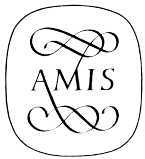
Journal of the American Musical Instrument Society

VOLUME XXV • 1999



Some Early American Boehm Flutes

PETER SPOHR

IN RECENT YEARS there have been two occasions to celebrate what Theobald Boehm did to revolutionize the flute: the 200th anniversary of his birth in 1894 and the 150th anniversary of his 1847 patent for the "cylindrical" flute.[1] These occasions gave me the idea of writing an article about the early American Boehm flutes in my collection; later, I realized that 1994 also marked 150 years of Boehm flute making in this country.

After studying the "modern" flute for many years, in the early 1970s I also became interested in playing "historic" flutes, and soon after that I started to build up a collection of transverse flutes from the baroque period to the present day. My admiration for the variety and the high quality of Boehm flute making in America and my contacts with relatives and friends in this country have led to the presence of many examples of American Boehm flutes in my collection. In this article I will describe eight instruments of special historical interest, which as a group can shed some light on the development of Boehm flute making in the United States.

Ever since the 1840s, when Alfred G. Badger (1815–1892) started to manufacture and promote the Boehm flute in New York, American flute makers have enjoyed a good reputation, especially for high-quality "handmade" Boehm flutes which are used by demanding artists worldwide. Not only famous flute makers in the Boston region such as William S. Haynes (who founded his own workshop in 1900), Verne Q. Powell (since 1927), Brannen Brothers (since 1977), and many of their former employees, but also larger companies using mass production (often located in the region of Elkhart, Indiana) have maintained a leading position in a highly competitive market to the present day.

1. Boehm's most influential invention is called a "cylindrical flute" in the following text even though its bore is partly conical (the head joint bore contracts slightly at its upper end, in order to permit the correct overblowing of the first octave without changing the fingering). His earlier design of 1832, in contrast, is generally called a "conical flute" because its body bore tapers gradually toward the foot, even though the head joint bore is cylindrical.

American Boehm flutes from the nineteenth and early twentieth centuries can be found in public and private collections all over the world, in this country most notably in the Dayton C. Miller Flute Collection in the Library of Congress in Washington, D.C.[2] An exhibition at the Metropolitan Museum of Art in New York in 1986 included four early American cylindrical Boehm flutes in addition to ten simple-system keyed flutes from this country.[3] Another source of information when preparing this article was a detailed description of twenty-nine American Boehm flutes which David and Nina Shorey of Bowdoinham, Maine, kindly put at my disposal from their sales catalogues and internal records.

Dissertations completed in the 1980s by Mary Jean Simpson[4] and Susan Berdahl[5] are invaluable references for the study of this topic, as is *The New Langwill Index* by William Waterhouse.[6] And Nancy Toff's book *The Development of the Modern Flute* describes and illustrates many flute systems and ideas in flute construction, with examples taken mainly from the Dayton C. Miller flute collection.[7]

The flutes described below are listed in chronological order and are numbered for easier reference; nos. 1–4 are illustrated in fig. 1 and nos. 5–8 in fig. 2, while details of several flutes are shown in fig. 3. (All photographs were taken by the author.) Some instruments still have their original cases but these are not mentioned in this study. Each (standardized) description is followed by comments on special features, style, and similarities to instruments by other makers, together with suggestions as to how the characteristics of each instrument can be connected with the development of American Boehm flute making in general.

2. Most of the instruments of this collection are described in Laura E. Gilliam and William Lichtenwanger, *The Dayton C. Miller Flute Collection: A Checklist of the Instruments* (Washington: Library of Congress, 1961). Descriptions and photos of some flutes can also be seen on the Internet at http://lcweb2.loc.gov./ammem/dcmindex1.html.

3. See Robert A. Lehmann, *Historic Flutes from Private Collections* (New York: The Metropolitan Museum of Art, 1986), with photos and detailed descriptions.

4. Mary Jean Simpson, "Alfred G. Badger (1815–1892), Nineteenth-Century Flutemaker: His Art, Innovations, and Influence on Flute Construction, Performance and Composition, 1845–1895" (D.M.A. dissertation, University of Maryland, 1982; UMI 8227993).

5. Susan Marie Beagle Berdahl, "The First Hundred Years of the Boehm Flute in the United States, 1845–1945: A Biographical Dictionary of American Boehm Flutemakers" (Ph.D. dissertation, University of Minnesota, 1986; UMI 8622568).

6. William Waterhouse, *The New Langwill Index: A Dictionary of Musical Wind-Instrument Makers and Inventors* (London: Tony Bingham, 1993).

7. Nancy Toff, *The Development of the Modern Flute* (New York: Taplinger, 1979).

Only flute no. 1 by Larrabee is a "conical" ("1832 model") Boehm flute with a cylindrical head joint bore of 18.9 mm diameter; the rest of the instruments are "cylindrical" with a standard bore diameter of c. 19 mm in the body and the foot joint (unless otherwise noted) and a head joint bore decreasing to c. 17 mm at its upper end. "Sounding Length" means the distance between the center of the embouchure hole and the foot end of the flute. Lengths were measured with a flexible steel tape measure (measurement tolerances ± 0.5 mm), embouchure and bore diameters with T-gauges and a micrometer (measurement tolerances ± 0.05 mm). Pitch was determined by the author with an electronic tuner after the flute had been warmed up. Because of the player's influence on the pitch, pitch tolerances are hard to give, but in general the author plays neither extremely high nor extremely low.

1. **Maker:** James D. Larrabee (died c. 1847)
Stamp: (lyre) / J. D. LARRABEE / NEW YORK / (lyre) on barrel, body, and foot joint
Year of Manufacture: c. 1845
Materials: body of cocuswood; decorative peg on the cap, rings, wide band surrounding head (including embouchure), and keywork of silver; head joint lined with a tin-plated brass tube
Sounding Length: 587 mm (C-foot)
Pitch: a′ = c. 443 Hz (with no extension of the tuning slide)
Embouchure Measurements: 11.0 × 12.0 mm (oval)
Cork Arrangement: screw cork but no indicator
Mechanism: early Boehm mechanism for conical ("ring-keyed") flutes with posts screwed directly into the wood (no ribs); D♯-trill for R1, D-trill for R2, B-trill for R3;[8] double thumb hole (B key only); Dorus G♯[9] with separate axle (see fig. 3.1); rods on both sides of the body with projecting arms equipped with threaded adjustable pins fitting into the deepened centers of the B♭ and F♯ keys; early foot-joint design with tone holes in line and with a gap between the axles for the D♯ and the C♯ and C keys; crescent-shaped D♯ touch and a cross axle for the C♯ and C levers; (original) flat springs on thumb, B-trill, and C♯ and C foot-joint keys;

8. Designation of the keys (in terms of the note which sounds when a given key touch is pressed) and the fingers (R1 = right forefinger, etc.) is given in the usual player's terminology.

9. "Closed" G♯ without additional tone hole (and key) on the back side of the flute, devised by the French flutist and teacher Louis Dorus (1812–1896) c. 1838 in collaboration with the Godfroy/Lot workshop in Paris.

FIGURE 1. Flutes by (from left to right) Larrabee, Badger & Monzani, Rönnberg, and Berteling.

