtonal tuba	II: bottom line
64	Evan Gardner	*Gunfighter Nation*	Basstuba-style F tuba	*Cowboys*: b. 29
65	Helmut Lachenmann	*Harmonica* (3)	Basstuba-style F tuba	b. 56–58
66	Sofia Gubaidulina	*lamento*	Basstuba-style F tuba	Fig. 20
67	Karlheinz Stockhausen	*IN FREUNDSCHAFT* (2)	Basstuba-style F tuba	p. 4
68	Haukur Þór Harðarson	*Air and Blood* (3)	Microtonal tuba	p. 3
69	Eric Egan	*of her Skin* (2)	Microtonal tuba	p. 8
70	Gustav Mahler	Symphony No. 3	Saxhorn-style C tuba	I: Fig. 7–8
71	Sylvain Marty	*Discreet 2* (2)	Basstuba-style F tuba	b. 34
72	Haukur Þór Harðarson	*Air and Blood* (4)	Microtonal tuba	p. 3
73	Karlheinz Stockhausen	*IN FREUNDSCHAFT* (3)	Saxhorn-style E-flat tuba	p. 2; p. 4
74	Dmitri Kourliandski	*Tube Space* (2)	Basstuba-style F tuba	b. 118–24
75	Georges Aperghis	*Parlando*	Microtonal tuba	p. 6; p. 13
76	Vinko Globokar	*Juriritubaïoka*	Basstuba-style F tuba	Fig. F
77	Helmut Lachenmann	*»… zwei Gefühle …«, Musik mit Leonardo*	Basstuba-style F tuba	b. 182–84
78	Patrick Friel	*Ezra's Telescope* (3)	Microtonal tuba	p. 9
79	Jesse Ronneau	*Carthage* (2)	Microtonal tuba	p. 5
80	William Kraft	*Encounters II*	Basstuba-style F tuba	b. 41–47
81	Georges Aperghis	*RUINEN* (2)	Microtonal tuba	p. 3; p. 6
82	Emily Howard	*Chaos or Chess*	Microtonal tuba	p. 1; p. 4
83	Sophie Pope	*Something Sacred* (2)	Basstuba-style F tuba	III: b. 1
84	Marta Ptaszyńska	*Two Poems*	Basstuba-style F tuba	p. 2
85	Morgan Powell	*Midnight Realities*	Basstuba-style F tuba	p. 1
86	Asia Ahmetjanova	*א [Aleph]* (2)	Microtonal tuba	p. 2
87	Edo Frenkel	*Megaphone* (3)	Microtonal tuba	b. 1–2
88	Rainer Rubbert	*depth* (2)	Basstuba-style F tuba	II: p. 1
89	Maya Badian	*Mosaïques sonores*	Basstuba-style F tuba	III: p. 7
90	Arnold Schoenberg	*Gurre-Lieder*	Saxhorn-style C tuba	Fig. 11; Fig. 23
91	Georg Friedrich Haas	*…aus freier Lust…verbunden…* (3)	Microtonal tuba	b. 14–15; b. 39–40
92	Giacinto Scelsi	*Maknongan*	Basstuba-style F tuba	p. 1
93	Claus-Steffen Mahnkopf	*Hommage à Brian Ferneyhough*	Basstuba-style F tuba	b. 42
94	Hans-Joachim Hespos	*Poogri-blues*	Basstuba-style F tuba	p. 2

I have also created audio resources in order to form case studies which examine the extent to which a guidebook can support new collaborative projects between tubists and composers. While analysis of the nature of performer-composer relationships is beyond the scope of this study, by providing examples of various modalities of such creative processes, I am able to examine the impact my publication can have across different forms of composer-instrument and composer-

performer interaction. Recordings were made of new works from four composers, representing a variety of career stages and experience levels, and none of whom had previously written for solo tuba; two followed collaborative workshops, and two were written following publication of the guidebook. These recordings, listed in Table 16, are available as videos with the accompanying score.

