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Liberal use is made of the sonograph, an instrument capable of displaying the intensities of the partials of a given note as a function of time. Thus there are quantitative data on the timbre of the instruments studied: on how the timbre varies with different fingerings or perturbations in the bore, for example, and on the transient changes in emitted sound with the attack.

In addition to the experimental results on the instruments themselves, there are chapters on the method of playing the flute and on the methods of manufacture and materials and tools used. These draw extensively on the contemporary literature, supplemented by modern knowledge of such matters as the species of wood available.

The writing style is concise, often using an outline form, so that the facts and conclusions are clearly visible and easy to follow. One could not ask for a more definitive, knowledgeable, and complete treatise on this instrument.

JOHN W. COLTMAN

Nancy Toff. *The Development of the Modern Flute*. New York: Taplinger Publishing Co., 1979. 268 pp. \$19.95.

Aptly titled, Nancy Toff's book is primarily a detailed examination of the Boehm flute concentrating on details of mechanism added or subtracted during the nineteenth century. In her acknowledgements, Toff recognizes Dayton C. Miller, the "patron saint" of the flute, and his collection of instruments, books, trade catalogs, music, and correspondence now housed at the Library of Congress, which constitute the major source for scholars and performers engaged in flute research. (The instructional treatises in the Miller collection, over 200 in number, were made available on microfilm a few years ago and can be obtained from the Library of Congress.) The introduction stresses the importance of studying mechanical developments in relation to the music for the instrument. Toff tells us later that this view of the evolution of the flute—a recognition of the influence of music on mechanism—was first put forth by Richard Carte in 1851. In 1906 Miller himself had begun a manuscript concerning the "synthesis of the art and science of the flute"; Toff's *Modern Flute* is a continuation and updating of this pioneering work.

The first chapter treats pre-Boehm flutes from their emancipation from vocal music in the Renaissance to their use by Beethoven. This chapter is much less detailed than those which follow. Three important

sources should be added to the bibliography here: Frederick Crane, *Extant Medieval Musical Instruments* (Iowa City: University of Iowa Press, 1972); Emmanuel Winternitz, *Musical Instruments and Their Symbolism in Western Art* (New Haven: Yale University Press, 1979); and the translation (the original is cited) of Michael Praetorius's *Syntagma musicum*, vol. 2, *De organographia* (Wolfenbüttel, 1619) by Harold Blumenfeld (New York: Da Capo, 1980) (the last two works also appeared in earlier printings).

While all of the material in this chapter is accurately presented, Toff slightes the critically important contribution of J. S. Bach to the literature of the flute. She quotes from Bate's comment concerning Haydn that "the transverse flute seems to lose something of the specialised emotional association that it had with Bach," but misses a chance by ignoring Bach's choice of unusual and difficult keys for the flute in the E-major and A-major sonatas (G sharp being a notoriously out-of-tune cross-fingered note on the traverso, despite her assessment of A as a "relatively safe key") and the E-flat-major and G-minor sonatas of which Bach is the putative author. Toff's real forte is improvements to the mechanical design of the instrument, and she is on solid ground from Tromlitz on. Some interesting ideas explained in the concluding section of this chapter are Laurent's glass flutes, the large-tone-hole instruments of Monzani, Wood, and Nicholson, and the Pottgiesser ring and crescent-key construction.

Theobald Boehm (1794–1881), whose flutes are the subject of the second chapter, was an inventor and performer who attempted to meet nineteenth-century orchestral requirements for force and power and the demand by soloists during this age of the virtuoso for a more perfect flute. Boehm's contributions were many: large finger holes placed according to acoustic principles rather than digital convenience, keys to control distant holes, and ring keys. Modifications were added by Buffet, Coche, and Dorus.

Superb line drawings by Jerry L. Voorhees illuminate the entire text of this book. Careful study of these drawings and the accompanying explanations, particularly from chapter 2 forward, give both a visual and literal survey of mechanical development.

Chapter 3, "Contemporaries and Critics of Boehm," describes nineteenth-century "inventions" such as Schwedler's reform flute, Cornelius Ward's seven-cone flutes, the Siccama chromatic flute, and several compromise and combination instruments, such as the Meyer-system Boehm flute and John Radcliffe's efforts in 1870 to reconcile the Boehm mech-

anism with old-system flutes. By this time, only minor mechanical modifications were left to be made. Toff's summary accurately describes this period of intense activity as confused, highly competitive, and influenced by the demands of such virtuosos as Taffanel.