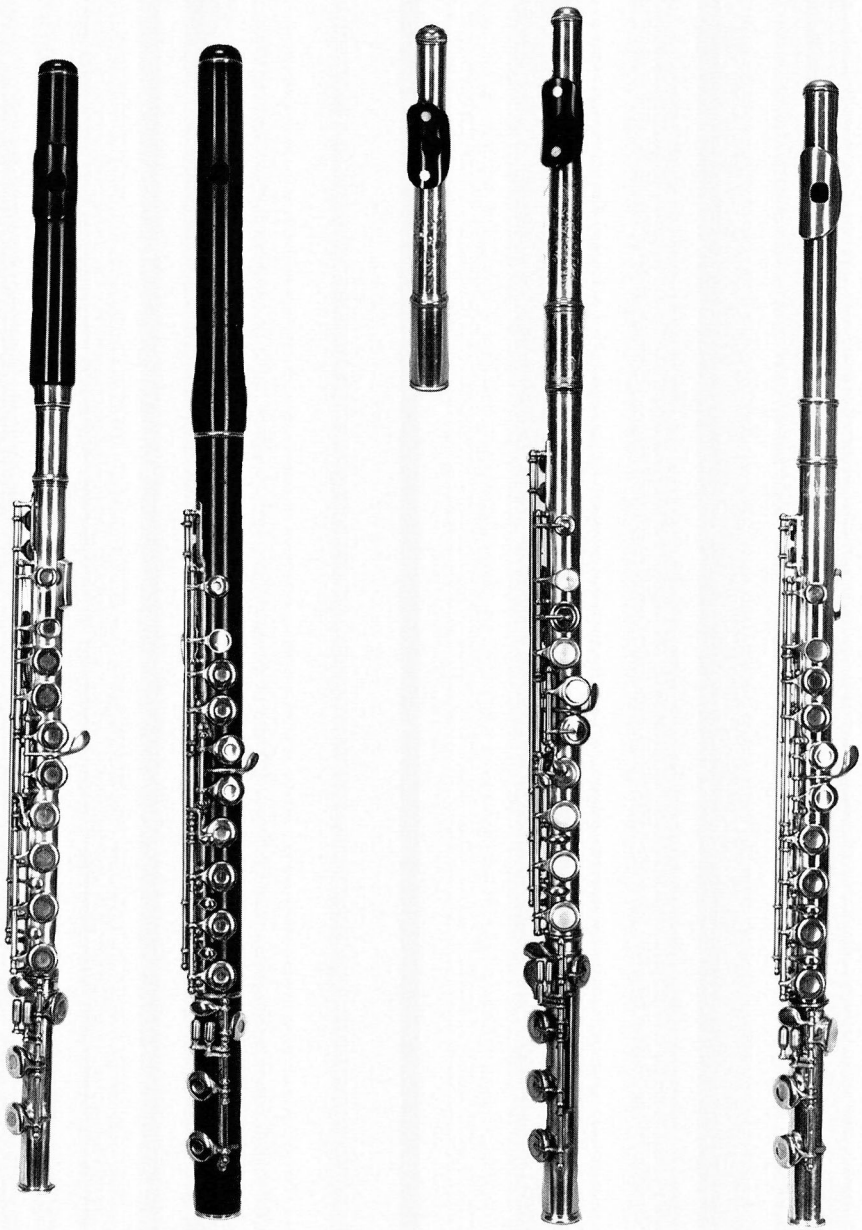
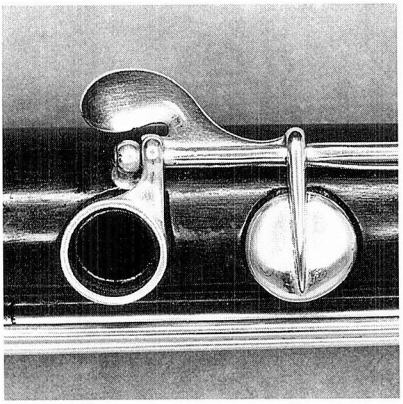
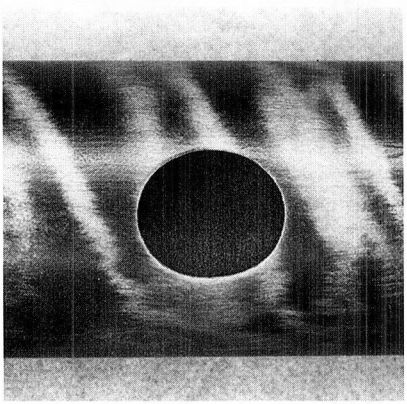


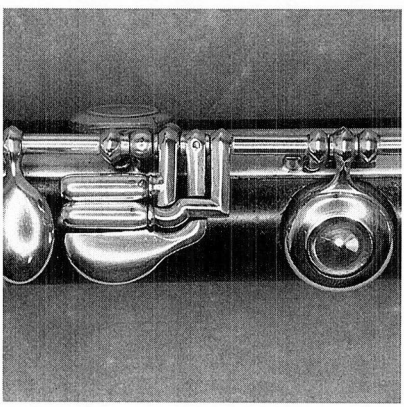
FIGURE 2. Flutes by (from left to right) Meinell, Wm. S. Haynes, Conn, and G. Haynes.



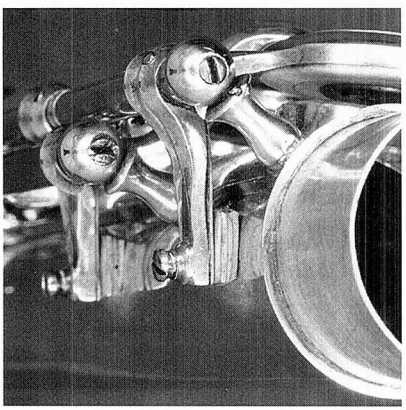
1. Larrabee: Dorus G♯



2. Rönnberg: embouchure hole



3. Rönnberg: detail of foot joint



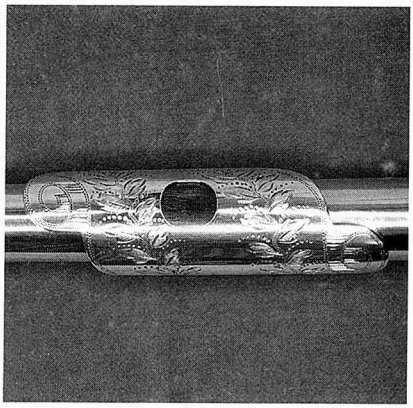
4. Berteling: spring-protected adjusting screws

FIGURE 3. Details of selected flutes.

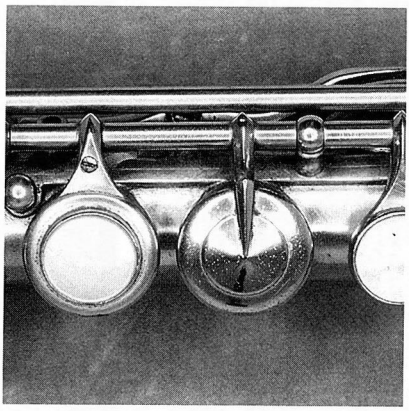
needle springs on the rest of the keys (most probably not original); key hole rims wide and flat with all pads glued in (no screws holding key cups and/or pads)

Comments: Scholars suggest that American manufacturing of (conical) Boehm flutes began around 1844, by the flutemaker James D. Larrabee of New York.[10] Susan Berdahl writes: "In 1844 Larrabee was awarded a

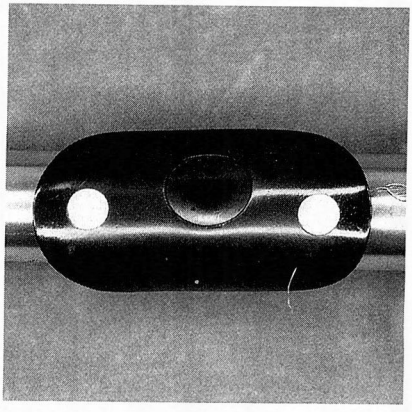
10. See Simpson, 29–30 and 314–15, and Berdahl, 46–48 and 583–84.



