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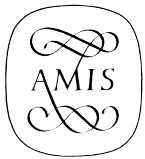

The twentieth century was an era in which agents of change (whose biographies appear in Appendix A, including that of Sun Zhuo's own mother, also a conservatory-trained player of *zheng*) have personally witnessed as well as contributed to this history. Sun Zhuo herself represents a next generation of such agents in the present century. As readers, therefore, we are beneficiaries of her advantaged position: in her intimate knowledge of the instrument itself as well as its traditional repertoires, techniques, and performance styles; in the personal connections she has made that have propelled her fieldwork in China and abroad; and in her ability to adopt new styles and techniques as required for performances of newly-composed, modern-style music for ensembles with mixed instrumentation (both western and Chinese). This recent music consists of three types—concert music by Chinese composers who have studied with western composers and emulate some of their techniques; concert music by western composers who incorporate Chinese elements into their works; and commercial music by western composer/arrangers who need to capture "Chineseness" for movie soundtracks, stage musicals, and video games. The experiences of Sun Zhuo in these performance circumstances have become part of the fieldwork and research methodology that she documents in this excellent, broad-scoped book. It is a pleasure to read her book and to listen—and watch—her recorded performances.

Beth Bullard
Carlisle, Pennsylvania

Patrizio Barbieri, *Physics of Wind Instruments and Organ Pipes 1100–2010. New and Extended Writings.* Latina, Italy: Il Levante Libreria, 2013. xii, 568 pp.: 38 color and 201 black and white illus. ISBN: 978-88-95203-40-9. $41.19 (hardback).

The historical development of musical acoustics is a fascinating but often misunderstood story. The recent archaeological discovery in southern Germany of bone and ivory flutes more than 40,000 years old confirms that musical instrument manufacture is one of the oldest recorded human activities. During these forty millennia makers have experimented with many different ways of generating musical sounds, but the evolution of the highly sophisticated instrumental families which were available to musicians of the early modern period was achieved almost entirely by a process of trial and error. The first attempts to find rational explanations

for the observed musical properties of instruments seem to have been those of the Pythagorean school of Greek philosophers. The ideas attributed to Pythagoras and Aristotle were highly influential throughout the Middle Ages, and it was not until the time of Galileo and his contemporaries that a rigorous experimental approach to the study of acoustics was adopted. In the eighteenth and nineteenth centuries many eminent mathematicians and physicists grappled with the problems involved in obtaining accurate descriptions of the vibratory properties of strings, plates and air-filled tubes. The development of electronic measurement techniques in the first half of the twentieth century resulted in an acceleration in the pace of research in musical acoustics, while in the last few decades the exponential growth of computational power has dramatically expanded the possibilities for numerical simulations of many aspects of musical instrument performance.

Patrizio Barbieri is a highly respected scholar with an impressive record of publications on many aspects of organology. In this volume he has assembled a collection of articles, originally published between 2001 and 2012, which provide an absorbing and illuminating survey of the growth of understanding of wind instrument acoustics over the last millennium. Several of the articles were previously inaccessible to an English-speaking readership because they were written in Italian; these have been translated, and many of the articles have been significantly extended or rewritten. Although each chapter began life as a separate article, most of them are now prefaced by a short introduction listing the points to be explored, and ended by a section which helpfully summarises the main arguments and conclusions. This structure is a valuable unifying feature, since the different chapters inevitably retain some variety of approach.

The chapters are labelled by letters rather than numbers. Chapters A is concerned with medieval views on the relative mechanical and sonorous properties of different metals; Chapter B extends this discussion into a historical comparison of pipe construction methods in Italy and France up to the end of the nineteenth century. The treatment is dense, and the scholarship sometimes a little uncompromising; the target reader is evidently a scholar with prior expertise in medieval history, who will undoubtedly relish this invaluable literature survey. Non-specialists can however find many rewarding nuggets of information in these two chapters, and anyone with an interest in the history of organ pipe technology will find Chapter B an essential and rewarding reference text. Among the splendid illustrations is a photograph of lead pipes

in an Italian organ which have been gnawed by mice, possibly attracted by the smell of the oil in which they were cooled during manufacture.