Table 16: Recent works for solo tuba

Ref.	Composer	Title	Instrumentation	Year of composition	Duration
5.2.1	Daniel Kalantari	*We are here because we are here*	Amplified tuba	2021	11:08
5.2.2	Ed Cooper	*…grown up, you are grown, and feeling stronger, feeling…*	Four valved tuba, heartbeat, fixed media	2020–22	25:08
5.2.3	Sarah Nemstov	*„watcher“*	Tuba and tape	2021	09:24
5.2.4	Michael Finnissy	*Berliner-Tuba*	Solo tuba	2020–21	14:16

Daniel Kalantari gained their knowledge of the tuba based upon the guidebook, and the creation of their piece *We are here because we are here* (5.2.1) did not involve any direct performer-composer relationship. The work features many precisely defined and accurately notated techniques, but also highlights a key limitation of the book. By isolating sonic creation and modulation processes, it cannot describe all of the practical limitations present when they are used in combination or in rapid succession. In the process of learning the piece, I needed to suggest compromises for situations where combinations of techniques led to impossible situations. For example, the passage over pages 2–3, which features fast alternation between techniques, needed to be reduced in tempo in order to enable a level of rhythmical precision that was still very challenging to produce reliably, but nevertheless achievable with concerted practice. The dynamic range for air noises away from the mouthpiece on page 12 also had to be altered in order to preserve phrase length, in this case due to the physical limitation of absolute lung capacity. In less complex circumstances, these limitations could be integrated as compositional parameters; for example, the composer added “intentionally audible” breathing in pages 14–16, and an exchange of mouthpieces in pages 1–2. However, a direct collaboration could have allowed for experimentation with more idiomatic solutions; for example, I would have suggested exchanging mouthpieces while buzzing through them in order to cover up undesirable percussive noises (see Annex, pp. 81–82), and the use of circular breathing to allow for longer air noises (see Annex, pp. 77–79). At the same time, the lack of a performer-composer interaction did lead to development in lesser-explored areas of my own practice. The combination of precisely controlled valve

movement, in- and egressive air sounds, and lip-reed modulation in pages 8–10 demanded significant practice development until the required level of control was achieved. The bell bowing technique in pages 19–20, meanwhile, is an original sonic resource, one that necessitates further exploration and refinement before I can integrate it into future editions of the guidebook.

I first worked with Ed Cooper in a workshop before the guidebook was published, at which point his piece was entitled *Glass on the pavement under my shoe* for "any brass instrument with three vertically-mounted piston valves, sine tone and video camera". By the time the work was recorded two years later, it had evolved to *…grown up, you are grown, and feeling stronger, feeling…* (5.2.2) for "four valved tuba, heartbeat, and fixed media", but maintained the same aesthetic concept, evoking an extremely quiet sound-world which combines the acoustic instrument with digitally processed media. Additional valves do not prevent performance of the work, and thus the score should reflect that the minimum number of valves is stated. The performance notes also need to clarify that the score includes parametrical valve notation for an F tuba; in creation of the score, it was necessary to define the valve combinations required for each individual pitch, a process which could now be achieved using the guidebook alone (see Annex, pp. 178–84). Universality of performance could be facilitated by allowing the entire piece to be transposed, a precedent established in James Fulkerson's *Patterns III* (Fulkerson 1969, p. 3), and also found in works which exist in multiple editions for tubas of different pitches, such as Sophie Pope's *Something Sacred* (2015) (Pope 2015, p. 1). Study of the guidebook could also help alleviate some notational complications. The majority of pitches used in the piece are in a register where, at very low dynamics, they can differ significantly from their theoretical positions, and so, resultant pitches could be defined more precisely through study of bending and factitious tones (see Annex, pp. 105–7). Similarly, the audible pitch content of air sounds differs significantly from the corresponding lip-reed pitch, and so could also benefit from notating resultant, instead of (or as well as) 'actioned' pitches (see Annex, pp. 101–2). Such parametrical notations are justified by the composer noting that tuba pitches are only intended to indicate approximate resultant sounds according to the given valve combinations. However, the pitches of vocalisations (the vocal range is helpfully possible by any amateur voice, see Annex, p. 152) and multiphonics (see Annex, pp. 113–14) do accurately correspond to which pitches are made audible. From my perspective as a performer, a more explicit definition of or differentiation between resultant and audible harmonies would be useful, especially in the contexts of a piece which often relies upon homo- or heterophonic writing.