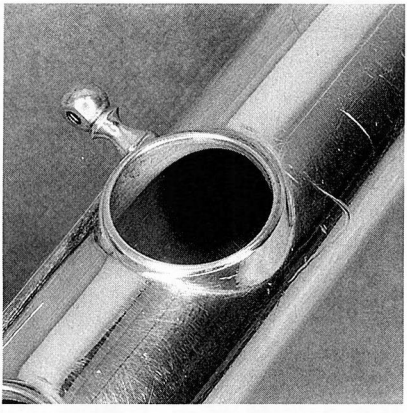
5. Berteling: lip plate in the design of a diagonal scroll



6. Conn: A key with pearl-inlaid cup and adjusting screw



7. Conn: ebonite lip plate with pearl-covered screws



8. G. Haynes: tone hole drawn through silver and aluminium tubes

FIGURE 3, *continued*

silver medal for the 'best Boehm system flute' exhibited at the Seventeenth Annual American Institute Fair of New York City. This may, indeed, have been the first Boehm flute made in the U.S. and it may have been the only one made by Larrabee, since it is thought that he died a few years later."[11] According to a letter cited in Badger's *Illustrated History*

11. Berdahl, 47.

of the Flute, Larrabee's first Boehm flute was a copy of a particular (European) instrument.[12] On the flute described here the head joint with tin-plated brass tube, the tuning slide, and the silver band surrounding the embouchure remind one of English flutes, and this kind of protection around the embouchure area[13] also became quite common among American simple-system and Boehm flutes made from wood and ebonite (see also the Badger & Monzani flute, no. 2 below). While the first conical Boehm flutes made by Rudall & Rose in London under the supervision of Rudolf Greve in 1843 very much resemble—except for the head joint—the original Boehm design (open G♯ key on a cross axle, flat springs, etc.), the French invention of the Dorus G♯ can soon be found on Rudall & Rose instruments,[14] often combined with typically English features like English pattern keys (key cup fixed to the arm by a threaded pin which is riveted to the cup and does not go through the pad to hold it as in Boehm's design) and pewter plugs on the C♯ and C foot-joint keys. Also, the fact that the Larrabee flute was originally equipped with flat springs throughout (as revealed by the associated extant or partly-removed wooden dowels and by impressions caused by the now-missing springs) and still retains the larger tone holes (and rings and keys) may be an indication that Larrabee had modelled this flute on an English instrument with a Dorus G♯ key.[15] On

12. See Alfred G. Badger, *An Illustrated History of the Flute* (New York: Firth Pond & Co., 1853), 30–31. The passage in question, in a letter from the New York flutist John A. Kyle (c. 1810–1870), reads: "About six years since I attended a musical party, where I met [a] gentleman from South America, who had purchased, while in Europe, a Flute invented by Boehm, the celebrated composer and performer, which was being generally introduced there. Upon attempting to play upon it, I found I could not execute the scale, owing to its peculiar construction. The next day, being desirous to see it again, I called on Mr. Brix, accompanied by a brother Flutist. After hearing him play on it again, I took the liberty of asking the loan of it to take the pattern, which he kindly granted. I then proceeded to Mr. Larribee's [sic], the Flute manufacturer, and having examined it, he was so much pleased that he made from it the first Boehm Flute made in the United States."

13. Besides offering easier control when manufacturing the blowing edge this arrangement also helps to protect the player against allergies caused by certain species of tropical woods, including the frequently-used cocuswood.

14. Karl Ventzke has kindly given me a list of extant 1832-system flutes made by Rudall & Rose from serial no. 1 to no. 268. Among these instruments no. 11 (private communication from Robert Bigio), no. 47 (Edinburgh University Collection no. 962), and no. 90 (private collection in Germany), probably all made in 1843 and 1844, already show the Dorus G♯ key.

15. Louis Auguste Buffet *jeune* had already applied for a patent for needle springs (and clutches for the coupling between the ring for R1 and the F♯ and B♭ keys) in France in 1838.

the other hand, the crescent-shaped D♯ lever looks more French and the design of the key cups with pointed arms spanning the whole cup (see fig. 3.1) is typical neither for English nor for French conical Boehm flutes at that time, so Larrabee may already have developed his own style when this flute was made. This would be in keeping with the fact that the flute looks by no means experimental and shows fine workmanship as well as good playing qualities. Comparing the Larrabee flute with the surviving early conical Boehm flutes made by Alfred G. Badger[16] one can find close similarities, and even their stamps (incorporating an almost identical lyre symbol) look as if they were designed with the competitor's stamp in mind.

2. **Maker:** Alfred G. Badger (1815–1892) & Theobald P. Monzani (fl. 1835–1866)
Stamp: (lyre) / BADGER & MONZANI / 181 BROADWAY / NEW-YORK / (lyre) on the head joint and body as well as GOODYEARS / PATENT / 1851,[17] also on the head joint (stamped into the hard rubber; no shield)
Year of Manufacture: 1858 or 1859[18]
Materials: body of hard rubber ("ebonite"—see below); rings, covers of cap and cork screw, wide band surrounding head (including embouchure), and keywork of silver
Sounding Length: 631 mm (B-foot)
Pitch: a′ = c. 448 Hz
Embouchure Measurements: 10.2 × 12.3 mm (oval)
Cork Arrangement: wooden screw with silver cover (indicator) and silver-covered wooden cap
Mechanism: French-style keywork including pointed arms and five perforated keys; Briccialdi B♭;[19] Dorus G♯; B-trill for R1; modern upper trill key arrangement; teardrop-shaped D♯ lever

16. Eight conical Boehm system flutes made by Badger are described in Simpson, 44–61, and Berdahl, 244–47. Another two instruments have been brought to the attention of the author by David Shorey (serial no. 46) and by Jaap Frank (serial no. 205), both "P. Ernst's Approved."

17. This inscription probably refers to U.S. Patent no. 8075 of 1851 for the invention of hard rubber, granted to Nelson Goodyear, the brother and collaborator of Charles Goodyear (private communication from Karl Ventzke).

18. It was only during this period that the already famous flute maker Alfred G. Badger was in partnership with Theobald P. Monzani, who was active as a flute maker and retail distributor in New York from 1835 to 1866 (see Waterhouse, 271, and Simpson, 317 and 342–43).

19. Arrangement of the thumb keys as in use today, devised by the Italian flutist and composer Giulio Briccialdi (1818–1881) in 1849.

Comments: Many features of this flute very closely resemble contemporary French wooden instruments, for example those from the workshops of Godfroy and Lot. As usual at that time we find equal-sized tone holes among the large ones including those on the foot joint (12.8 mm diameter, compared to the upper B- and C-holes which are only 12.3 mm). Holes in the perforated keys are quite small (7.2–7.5 mm diameter). As on many other Badger flutes the cover of the cap and the tube around the embouchure show beautiful engravings. Alfred Badger was the first to use vulcanized (hard) rubber, called "ebonite," in the construction of musical instruments, and in 1859 he bought the patent rights for using this material in flute manufacture.[20] Three Boehm flutes, one simple system flute, and a clarinet made by him were shown in Charles Goodyear's exhibits at the Exhibition of the Works of Industry of All Nations in London in 1851.[21] Due to some desirable properties for flute making (similarity of appearance to ebony or blackwood, resistance to moisture and both hot and cold temperatures, sturdiness, poor heat conductivity, and cheapness), ebonite became a widely used material for flutemaking in America (sometimes for head joints only, as with the Meinell flute, no. 5 below) and in England (Rudall Carte & Co., Boosey, and others), especially in the last quarter of the nineteenth century.[22] In 1859 ebonite was improved so that it took a better polish and the flute described here is probably made from this material. This flute is interesting because it was made by the most renowned American Boehm flutemaking workshop of its time and can be dated quite exactly. It shows that at least for a time Badger offered a model with keywork virtually identical to contemporary French instruments and including the five perforated keys.[23] Though the condition of its mechanism has suffered

20. Berdahl, 249.

21. Simpson, 70–83, and Berdahl, 111–16. See also Karl Ventzke, "Hartgummi (Ebonit) als Werkstoff im Flötenbau," *Tibia* 17 (1992): 45–48.

