

and dominating for most types of sediments except very fine ones, such as mud and fine silt. In this paper, effects of the transition layer on both roughness and volume-scattering components are considered. These effects are shown to reduce substantially the role of roughness scattering at high frequencies. In particular, the roughness contribution is shown to be strongly dependent on real discontinuity of acoustical parameters at the water-sediment interface, which can be significantly reduced even for

some sands due to existence of the transition layer. The possibly dominating role of volume scattering caused by continuous and discrete heterogeneity of the sediment is discussed. The necessity of more detailed study of physical properties of the transition sediment layer is emphasized. Related issues of interpretation of recent results on seabed scattering obtained in the Key West and SAX99 experiments are discussed as well. [Work supported by ONR-US and CNRS-France.]

THURSDAY AFTERNOON, 7 DECEMBER 2000

CALIFORNIA SALON 2, 1:25 TO 4:30 P.M.

Session 4pMUa

Musical Acoustics: Historical Brasses and Related Instruments

R. Dean Ayers, Chair

Department of Physics and Astronomy, California State University, Long Beach, California 90840-3901

Chair's Introduction—1:25

Invited Papers

1:30

4pMUa1. An overview of the brass collection in the Kenneth G. Fiske Museum. Albert Rice (Kenneth G. Fiske Museum of The Claremont College, Claremont, CA 91711, alrice@cuc.claremont.edu)

The Kenneth G. Fiske Museum of Musical Instruments at The Claremont Colleges is one of only seven comprehensive musical instrument museums in the United States. Its collection of brasses and cup-mouthpiece instruments made of wood consists of over 400 instruments dating from the 18th through the 20th centuries. It includes cornets, trumpets, bugles, trombones, French horns, mellophones, euphoniums, tenor horns, ophicleides, keyed bugles, over-the-shoulder horns, serpents, cornettos, Russian bassoons, bass horns, tubas, instruments from Africa, Tibet, China, and other countries. The collection is especially rich in its representation of important 19th century American makers and of examples of valve designs such as Stoelzel, Berlin Pumpen, Vienna, Allen, and various designs of the Perinet valve. Valves were initially introduced by German makers in 1818, and were gradually accepted by players during the 1830s and 1840s. The Perinet valve of 1838 emerged as the standard design only by the 1870s and 1880s. With the use of slides of several instruments the presentation will illustrate four broad aspects of the collection: (1) the development of the low brasses; (2) types of valves; (3) brasses in Asia and other countries; and (4) unusual designs.

2:00

4pMUa2. The evolution of lip-reed instruments and their manufacture. Robert W. Pyle, Jr. (11 Holworthy Pl., Cambridge, MA 02138)

Lip-reed instruments began in prehistory as animal horns and tusks and have evolved into the brass instruments of modern orchestras and bands. After a brief look at instruments of biblical times and earlier, this paper will concentrate on developments from the 15th century to the present. By the mid-18th century, the typical trumpet bell contour had changed from an "animal horn" shape to something very close to that of the present-day trumpet and players had achieved remarkable technical proficiency, as shown in the compositions of Bach, Handel, and others. On the other hand, manufacturing techniques had changed hardly at all and the instruments were still mechanically simple. The introduction of steam power in the late 18th century profoundly changed metal-working techniques and, with the invention of the valve, led to an explosion in the variety and complexity of brass instruments. Of the numerous dead branches and twigs on the brass family tree of the 19th century, some were killed by bad acoustics, some by economics, and some by poor marketing. In our own day, computer-controlled machining not only has changed traditional manufacturing economics, but also has allowed the production of new components that would formerly have been prohibitively expensive.

2:30

4pMUa3. An acoustical comparison of the serpent and the ophicleide. D. Murray Campbell (Dept. of Phys. and Astron., Univ. of Edinburgh, Edinburgh EH9 3JZ, UK)

The serpent is a lip-excited wind instrument with an air column length of around 2 m and an approximately conical bore. In the form in which it emerged in France in the sixteenth century, it is a wooden tube with six finger holes and a chromatic compass of three octaves. The serpent suffers from some problems related to the fact that all the holes are covered directly by the fingers. The holes are grouped in two clusters, and the hole diameter is too small to provide adequate venting. The ophicleide, invented in the early nineteenth century, has a similar bore profile to the serpent. Eleven or more side holes in the thin-walled metal tube are covered by lever-operated padded keys; these allow most notes to be obtained without cross fingering, and the size and placing of the holes are not limited by the anatomy of the human hand. Several acoustical investigation techniques, including input impedance analysis, pulse reflectometry and excitation by an artificial mouth, have been used to investigate the extent to which the ophicleide is a successful solution to the acoustical problems posed by the serpent.