Sarah Nemstov's work *„watcher"* (5.2.3) for tuba and tape was commissioned after the guidebook was published, and thus was written largely based on its contents. The extensive use of complex techniques and notations idiomatically reflects the available sound world, but there are, nonetheless, notations that could be clarified further. Text-based vocalisation notation ("sing/growl" or "breaking/choking") needs to be expanded upon to avoid potentially undesirable sonic results (see Annex, pp. 157–58). Multiphonics are still relatively nascent in tuba writing (see chapter 5.1), and as yet, there is no codified method of notation (see Annex, pp. 114–15), but nevertheless they require some method of indicating the desired resonance modes (harmonics) and corresponding pitches. Nemstov generally notates these accurately, but I did need to clarify some examples; most of these were likely typographical errors—the F sharp/D sharp in bar 68 uses harmonics 6/5 rather than 6/3, bar 71 is G quarter-sharp/F rather than G/F quarter-sharp—but others, such as the G/F quarter-flat in bar 81, lack harmonic numbers altogether. Moreover, some multiphonics were given unachievable dynamic indications. As my practice develops, I am continually widening my range of dynamic and other timbral modifications that can be combined with multiphonics, but it is still important to provide limitations; the dynamic swells in bar 68 are very difficult but can be realised, whereas the crescendo to *forte* in bar 79 is impossible. Air sounds and slap tongues are also generally notated with precision, but would benefit from a more refined use of pitch notation. After the composer explained to me that the air sound notation reflects relative rather than audible pitch, this notation was easier to interpret (although would therefore, perhaps, be better suited to a single-line stave and/or different clef), but I did need to change the octave of several slap tongues (for example, b. 61, 105) due to the requirement that they be limited to one harmonic series (given the lack of specification as to the mode of production) (see Annex, p. 133). The wide range of pitches and articulations also required some adjustment in the extremities, notably in bars 52–53, which necessitated different articulations to those notated. Bars 76 and 78 required extra breaths for the C1 at the indicated dynamic, although this situation is astutely avoided in bars 54–55, which suggests that, while the fundamental principles of sound production and control are clear, direct consultation with a performer could still assist in the final processes of composition.

After first contact with Michael Finnissy in 2016, an initial workshop took place in 2019, and the piece *Berliner-Tuba* (5.2.4) was completed by mid-2021, independent of the guidebook. This piece makes extensive use of quarter- and eighth-tones, which means that an accurate realisation requires the microtonal valve system (see Annex, pp. 92–95). However, these intervals are

contained within a limited pitch class (E-flat 3–B3), which is a register with many possibilities for creating quarter-tone intervals using standard valve configurations (see Annex, pp. 183–84). The composer described intervals smaller than a quarter-tone as "colourations" rather than as compositional parameters, and therefore dispersion of the work can be aided by clarifying that the microtonal system is not a prerequisite for its performance (see chapter 5.1). The singular F-sharp 1 (p. 5, line 4) did indeed limit the possibility of using the 'adapted' microtonal system (see Annex, pp. 94–95) that I chose to employ for this piece, but this situation could be overcome by bending up an F1, once the composer approved of the necessary timbral alteration. Nevertheless, a deeper awareness of the tuba's acoustic structure and mechanical capabilities could make the work more idiomatic towards the instrument. Through workshop demonstrations of the instrument's upper register, I encouraged the composer to use higher pitches than he had previously employed in his tuba writing. However, frequent use of pitches at or close to the bell cut-off frequency (see Annex, p. 60) reduces the stability of intonation and can lead to an increased risk of mispitching, particularly given the extreme variations in dynamic. We also explored some of the effects that can be produced through fractional valving (see Annex, pp. 140–43), but a more detailed study of this technique would enable precise execution of his "½ valve" indications, and allow for greater refinement in the control of timbre and resonance. Certain degrees of freedom enable more improvisatory passages, with the "echo" phrases and "very irregular and fluctuating tempo[s]" allowing a wide scope for interpretation; in contrast, the precisely notated sections could be defined more emphatically through recognition of the instrument's dynamic curve (see Annex, pp. 63–64) and range of articulation possibilities (see Annex, pp. 123–27).