22. Ebonite was much praised by the flutist and author Richard Shephard Rockstro (1826–1906) as the ideal material for flute making in his important book *A Treatise on the Construction the History and the Practise of the Flute* (London, 1890). Theobald Boehm made at least one flute out of ebonite (no. 106 in 1856) but did not like its sound.

23. Two more Badger flutes which originally had all five perforated keys are in the Dayton C. Miller collection (DCM 828 and 58) and are described in Simpson, 166, and Berdahl, 253. DCM 828 is also made from ebonite and bears a gold shield with the Badger & Monzani mark. It is described by Berdahl, p. 249, as ". . . the earliest known Boehm system cylinder bore flute (which can be definitely dated) made in this country and it is the first known American made Boehm to have the five perforated keys." Recently David Shorey, in his *Descriptive Listing of Antique Flutes* (private records, partly published in sales catalogues), has suggested that a Badger silver flute formerly in the von Huene collection (Shorey no. 695) may have been made as early as 1855 or even

somewhat from numerous repairs and overhauls, the flute's playing qualities are still excellent, with easy response and a colorful sound. Another Badger flute in the author's collection, which can be dated between 1860 and 1867, is an instrument with a silver-plated tube and silver keywork, bearing the maker's name engraved on a gold shield: A. G. BADGER & Co. / NEW YORK. This flute still has the Dorus G♯, combined with covered keys (of the "raised nipple" style for those which are not touched by the fingers) with short Y-shaped arms. Quite small (13.05 mm diameter), "equal-sized" tone holes are still retained, including on the (B-) foot joint.

3. **Maker:** William Rönnberg (1803–c. 1889)
Stamp: (four-diamond motif) / RÖNNBERG / N.YORK / (four-diamond motif) on head joint, body, and foot
Year of Manufacture: c. 1865
Materials: body of curly, stained boxwood; mounts and keywork of silver
Sounding Length: 628 mm (B-foot)
Pitch: a′ = c. 450 Hz
Embouchure Measurements: 10.35 × 11.7 mm (oval)
Cork Arrangement: wooden screw with silver cover (indicator) and wooden cap
Mechanism: plateau keys, of the "raised nipple" style for those which are not touched by the fingers, with short Y-shaped arms; Briccialdi B♭; Dorus G♯; modern arrangement of the upper trill keys but with their touches moved upwards because of the Rockstro F♯: D-trill for R1, D♯-trill for R2, Rockstro F♯ for R3;[24] no B- (or B♭-) trill

---

earlier, mainly because of its old style foot joint, which is constructed in the same manner as is found on Badger's conical Boehm flutes (and the Larrabee flute, no. 1 above). This is a strong argument which was already raised by Mary Jean Simpson; on the other hand she could not find specific mention of flutes with silver tube and keywork prior to Badger's broadside for his "Improved Metallic Cylinder Boehm Flute" in 1867. A silver Boehm flute by Badger dated 1866 (owned by the Hancock Museum of the University of Southern California and presently on loan to the Fiske Museum) is the earliest dated metal Boehm flute made in America. Its G♯ key was originally made to be open and was later converted twice: see Simpson's description of this instrument and photographs in Lloyd P. Farrar, "Under the Crown & Eagle," *Newsletter of the American Musical Instrument Society* 18/2 (June 1989): 4.

24. This key was already added by Richard S. Rockstro (see footnote 22) in his first modification of the Boehm flute in 1852 to avoid cross-fingering of the F♯. This was also the purpose of the Brossa F♯ key and other inventions which were later quite common in England. A detailed description of these devices can be found in Toff, *The Development of the Modern Flute.*

Comments: This flute is interesting for the development of American Boehm flute making because it seems to predate most of the many existing cylindrical flutes by Badger. It may even have been manufactured earlier than the estimated year given above because Rönnberg had already been awarded a diploma for a Boehm-system flute at the annual fair of the American Institute of the City of New York in 1857.[25] What makes this flute appear early are the Dorus G♯ and the small, equal-sized cups and tone holes (13.0 × 13.2 mm), the use of (very beautiful) boxwood,[26] and a plain, thin-walled head joint with a quite small embouchure hole which is more round than oval in appearance (see fig. 3.2), something one would not expect on a cylindrical Boehm flute. The key cups are rounded in a manner similar to those on early Godfroy and Lot flutes, and show an individual design, especially those touched by the fingers. Its workmanship is excellent (see fig. 3.3) and its playing qualities—as far as they can be tested with slightly leaking pads—are obviously influenced by the thin-walled head joint with its almost-round embouchure hole, combining sweetness with the more open sound of the cylindrical flute.

4. **Maker:** Theodore Berteling (1821/22–1890)
Stamp: T. Berteling & Co. N.Y. (engraved in script around barrel)
Year of Manufacture: c. 1880
Material: silver
Sounding Length: 582 mm (C-foot)
Pitch: a′ = c. 457 Hz
Embouchure Measurements: 10.25 × 11.75 mm (rounded rectangle)
Cork Arrangement: wooden screw with silver pin (indicator) and silver-covered wooden cap
Mechanism: plateau keys, of the "raised nipple" style for those which are not touched by the fingers, with longer Y-shaped arms; (modern) Briccialdi B♭; converted to open G♯ (originally modern closed G♯); modern

25. Berdahl, 692.

26. Because boxwood reacts to changes in humidity by swelling and shrinking to a greater extent than other woods used for flute making (such as ebony, grenadilla, and cocuswood), its use had already decreased by the time flutes with many keys became more common. The cylindrical Boehm flute, with its large tone holes and its complicated mechanism, is even more sensitive to dimensional changes of the flute tube, which can cause sticking keys and leaking pads. Nevertheless, early cylindrical Boehm flutes made from boxwood can occasionally be found, including instruments from the workshops of Boehm & Mendler and Rudall Carte & Co.

upper trill key arrangement; B-trill for R1; spatula C♯ touch on the foot joint (roller for C only)

Comments: This flute is of special interest because it shows most of the features of Berteling's 1868 patent, being the first American patent for improvements specifically to the Boehm system flute:[27] all clutches for the coupling of the keys are moved to the back side of the flute. They have adjusting screws which are protected by flat springs (see fig. 3.4); separate axles for the thumb key and the Briccialdi B♭ lever[28] (but not, as shown in the patent, for the keys on the foot joint); tone hole rims are chamfered only and somewhat countersunk, resulting in a quite sharp pad seat, while the spring holders at the trill keys are of a special design. The flute has an extraordinary lip plate designed as a diagonal scroll[29] (see fig. 3.5) and is beautifully engraved also on the crown, the upper end of the head joint, the barrel, and the upper and lower ends of the foot joint. Berteling's workmanship on this flute is fine; the instrument's sound is not loud but very clear, though intonation seems to be somewhat problematic.