3:00

4pMUa4. A survey of the historical and acoustical development of the horn. Brian Holmes (Dept. of Phys., San Jose State Univ., San Jose, CA 95192-0106)

In the 17th century, the hunting horn entered the orchestra. With its shallow mouthpiece and rapidly flared bell, the baroque horn had a bright sound like that of the trumpet. Indeed, the same musicians often played either instrument. In modern authentic performances, players use side-vents or hand-stopping to improve intonation, though no evidence suggests that 18th century players used these techniques. When the hand entered the bell, the bell was widened and the mouthpiece deepened, giving the instrument its modern character. Despite the invention of the valve, acoustics requires that the hand remain in the bell. The modern double horn, with its wider bell and rotary valves, was introduced by Kruspe in 1902. Older designs (such as the Vienna horn, with its narrower bell, terminal crook, and curious Vienna valves) persist in some areas. The drive to compete with trumpets for volume and recordings for accuracy has led some modern players to adapt higher pitched descant horns.

3:30

4pMUa5. Design characteristics of nineteenth century American-made brass instruments. Richard P. Birkemeier (Dept. of Music, California State Univ., Long Beach, 1250 Bellflower Blvd., Long Beach, CA 90840, birkemei@csulb.edu)

The brass band was arguably the most popular form of entertainment for most American citizens in the nineteenth century. This ensemble flourished in nearly every town and eventually led directly to the development of jazz, the basis for all American popular music in the twentieth century. American brass instrument design underwent significant changes in a relatively short period of time during the second half of the nineteenth century. These design changes resulted in noticeable variations in instrumental timbre, changes that clearly had an effect on the music written for wind bands during this period. This presentation will feature two complete sets of nineteenth century brass band instruments, one from the Civil War era and one from the end of the century. They will be analyzed from the following perspectives: design specifications of bore, bell shape, valve configuration and mouthpiece design; weight and thickness of metal; and instrument timbre as demonstrated in live performance. It is hoped that the comparison of design characteristics followed by the actual sounds of the instruments will offer insights into this most important of relationships for the musician.

Contributed Papers

4:00

4pMUa6. Pitch drift as a result of just intonation. Patrick K. Mullen (Art Dept., CSU Long Beach, Long Beach, CA 90840)

The most easily recognized difficulty with just tuning is the large and confusing array of pitches that must be made available on a keyboard instrument in order to allow modulation to several keys. A given note name may have more than one pitch associated with it, sometimes several, depending on the context in which it is used. Using computer-generated instruments that provide a limitless supply of unique pitches, just intervals can be used exclusively and explored thoroughly. When applied to Giovanni Gabrieli's Sonata Pian' E Forte, the strict use of just tuning forces the pitch center to drift lower as the music progresses. When pitches are held across certain chord changes, lower versions of previous pitches must be used in order to maintain just tuning. Though most nonkeyboard acoustic instruments, the brasses in this case, can vary the tuning of each pitch somewhat, most cannot match the degree of drift that occurs in the Gabrieli ("A" begins the piece at 440 Hz and ends it at ~398 Hz!). For players of these instruments a compromise between physical tuning limitations and the ideal of just intonation must be made. Players use just

intervals wherever possible, until the pitch drift forces a decision as to where the "rub" will be. The pitch-drift phenomenon will be demonstrated.

4:15

4pMUa7. Musical instruments of antiquity as illustrated in *The Adventures of Asterix the Gaul*. Daniel A. Russell (Sci. & Math Dept., Kettering Univ., 1700 W. Third Ave., Flint, MI 48504)

The Adventures of Asterix the Gaul, a series of books written by Goscinny and illustrated by Uderzo, between 1960 and 1999, have received much acclaim for the attention to detail in their drawings of ancient architecture and civilization. Equally interesting to a musical acoustician are the illustrations of musical instruments (including carnyx, buccina, lur, bagpipe, harp, lyre, pipes, drums, and singing) used by ancient Romans, Greeks, Egyptians, and Gauls. This talk will compare Uderzo's illustrations to photographs of period instruments and comment on their acoustic qualities, performance techniques, and the roles they played in their respective societies, both in real history and as experienced by Asterix and his friends.