These pieces demonstrate the benefits provided by such a guidebook, and also those gained through direct interaction between composers and performers. Kalantari and Nemstov's works show the extent to which techniques can be exploited on the basis of such a text, creating highly challenging, idiomatic works, and even stimulating the development of as-yet nascent techniques. They also demonstrate the need for clarification of notational complications, and the shortcomings that result when there is limited in-person collaboration to ensure that the borders between technical demands that are difficult and those that are impossible are deftly navigated. Cooper and Finnissy's pieces show how previously existing compositional idioms can be effectively transferred onto an instrument and worked to fit its own technical possibilities. However, without a supporting text to provide a guide to the instruments' fundamental parameters, they also show the limitations in levels of nuance in sound production, modification, and notation that could otherwise aid in

creation of better defined, more reliably reproducible sound worlds. By engaging with composers in these various manners, I am able to provide recordings which illustrate the extent to which the guidebook can fulfil its aim as a learning resource for performers and composers. It is not designed to serve as substitution for experimental collaboration, but rather to establish a fundamental level of knowledge and mutual understanding, which can then be used as a base for further creative developmental practices.

Conclusion: Areas for future development

Continual development and expansion of these resources is not only desired but inherently necessary by design. In a field as nascent as artistic research, particularly with regard to instruments as uncodified and under-explored as those of the tuba family, it is not surprising that much primary source research is still ongoing. Many references cited were published since this research project began, with several important works on labrosone organology and acoustics having been released since the guidebook was published in 2020. For example, the text, illustration, and video example regarding the contrabass tuba were left intentionally vague in order to reflect the state of research at the time (see Annex, pp. 25–26), a situation which has since been enlightened by Hofer and Schiwietz 2020 and Zechmeister 2021b (see chapter 2.1). Labrosone acoustic phenomena (see Annex, pp. 56–67) have also undergone significant clarification and expansion via the publication of Campbell, Gilbert, and Myers 2021. While the currently published information is still accurate, I would hope to update any future editions of the guidebook on the basis of these publications and other new sources of information. More experimental areas can also be expanded; charts of techniques that are, thus far, encountered relatively infrequently, such those for multiphonics (see Annex, p. 114) and factitious tones (see Annex, p. 106), reflect my current state of practice, which is continually being developed and refined, and can also be applied to a wider variety of instruments. Nevertheless, as the guidebook focused on descriptions of these techniques as sonic resources and modulation possibilities (see chapter 5.1), such developments can also be logically inferred and expanded upon by other performers and composers. I could also add further audio examples to illuminate the described techniques; a recording of factitious notes which required improvisation (see chapter 5.2, No. 34), for example, could be replaced with an excerpt from Ed Cooper's work discussed above (see 5.2.2). The possibilities for use of external equipment and electronics is limited only by imagination and technological progress, and so could never be covered comprehensively by such a guidebook. However, additions could be provided

from my own recent practice looking at acoustic and electronically assisted additions to the instrument's available palette of sounds, including further experimentation with the bowed tuba bell (see 5.2.1), and the development of a controllable feedback loop system with composer Luciano Azzigoti, in which we used a piezoelectric pick-up microphone connected to a modified valve slide, an in-bell speaker, and a bass pedal.