5. **Maker:** William R. Meinell junior (1846–1927)
Stamp: W. R. MEINELL / NEW YORK on head joint
Year of Manufacture: c. 1885
Materials: (thinned) head joint and crutch of ebonite; the rest of the flute of silver
Sounding Length: 585 mm (C-foot)
Pitch: a′ = c. 452 Hz
Embouchure Measurements: 10.25 × 11.7 mm (rounded rectangle)
Cork Arrangement: wooden screw with silver cover (indicator) and ebonite cap
Mechanism: covered keys of slightly modified "Mendler" style with somewhat longer Y-shaped arms; no adjusting screws; "wart" (finger rest for L1); crutch (thumb rest); Briccialdi B♭ with B♭ touch below and B♮ above; open G♯; B-trill for R1; modern upper trill key arrangement; teardrop-shaped D♯ touch; rollers for C♯ and C on the foot joint

27. See Berdahl, 293–94 and 759–60, with facsimile of the patent.

28. Double axles at the thumb keys can later often be found on flutes made by Florent Hofinger in Brussels, and even a modern American flute maker introduced them again some years ago.

29. As shown on the Berteling brochure reproduced in Berdahl, 296.

Comments: With the exception of the probably original thumb keys, this flute is modelled closely after the Boehm & Mendler pattern, including a (silver) support for the left forefinger and a crutch made from ebonite. Silver flutes with wooden head joints had already been made by Boehm and by Boehm & Mendler,[30] and Theobald Boehm himself recommended this combination. With the help of Boehm's pupils Edward Heindl (1837–1896), Carl Wehner (1838–1912), and Eugene Weiner (1847–1903), who had established themselves as players in major orchestras and music groups in America, the Boehm & Mendler flute design started to become fashionable here in the 1870s. The combination of a metal body with a wooden or ebonite head joint was common mainly in the 1880s, before it was superseded by the all-wooden flute in the 1890s. Susan Berdahl has published excerpts from a very interesting correspondence between Meinell and Dayton C. Miller[31] concerning Miller's purchase of a Meinell flute and including the opinions of other advisers. This shows the good reputation and self-confidence of Meinell, who was trained under Badger from 1868 to 1873 before he opened his own workshop in 1874. Furthermore, Miller is quoted that "Meinell had always made the headjoints with the straight taper, rather than figuring out some sort of parabolic curve. To Miller's view, the heads were not inferior in any way."[32] The reason for this is given as: ". . . due to the difficulty of working with the wood he had discontinued the parabolic curve in the headjoint, yielding to a straight taper instead."[33]

It is commonly accepted among scholars that both the shape of the bore and the design and execution of the embouchure hole are of great importance for the sound and playability of transverse flutes of all types. With regard to the cylindrical (Boehm) flute, the importance of the shape of the "parabolic" curve inside the head joint and the gradient of the curve and the diameter at the embouchure hole are often emphasized.[34] Keeping this in mind, it may be interesting to examine the graph in fig. 4, showing bore measurements of the ebonite head joint of

30. In the Dayton C. Miller collection five out of thirty-one cylindrical flutes from the Boehm and Boehm & Mendler workshops are preserved with one original or an additional wooden head joint.

31. Berdahl, 598–601.

32. Ibid., 602.

33. Ibid., 102.

34. Albert Cooper, for example, prefers a bore diameter of 17.36 mm at the center of the embouchure hole, and measurements between 17.3 and 17.4 mm are most frequently found.

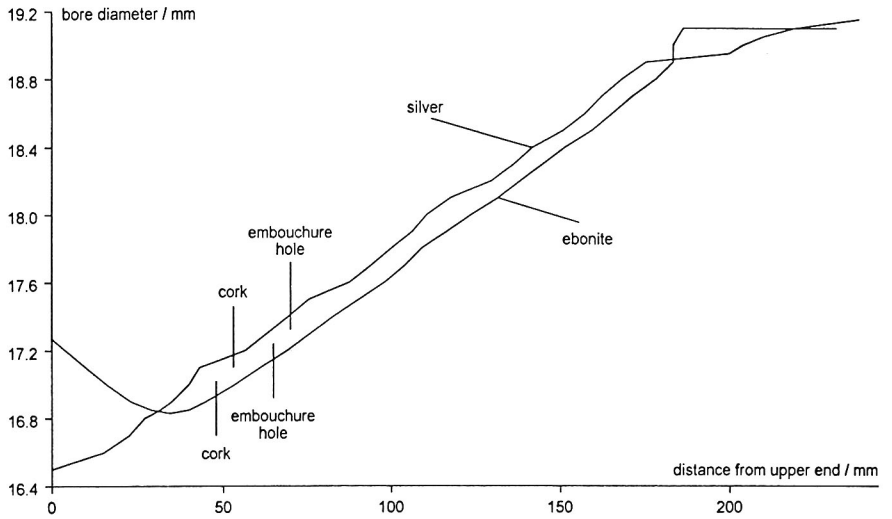


FIGURE 4. Bores of two headjoints by William R. Meinell.

the Meinell flute described above and of a silver head joint of another Meinell flute in the author's collection with keywork of an almost identical design. Except for a step where the silver tenon is glued into the ebonite, without any doubt the bore of the ebonite head shows a straight taper, with a bore diameter of only c. 17.15 mm at the center of the embouchure hole. The graph of the bore of the silver head joint is more wavy, which may be due to its seamed tube, its distinct ovality (means between minimum and maximum diameters are shown), and difficulties in measuring exact diameters of very thin-walled tubes. Nevertheless, "straight taper" is also the best description for this head-joint bore, and its diameter at the center of the embouchure hole equals the more common c. 17.4 mm. The strikingly good playing qualities and pleasant sound of both Meinell flutes confirm Miller's statement, and no peculiarities in intonation could be detected.[35] The flute with the ebonite

35. Of course intonation is also affected by many other factors, such as tone hole height and placement (scale), cork position, embouchure hole height and size, etc. It seems to me that a lot of variation is possible without sacrificing quality as long as all determining factors go well together, and that Meinell was a creative maker in this respect. Of course it cannot be expected that head joints like the ebonite head joint of this flute can be used on other instruments with good results because tone hole placement and taper of the head joint have to go together for best results in tone and intonation.

head has obviously been heavily used; quality of workmanship is good though not exceptional.

6. **Maker:** William S. Haynes (1864–1939), while superintendent of flute making at John C. Haynes & Co.
Stamp: BAY STATE / J. C. HAYNES & CO. / BOSTON, MASS. / U.S.A. / 181. on body, with monogram "JCH" instead of name and without number on head or foot joint; "235" on underside of G♯ touch
Year of Manufacture: c. 1898
Materials: body of blackwood (grenadilla); rings and keywork of sterling silver
Sounding Length: 608 mm (C-foot)
Pitch: a′ = c. 432 Hz
Embouchure Measurements: 10.25 × 12.3 mm
Cork Arrangement: wooden screw and wooden cap with inset silver disk (no indicator)
Mechanism: covered keys of the "Mendler" style with slightly longer Y-shaped arms; ball-mounted adjusting screws; Briccialdi B♭; (modern) closed G♯; modern upper trill key arrangement; B-trill for R1; teardrop-shaped D♯ touch; rollers for the C♯ and C keys on the foot joint
Comments: After William S. Haynes had worked together with his brother George Haynes (see below, no. 8) from 1888 to 1894, he was in charge of the flute department of John C. Haynes & Co. from 1894 to 1900. After that he founded one of the most prestigious flute-making businesses in the world, the William S. Haynes Company of Boston. During his years with John C. Haynes, who was neither a flutemaker nor a relation, William S. Haynes made all styles and sizes of Boehm flutes in use in America at that time, and was responsible for the good reputation of the "Bay State" flutes (trademark of John C. Haynes & Co.) after only a few years. William S. Haynes probably made the first gold flute in America in 1896 and was described as "the most skilful flute maker in America" in a John C. Haynes & Co. brochure issued c. 1897.[36] Carl Wehner, the famous pupil of Theobald Boehm, wrote about a wooden flute which William S. Haynes had made for him in 1898, while still with John C. Haynes & Co.: ". . . and I do not hesitate to express the opinion that my teacher, Mr. Theobald Boehm, could he have seen this instrument, would have been delighted with it, especially with the beautiful