The two paths followed in the twentieth century are exemplified by the artist models made by Haynes and Powell and the school-instrument makers based in Elkhart, Indiana. Modifications of Boehm's design during this period include Borne-Julliot's attempt to "complete" Boehm's work and McAvoy's provision for simple chromatic fingering on a C-to-D flat transposing flute (perhaps the woodwind analog to the harpsichord with transposing keyboard). Of special interest to performers is an extremely well-presented description of the Alexander Murray flute, which was first designed by Murray in 1948 in collaboration with the brilliant English acoustician and flute maker Albert Cooper and the mathematician Elmer Cole. Several prototypes were made by Cooper, and the Murray flute is now made by Jack Moore, formerly of the Armstrong Company. Heated debate ensues whenever a Murray flute is praised or damned by any performer, and Toff's description, several fine photographs, and Voorhees's drawings provide an effective and interesting guide to an understanding of this controversial instrument. The elegance and sophistication in the wide range of flutes now available is due to such recent developments as the application of the Cooper scale to Powell flutes, more accurate cork placement, and the use of the O-ring, all of which free the performer to deal with the refinement of such aspects of tone production as "articulation, timbral subtleties and improvisatory decisions."

The final chapter is a guide to avant-garde flute technique as described by Thomas Howell, Robert Dick, and Bruno Bartolozzi, whose *New Sounds for Woodwind*, trans. and ed. Reginald Smith Brindle (London: Oxford University Press, 1967), introduced many flutists to multiphonics, glissandi, and the like.

The two appendices are interesting. The first is a bar-graph illustrating the systems used by leading performers between 1770 and 1930, centered, for obvious reasons, on the nineteenth century. Some surprises are that Franz Doppler (1821–83) and Moritz Fürstenau (1824–89), in their long professional careers, never converted to the Boehm flute, and that Georges Laurent, famed performer and teacher, began on a seven-keyed flute and did not convert to a Boehm-system instrument until the mid-1890s. The second appendix is a compilation of avant-garde notational devices which should be useful to readers because it is specifically related to the flute.

Some additions to the bibliography would be appropriate for a second edition: Christopher Welch, *Six Lectures on the Recorder and Other Flutes in Relation to Literature* (London: Oxford University Press, 1911); Hans-Peter Schmitz, *Querflöte und Querflötenspiel in Deutschland während des Barockzeitalters* (Kassel: Bärenreiter-Verlag, 1952); Karl Ventzke, *Die Boehmflöte: Werdegang eines Musikinstruments* (Frankfurt am Main: Verlag Das Musikinstrument, 1966); and Gustav Scheck, *Die Flöte und ihre Musik* (Mainz: B. Schott's Söhne, 1975). Toff gives us several bibliographical items not available elsewhere: patent specifications for France, Great Britain, and the U.S. (but, surprisingly, not for Germany), and a list of trade catalogs. A separate listing of instructional treatises, especially for the transitional period, would have been useful and interesting. The published tutors of such composer-performer-teachers as Gunn, Devienne, Tromlitz, Hugo and Wunderlich, and Toulou and Tillmetz can add the dimension of practical applicability to a study of mechanical development. They are all available from the Library of Congress, Frits Knuf (The Flute Library), or Minkoff Reprints in Geneva.

This excellent survey should be an important reference for flutists and flute historians who want to examine the critical impact of Boehm and his successors. Toff's information is presented in a clear and objective manner, allowing readers to decide for themselves the merits of each design change and to understand the current state of the art of flute construction.

JANE P. AMBROSE

Helmut Ottner. *Der Wiener Instrumentenbau 1815–1833. Wiener Veröffentlichungen zur Musikwissenschaft*, vol. 9. Tutzing: Hans Schneider, 1977. 172 pp.

Konrad Ruhland. *Alte Musikinstrumente aus niederbayerischen Werkstätten. Bavaria antiqua: Verborgene Kostbarkeiten der bayerischen Kulturgeschichte.* Munich: Bayerische Vereinsbank, 1978. 63 pp.; 28 plates, 8 in color; 1 map.

Anyone who has ever attempted to study a historical subject is well aware of the valuable work done by bibliographers and lexicographers, those who painstakingly ferret out individual bits and pieces of information without which conclusive studies could never be written. It is just this sort of information that is presented by Helmut Ottner in *Der Wiener Instrumentenbau 1815–1833*, the final, published version of his