The recordings listed in Tables 1–13 reflect examples of broader categories, and so, offer numerous routes for expansion. These could include further examples of works (for a non-exhaustive repertoire list, see Annex, pp. 200–6), instruments (especially if access is made available to the earlier 'Berliner' and 'Wiener' tubas which are currently in private storage (see chapter 4.1)), and instrument types. These recordings reflect the current state of research with regard to associations between locations, instrument types and repertoire, yet conclusive sources are often lacking, particularly regarding orchestral use of bombardons in Bavaria (see chapter 2.1, also Table 8) and Russia (see chapter 2.3, also Table 10) in the late-nineteenth-century. As further resources are discovered in these and other areas, the comparative recordings in Table 14 can also be built upon. Some of these could be expanded by means of existing instrumental resources: with regard to four work excerpts, I have already provided recordings of two historical instruments (4.2.3, 4.2.10, 4.2.17 and 4.2.18), while others which research suggests could benefit from similar treatment include Mendelssohn's music (4.2.6) using a form of bass horn (see chapter 1.2), Verdi's early music (4.2.8) using a form of ophicleide (see chapter 1.2), and Leoncavallo's music (4.2.25) using a 'Wiener' tuba or an F bombardon (see chapter 2.4; in particular, footnote 77). Measurements of each instrument's Brassiness Potential Parameter (BPP) (see footnote 106) could also be taken. Since March 2021, I have been collaborating with researchers at the Musikinstrumentenmuseum der Universität Leipzig, home to several examples of historical low labrosones (for example, see Figs. 7, 12, and 14). We have been updating the records for the relevant objects (which remain largely unchecked since publication of Heyde 1980 and Heyde 1982) and associated mouthpieces (which have never been fully assessed or catalogued), and developing rigorous methods of quantitative analysis and measurement for calculating BPP. Such data can potentially be used to support arguments regarding organological evolution or the suitability of modern substitutions, while also finding greater impact in and of itself in combination with practical audio-visual resources. This can be logically expanded into comparisons between recently made instruments. The instruments used in Tables 1, 3, and 4 are based on nineteenth-century models, as are the newly available copies of English F tubas and French C tubas from Wessex, and 'Berliner' tubas

from Louis Jake Klein, whereas others, in particular, some forms of bass horn (including keyed and valved ophicleides) from Takao Nakagawa, Gunter Hett and Jérôme Wiss, are based upon brand new designs. While modern tubas produce broadly homogeneous sounds (see chapter 4.2), the various approaches to manufacture and development of modern versions of older instruments could be assessed through such a combination of qualitative and quantitative research.

At the broadest level, such recordings need to be placed in the context of the ensemble with which they are working, or at least with the other labrosones. While my own practice of historical repertoire has been greatly aided through experimentation with older instruments, it could be enhanced further through collaborations with performers of other instruments. The combination of historical-critical and contemporary-experimental approaches demonstrated here could also be applied to other instrumental families which are also lacking either reflexive, critical evaluations from performers, or active, creative engagements with composers. My recordings of new solo pieces effectively demonstrate how the tuba can be treated in isolation, but can hopefully also provide inspiration as to how it can be combined with other sounds and used as part of larger ensembles. While still relatively rarely encountered, historically informed ensembles specialising in nineteenth- and early-twentieth-century repertoire are increasing in number (see chapter 4.1), while other instrumental guidebooks are currently being written.[138] There is, therefore, reason to be optimistic that critical performance practice reflections in these areas on a larger scale and across broader fields will increase in potential in the near future.

138 Through personal contact I am currently aware of publications on the trumpet, viola and violoncello that are currently in preparation.

Annex: *The Techniques of Tuba Playing / Die Spieltechnik der Tuba* (Kassel: Bärenreiter, 2020)

Available to download at the following password-protected link.

To obtain the password, please contact the author. The published guidebook is also available for purchase here: https://www.baerenreiter.com/en/shop/product/details/BVK2421/

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