36. Berdahl, 442.

mechanism. You may indeed be proud of the instrument; it is in good tune, it responds easily and quickly throughout its whole compass, and the tone is noble and of great brilliancy. In short, it is by far the best Flute I have played upon during my 26 years sojourn in the United States. . . ."[37]

Like the Meinell flute (no. 5), the flute described here is very similar to the ones made in the Boehm & Mendler workshop, and this was also to be the style in which the early flutes of the William S. Haynes Co. were manufactured.[38] The influence of Boehm's pupils favoring their teacher's model has already been mentioned in discussing no. 5, above. This flute was made during the period from c. 1890 to 1912, when the wooden flute was the standard instrument and only few makers like Conn (see below, no. 7) were recommending other materials. The pitch of this instrument seems to be slightly lower than the French *diapason normal* of 1859 (a′ = 435 Hz), which was introduced in some places in America during the 1880s and 1890s before the somewhat higher "low pitch" of a′ = 440 Hz was commonly accepted around 1917.[39] The number "235" on the G♯ touch is a model designation meaning "wood, with sterling silver keys."[40]

When the partnership between George W. and William S. Haynes was dissolved in 1894, George Haynes's equipment (tools, dies, etc.) was taken over by John C. Haynes & Co. With this in mind an early wooden flute by George Haynes in the author's collection (made of cocuswood with silver keywork, engraved in Boehm & Mendler style "George W. Haynes. / Boston." on the lower ring of the upper body tenon), probably made before 1894, has been compared with the William S./John C. Haynes & Co. instrument. There is an amazing similarity in the shape of the key cups, touches, posts, etc. On the other hand, these features are also almost identical on the later wooden Boehm & Mendler flutes. Exact measurements reveal that on the wooden George Haynes flute, for example, the key cups from the F♯ key down to the foot joint are larger than on the William S./John C. Haynes & Co. instrument. In fact,

37. Ibid., 452.

38. A slight difference is the key design of the William S. Haynes flutes, showing ledges where the key arm meets the (Mendler-style) key cup. This design was later also used by other American and Japanese makers.

39. In some places the very high "concert pitch" (a′ = 450–460 Hz), which was the standard before c. 1880, continued to be used until the 1920s, and high-pitched instruments were still offered at that time.

40. Berdahl, 443.

the George Haynes flute has graduated tone holes in three groups as introduced in France in the 1860s[41] and still used today, while the William S./John C. Haynes & Co. flute has somewhat larger tone holes on the foot joint only (13.2 instead of 12.7 mm diameter) with equal-sized cups. It is therefore hard to say if the same dies or tools were used for the parts which are practically identical on the two flutes.

Workmanship and playing qualities of the William S./John C. Haynes & Co. flute are both excellent. It has a pleasant sonority which may be enhanced by its very low pitch.

7. **Maker:** C. G. Conn & Co. (founded by Charles Gerard Conn, 1844–1931)
Stamp: MADE BY / C. G. CONN / ELKHART, IND. & / NEW YORK on barrel, "3102" on tube below barrel as well as on the undersides of the G- and B-trill touches and B (thumb) key, "3102/Y" on the underside of the G♯ touch
Year of Manufacture: c. 1898
Materials: German silver, gold plated; ebonite lip plates attached by screws covered with mother-of-pearl; key cups for L1–3 and R1–3 (and upper C touch) inlaid with mother-of-pearl
Sounding Length: 635/625 mm (B-foot, two head joints)
Pitch: a′ = c. 442/457 Hz
Embouchure Measurements: 10.65 × 12.7 mm (oval), on both head joints
Cork Arrangement: modern style, with longer threaded tube fixed to the crown
Mechanism: plateau keys with French (pointed) arms for those which are not touched by the fingers; holder for crutch (which is missing); Briccialdi B♭; (modern) closed G♯; modern arrangement of the upper trill keys; trill keys for G and B, both for R1
Comments: Like John C. Haynes, Charles Gerard Conn was not himself a flutemaker, yet he managed to become the largest single producer of wind instruments in the United States and the first to mass-produce inexpensive Boehm flutes here, which enabled his instruments to compete with cheap imported flutes from Europe. Details about Conn's unconvential life and his many activities can be found in Berdahl's dissertation

41. Karl Lenski & Karl Ventzke, *Das goldene Zeitalter der Flöte* (Celle: Moeck Verlag, 1992), 137.

and an article in this JOURNAL by Margaret Downie Banks and James Jordan.[42]

The flute described here is an example of the ever-changing "Conn Wonder Boehm System Metal Flute" which was first introduced in c. 1892. It was Conn's top model with "Finish I,"[43] characterized by engravings on head joint and barrel, heavy gold plating (which has suffered through the years), burnished finish (sandblast velvet finish was optional), and keys and fingerhole caps inlaid with mother-of-pearl (see fig. 3.6). The black ebonite lip plate attached by screws covered with mother-of-pearl (see fig. 3.7) makes a beautiful contrast to the gold plating. At a time when most professionals in symphony and opera orchestras were using wooden instruments, Conn was still promoting the metal flute, often in combination with ebonite lip plates or head joints (for example the "Howe Model"),[44] while even making instruments from metal-covered ebonite.[45] Probably also due to his clever marketing strategies, his low prices, and publications like Henry Clay Wisham's book,[46] large quantities of Conn flutes must have been sold.

Among the distiguishing characteristics of this flute are the numerous adjusting screws for the mechanism: besides three in the back-side clutch there are screws in the arms of the keys for L2, R2, and R3 as well as in the arms of the C♯ touch and the C♯ key on the foot joint. Movement of the D♯ touch is stopped by a metal post underneath. Also of interest is the presence of two head joints for "high" and "low" pitch, a feature which can be found occasionally during the time when two (or more) different pitch standards were used in different places, orchestras, bands, etc. For example, imported instruments by Carl (August)

42. Berdahl, 347–87; Margaret Downie Banks and James W. Jordan, "C. G. Conn: The Man (1844–1931) and His Company (1874–1915)," this JOURNAL 14 (1988): 61–113.

43. Berdahl, 362.

44. Named after Charles T. Howe, a flute professor in Columbus, Ohio. Conn called his metal flute with ebonite head joint "Howe Model" until 1896, when the arrangement between him and Howe was no longer in effect and the Buescher Company started to manufacture a Howe Model (see Berdahl, 124–28).

45. The author's collection also includes two Conn Boehm piccolos: a conical one, serial no. 4027, made c. 1899, with ebonite head joint and ebonite body covered with silver-plated brass and gold-plated keywork, as well as a cylindrical one, serial no. 46649, made c. 1918, with ebonite head joint and gold-plated body and keywork in sandblast velvet finish.