Chapter C begins a review of the acoustics of tubes in an unusual but fruitful way, taking as an example the history of the megaphone. Barbieri points out that attempts to explain the acoustics of the speaking trumpet by Newton and other contemporary scientists were unsuccessful because they pursued an inappropriate analogy between geometrical optics and acoustics. The development of the theory of wave acoustics in the eighteenth century by Huygens, Bernoulli, and Euler eventually led to a correct description, although a full derivation of the gain in radiated sound power had to wait for the introduction of the idea of acoustic impedance by Webster in 1919. In Chapter D the analogy between the vibration behaviour of a stretched string and that of an air-filled tube is further explored, and the contributions of seventeenth-century Jesuit acousticians including Giuseppe Biancani, Ignaz-Gaston Pardies, and Claude-François Milliet de Chales are highlighted.

The following three chapters are concerned with the acoustics of the pipe organ. The history of flue organ pipe acoustics is reviewed in Chapter E. In 1747 d'Alembert found a mathematical solution for the vibration of a uniform stretched string. A little over ten years later both Lagrange and Euler published similar equations for plane waves in a cylindrical tube, explaining why a stopped pipe emits only odd harmonics. Experiments showed, however, that the sounding length of a pipe was significantly longer than its geometrical length; the explanation of this fact, and the calculation of the corresponding "end correction," remained a theoretical challenge until the work of Helmholtz and Rayleigh in the second half of the nineteenth century. The final part of Chapter E gives a clear summary of the understanding of the jet mechanism of sound production in flue pipes, while Chapter F reviews the corresponding mechanism of sound production by the vibration of a metal tongue in an organ reed pipe. In Chapter G several controversial topics related to the sound radiated by an organ pipe are summarised in a balanced and authoritative review. Barbieri presents experimental evidence demonstrating that in certain circumstances wall vibrations can disrupt the speech of an organ pipe, while accepting that in a normal flue pipe the type of metal is unlikely to have a direct influence on the radiated sound. The influence of pressure rise time on pipe speech and the possibility of exerting control on the transient timbre through touch are also reviewed.

The final four chapters follow the development of wind instrument acoustics from the late nineteenth century up to the present. In Chapter H Barbieri identifies the crucial step as the adoption by Webster in 1919 of the electro-acoustic analogy, in which musical instrument components are represented as elements of an electrical circuit. This approach has continued to be fruitful up to the present in describing the influence of bore profile and tone-hole parameters on the intonation and timbre of woodwind instruments. The modelling of mechanical and lip reeds is also explained in Chapter H. In Chapters I and J the ideas of input impedance, mode frequencies and acoustic filtering by tone holes are applied in more detail to the clarinet and the flute respectively. In Chapter K the acoustics of brass instruments is briefly but comprehensively summarised. This chapter includes a section on early brass instruments, but does not consider labrasones with side holes.

This is a book of immense and outstanding scholarship, with a bibliography containing more than 1200 references. A large number of quotes from original sources are presented with parallel translations into English. The volume is beautifully printed and bound, and the excellent illustrations are for the most part reproductions of the original diagrams from the books or papers cited. For anyone interested in the history of science, and particularly the development of scientific ideas and theories about musical instruments, this book will be an indispensable resource.

MURRAY CAMPBELL
UNIVERSITY OF EDINBURGH

Stewart Pollens, *The Manual of Musical Instrument Conservation.* Cambridge: University Printing House, 2015. ix, 448 pp. 54 black and white photographs, approximately 123 tables, bibliographical references, bibliography, index. ISBN 978-1-107-07780 – 5. $150 (hardbound)

Most artistic and historic objects of importance have the luxury of a dedicated population of conservation professionals to see to their preservation and restoration. With graduate degrees in the science and methods of conservation and specialties in particular object types (paintings, sculpture, etc.) or material (wood, textile, paper), these practitioners number in the hundreds and can be found in larger museums and in private practice in most regions. If there are similarly trained conservators specializing in musical instruments, however, they are so rare as to be unavailable to the thousands of instruments in need of professional