46. Henry Clay Wisham, *The Evolution of the Boehm Flute* (Elkhart, Indiana: C. G. Conn, 1898).

Schreiber junior (1863–1929) of Markneukirchen and Emil Rittershausen (1852–1927) of Berlin were sometimes made with two head joints for the various pitch standards in America. Naturally, intonation cannot be equally good with head joints differing 10 mm in length and about 15 Hz in their pitch for a′. Some compensation, especially for the third octave, can be made with the head-joint taper and the cork position, but for the lower octaves the influence of the tone hole positions cannot be overcome. When comparing scales of cylindrical flutes a reliable gauge is the distance between, for example, the upper ends of the outer large tone holes on the body (the B and E holes, acoustically speaking), because one hardly ever finds a flute where this measurement has been changed (except for some "retuned" or "rescaled" instruments from the great times of French flutemaking that were often beautiful only before this operation took place). On the Conn flute this distance is 172 mm, which one would expect on a cylindrical flute with equal-sized tone holes and a pitch of a′ = c. 447 Hz, not quite halfway between the two pitches at which this flute actually plays. As with the William S. Haynes flute, no. 6, the Conn flute also has larger tone holes on the foot joint only, having a diameter of 15.1 instead of 14.1 mm. This shows that Conn was trying to find a compromise between higher and lower pitches (though in this case the latter is clearly above a′ = 435 Hz). Nevertheless, the longer head joint, which gives the better ratio between sounding length and tone hole distances, seems to produce the more even intonation.

Workmanship on the flute looks fine and playing qualities are quite good with a pleasant, dark sound.

8. **Maker:** George W. Haynes (1866–1947)
Stamp: GEORGE W. HAYNES. / NEW YORK. on tube below barrel
Year of Manufacture: c. 1915
Materials: tube of silver-covered aluminum; keywork of silver
Sounding Length: 596 mm (C-foot)
Pitch: a′ = c. 440 Hz
Embouchure Measurements: 10.3 × 11.8 mm
Cork Arrangement: wooden screw with silver-covered wooden cap
Mechanism: covered keys in modified "Mendler" style; ball-mounted adjusting screws; "wart"; Boehm thumb keys (B key fixed to the upper rod, B♭ touch below); open G♯; modern arrangement of the upper trill keys; no B- or B♭-trill key; rollers for the C♯ and C keys on the foot joint

Comments: The use of aluminum in flute construction had already been patented in France in 1903.[47] While it is known that William S. Haynes manufactured flutes with aluminum tubes in 1912–13 and that the problems with soft soldering of aluminum led to the introduction of drawn tone holes,[48] there are no written records that his brother George also used this material in flute construction. On this flute the inner diameter of the aluminum tube is larger than normal (19.35 mm), perhaps because this was the inner diameter of tubings commercially available. In the head joint the inner diameter of the aluminum tube is 17 mm at the upper end, while at the lower end of the taper and inside the tenon the aluminum tube has been removed completely, leaving only the outer silver tube. The outer diameter of the head joint is 21 mm (cylindrical) and 23 mm for the rest of the flute. The wall thickness of the silver tube is about 0.35 mm with no visible seam. The attached silver head-joint tenon and the body tenon (inner aluminum tube turned down) are covered with thin layers of cork. It is obvious that the tone holes have been drawn through both the aluminum and silver tubes simultaneously (see fig. 3.8).

Dating this flute is not easy because it shows no serial number. But according to the stamp it must have been made between 1905 and 1922 because this is the time when George Haynes was working in New York under his own name. Depressions in the centers of the key cups have a larger diameter than on early George Haynes flutes made in Boston (see notes about the wooden flute by George Haynes, no. 6 above), but they are smaller than those on flutes made when he worked for H. & A. Selmer, Inc., in New York from 1920 until 1922 (during which time he continued to stamp his instruments with his own name only). Arms and cups of the keys are soldered together and are not of the later "one-piece," drop-forged type. Graduation of the large tone holes (12.75/

47. Patent no. 330,592 of March 25, 1903, by Henri-Émile Ehrmann (see Toff, 191 and 248). A flute has recently been brought to the attention of the author which was made by C. Rive/A. Robert in Paris, serial no. 2420, with the additional engraving "EHRMANN/ Invent^{R} breveté/S.G.D.G." This flute has a thick-walled aluminum tube (2.5 mm after thinning) and is made like a thinned wooden flute (protruding tone holes, "carved" lip plate), with silver keywork. According to the maker's address inside the case it must have been made not later than 1905.

48. Berdahl, 546–47. As far as the author knows, the current whereabouts of any of these aluminum flutes is still unknown. William S. Haynes's patents for drawn tone holes in 1913 (Great Britain and Germany) and 1914 (U.S.A.) were worthless because it turned out that his brother George W. Haynes had already made them on an alto flute in F in 1898 (now in the Dayton C. Miller collection, no. 118).

14.1/15.55 mm diameter) also cannot help to date the flute more exactly because this seems to change irregularly among extant George Haynes flutes. A possible indication for an even later year of manufacture than the one given above is the pitch of a′ = c. 440 Hz (for some remarks about pitch fluctuations see above, no. 6), so that the time of manufacture might not necessarily be directly connected with William S. Haynes's experiments with aluminum and drawn tone holes. Another unusual feature at that time, and one of George Haynes's specialities, is the replacement of pins (almost all on this flute) by screws inserted into the steel rods.

George Haynes's flutes show a great deal of variety, yet it has been pointed out by Berdahl that this innovative maker (who also made many creative inventions in the field of tools, dies, machines, etc.) stood in the shadow of his younger brother, William S. Haynes, a more determined personality and by far the more successful businessman.[49] Workmanship on many earlier George Haynes flutes, including the one described above, does not look as refined as, for example, on the best specimens made by Alfred G. Badger or William S. Haynes, but most of these flutes couple the creativity and devotion of a great flute maker with good playing qualities.

Concluding Remarks

The instruments described above were made from the beginning of Boehm flute making in America, c. 1844, up to the turn of the century (with the exception of the probably somewhat later George Haynes flute, which I have included mainly because of its interesting materials and construction). Although the selection was made primarily with the idea of publishing detailed information about rare flutes and of showing some specialities of American Boehm flute making in the nineteenth century, some general trends during this period also become apparent, such as the obviously strong influence of European makers like Godfroy, Lot, and Rudall & Rose (later Rudall Carte & Co.). It is quite possible that at least Badger had seen and studied the instruments made in Boehm's own workshop in the mid-1850s, through the assistance of his friend Philip Ernst (1792–1868), who purchased seven wooden flutes and one of silver directly from the inventor between 1854 and 1857.[50]

49. Berdahl, 403 and 414–15.
50. Ibid., 51.

In addition to numerous original ideas in design and construction, French influence is obvious when studying the instruments by Badger & Monzani (no. 2),[51] Rönnberg (no. 3), Berteling (no. 4), and Conn (no. 7), whereas the other flutes—those made by Meinell (no. 5), William S. Haynes (no. 6), and George Haynes (no. 8)—demonstrate a close similarity to the Boehm & Mendler design. As mentioned under no. 5, the fact that some of Boehm's pupils were playing an important role as flutists in America from the 1870s onward might have been the main reason for this change. Flutes made after the transition to the metal (silver) flute between 1912 and 1918 (partly caused by the difficulties in obtaining high-quality wood during World War I) and especially those made after the (re-)introduction of the "French Model" by William S. Haynes and Verne Q. Powell (1879–1968) in the 1920s, have not been discussed in this article. Both the Boehm & Mendler model as well as the ultimately even more successful Louis Lot model were introduced and promoted by players using this type of instrument, including such famous French-American flutists as Georges Barrère (1876–1944) and Georges Laurent (1878–1964), with anti-German sentiments during World War I accelerating this transition.

Such features as seamed tubes, soldered tone holes, and a low chimney (or a low wall thickness) at the embouchure hole (compared with the measurements used today) were standard in Boehm flute making everywhere during the entire nineteenth century. Another development which could be observed worldwide as time went on was the efforts to increase both the loudness and carrying power of the instrument as well as the sturdiness and reliability of its mechanism. Thus, the wall thickness of metal flutes became greater (compare Meinell's 0.26 mm with Conn's 0.48/0.54 mm), the diameter of the tone holes increased, and graduation of the tone holes was (re-)introduced. The flutes made by Badger & Monzani, Rönnberg, and Berteling have "equal-sized" tone holes throughout, while those by Meinell, William S. Haynes, and Conn have larger tone holes on the foot joint only. The early twentieth-century flute by George Haynes has the "modern" graduation with the large tone holes divided into three groups each with different diameters.

Concerning the varying preferences for different materials for flute tubes, it is interesting to note that while the wooden flute was by far the more common model in France (until the 1860s, only slowly changing

51. Unlike most of Badger's flutes up to the 1870s, this one looks exactly like a French flute.

until the 1890s),[52] in America the metal flute seems to have been equally accepted from the beginning of cylinder-flute making until the 1880s.[53] Even after the silver (or *maillechort,* i.e., nickel silver) flute became the standard instrument in France, American professionals were using wooden instruments (in the Boehm & Mendler style) almost exclusively; and while in England and Germany preference for wood continued well into the first half of the twentieth century, in America the overall transition to metal flutes took place around 1915, and the preference for the Lot model started about ten years later.

Most flute players who are acquainted with the different feel and playing characteristics of flutes made from different materials are convinced that, for example, "identical" instruments made from wood, silver, or gold will produce colors whose differences are clearly audible. Some even believe that the impurities in Louis Lot's silver alloy make a difference not unlike that supposedly caused by the mysterious varnish used by Stradivarius on his violins. On the other hand, most flute players will agree that the way a flute sounds depends in the first place on the person playing it, and in the second place on the quality of the instrument itself, which in turn is determined by the skill and knowledge (and luck) of the person who made it—in whatever material—as well as on the flute's current playing condition, including above all the quality and airtightness of the padding. In addition, it can easily be demonstrated that a flute's tone is strongly influenced by the design of the head joint, especially the gradient of its taper in different places, as well as the precise characteristics of the embouchure hole, such as its position, its form and size, and the way it is undercut and chamfered. However, anyone who has ever taken part in a test in which a hidden flutist plays in a large room will most probably have discovered that distinguishing different materials by ear is almost impossible even for an experienced listener. As John Backus has observed, "although the walls of a woodwind instrument do vibrate when the instrument is sounded, these vibrations are insufficient to affect the steady-state tone quality either by radiating sound themselves or by altering the form of the internal air-column vibration.

52. This statement is based on levels of production for the Louis Lot firm as given in Tula Giannini, *Great Flute Makers of France: The Lot and Godfroy Families 1650–1900* (London: Tony Bingham, 1993), 209–10. The number of wooden flutes listed there from the period 1855 to 1891 may include a considerable portion of conical Boehm flutes as well as some ordinary (keyed) flutes, especially in the earlier years.

53. This opinion is supported by the catalogues of early American Boehm flute makers as well as by extant instruments and may also be an indication of English influences as discussed under no. 1, the conical Boehm flute made by Larrabee.

Therefore, it appears that the material from which the instrument is made can be selected for other qualities such as dimensional stability, ease of fabrication, etc., and not because of any tone quality associated with the material."[54]

Noticeable differences in sound, often ascribed to the use of different materials, are generally caused by characteristics normally existing in or typically resulting from working on a specific material—surface structure or roughness (which also influences the blowing resistance), heat conductivity, formation of condensation (influenced by heat conductivity and micro-structure of the surface), chamfer at the edges, and so on —as well as by psychological factors (such as whether the material is pleasant or unpleasant to the touch). Vibrations of the material felt by the player (but inaudible to a listener even a short distance away) can also influence the style and way of playing and so change the sound indirectly. Finally, it is easy to imagine that a flute maker will take more time and trouble (or assign his best workman to do the job) when a very expensive material such as gold or platinum is used, thus creating a somewhat better instrument—but only as an indirect result of the material chosen.

Though a lengthy discussion of this issue is not the topic of this article, the following suggestions might perhaps explain the reasons for the different materials used for flutes in general and for the specific instruments described above. Practical considerations from the maker's point of view include workability (boring, turning, soldering, drawing), strength, stability, price, and availability, as well as appearance (color, surface structure, gloss, ability to take a polish), sensitivity (for example, discoloration, corrosion, hardness, elasticity), and last but not least how the instrument "feels" when held by the player (such as rough, smooth, or slippery, cold or warm). It should not be overlooked that changes in materials, models, embouchure designs, preferred wall thicknesses of the tube, and pitch, etc., were sometimes welcomed or even initiated by the makers because this could result in a large increase in the demand for new instruments.

As in France, the question of whether to use wood or metal for the flute tube seems to have been decided in America many years ago, though after the wooden flute became completely obsolete here in the 1920s two prominent flutists, Emil Medicus (1882–1980) and Leonardo de Lorenzo (1875–1962), continued to emphasize its merits. Interestingly

54. John Backus, "Effect of Wall Material on the Steady-State Tone Quality of Woodwind Instruments," *Journal of the Acoustical Society of America* 36 (1964): 1887, quoted in Toff, 185.

enough, the wooden Boehm flute has gained some popularity again today;[55] some of its desirable characteristics can be ascribed to its normally rougher inner surface and above all to the increased possibilities of shaping the tone holes. Advantages include a greater blowing resistance, making it easier for the less relaxed player; a decreased tendency to produce a shrill sound in the third octave; easier slurring across large intervals; a warmer touch, especially at the embouchure area; and less susceptibility to temperature changes due to its lower heat conductivity. Undercutting of the tone holes has been of crucial importance for the playing qualities of woodwind instruments for centuries, and such qualities as sound, response, loudness, and slurring can be improved considerably if undercutting is executed in the right way. Therefore it is not surprising that on nineteenth-century metal flutes made, for example, by Louis Lot and Alfred G. Badger, conically drawn (soldered) tone holes can be found in combination with careful chamferring here as well as at the embouchure hole.

All in all, the flutes described above show the high standards of American Boehm flute making from the very beginning and the variety of models caused by changing preferences and original ideas of the individual makers. The example of the unusual bore measurements of the William R. Meinell ebonite head joint tells us that the art of making excellent musical instruments consists not only of applying fixed rules but just as much of matching, optimizing, and bringing into accord all factors which are responsible for the sound and playing qualities of an instrument. Instrument makers can support the understanding of music and the pleasure of musicians and listeners by creating tools which help to motivate players and to expand their expressiveness. There can be little doubt that early American Boehm flute makers were extremely successful in this respect.[56]

55. The tradition of making wooden Boehm flutes never completely ceased in England, and also in Germany they could always be bought from some makers on special order. In recent years flutes of this type have reappeared in many European orchestras, mainly as an alternative instrument for playing classical and romantic music. In England, Robert Bigio began making complete wooden flutes with a "modern" scale in the 1980s; even before this, in 1975, Alexander Eppler of Seattle was making wooden head joints, and today many makers offer them for use with metal flutes. American makers currently offering wooden Boehm flutes include Chris Abell, William S. Haynes, and Verne Q. Powell.

56. My special thanks go to Jaap Frank (Amsterdam) and to Thomas G. MacCracken for their valuable comments and numerous suggestions for improving the text of this article.