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Apparatus for studying wave motion and sound at the University of Nebraska– Lincoln's “Historical Scientific Instrument Gallery”

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Apparatus for studying wave motion and sound at the University of Nebraska-Lincoln's "Historical Scientific Instrument Gallery"

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The University of Nebraska-Lincoln's "Historical Scientific Instrument Gallery," compiled by the second author in 1998, contains approximately 700 inventoried items and may be visited on-line at <http://physics.unl.edu/outreach/histinstr/>. Amidst the collection are several acoustical instruments that were used in the early 1900s. These include equipment that demonstrate wave motion (traveling wave machine, mercury ripple dish, vibration microscope), wave interference (interference machine), resonance conditions (Helmholtz resonators, vibrating rods, singing flames, sonometer), and sound generation (Galton's whistles, high-frequency tuning forks, large tuning forks, organ pipes, siren saw). A review of the equipment and the history of their use at the University of Nebraska are discussed. Much of the equipment was superbly manufactured by the Max Kohl/Chemnitz Company in Germany and Rudolph Koenig in France. Pages from the Max Kohl/Chemnitz equipment catalogs of 1910 and 1925 helped to characterize several of the pieces and are shown in this presentation.

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4:50

2pBB13. Dosimetry measurement of HIFU field using a fiber-optical probe hydrophone. Liang Zhai, Yufeng Zhou, and Pei Zhong (Dept. of Mech. Eng. and Mater. Sci., Duke Univ., Box 90300, Durham, NC 27708, pzhong@duke.edu)

Characterization of the acoustic field of high-intensity focused ultrasound (HIFU) transducers by conventional PVDF membrane and needle hydrophones is problematic due to limited bandwidth, spatial averaging, and damage to the hydrophone. Here, we report the use of a self-calibrated fiber-optical probe hydrophone (FOPH-500) for HIFU dosimetry measure-

ment. The hydrophone (0.1-mm sensing element) was scanned in the focal volume of a 1.1-MHz HIFU transducer ($F=63$ mm, f number=0.9) at 0.2-mm steps using a computer-controlled 3D positioning system. When the input voltage V_{p-p} applied to the transducer was increased from 28 to 225 volts, the peak compressive and tensile pressure values at the transducer focus were found to be $P^+=1.7\text{--}18.9$ MPa and $P^-=-1.33\text{--}-8.14$ MPa, respectively. The corresponding spatial peak intensities were calculated to be $I_{sp}=69\text{--}3968$ W/cm². Nonlinear propagation with harmonics generation was dominant at high intensity levels, leading to a reduced -6 -dB beamwidth of the compressive wave from 1.8 to 1.3 mm and an increased -6 -dB beamwidth of the tensile wave from 1.6 to 1.8 mm. Overall, FOPH-500 was found to be a reliable tool for characterizing the acoustic field of HIFU transducers.

TUESDAY AFTERNOON, 25 MAY 2004

LIBERTY 5, 1:30 TO 4:00 P.M.

Session 2pED

Education in Acoustics: Apparatus for Teaching Acoustics, 1929 and Before

Thomas D. Rossing, Cochair

Physics Department, Northern Illinois University, De Kalb, Illinois 60115

Peter L. Hoekje, Cochair

Department of Physics and Astronomy, Baldwin-Wallace College, 275 Eastland Road, Berea, Ohio 44017

Chair's Introduction—1:30

Invited Papers

1:35

2pED1. Apparatus for studying wave motion and sound at the University of Nebraska—Lincoln's "Historical Scientific Instrument Gallery." Lily M. Wang (Architectural Eng. Prog., Univ. of Nebraska, Peter Kiewit Inst., Omaha, NE 68182-0681, lwang4@unl.edu) and M. Eugene Rudd (Univ. of Nebraska, Lincoln, NE 68588)

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1:55

2pED2. Early 20th century acoustics apparatus in Iowa. Roger J. Hanson (Dept. of Phys., Univ. of Northern Iowa, Cedar Falls, IA 50613, roger.hanson@cfu.net)

In the first half of the 20th century G. W. Stewart was a physics faculty member at the University of Iowa (UI) with a distinguished record of research and teaching, especially in acoustics. Much of his research focused on the design and use of several types of acoustical filters. Some apparatus which he developed or utilized are still housed in the Department of Physics and Astronomy or are available in detailed diagrams. Demonstration apparatus (apparently homemade) from his era are still available for use. Carl E. Seashore, a renowned psychologist also at UI in the early 20th century, had interdisciplinary interests linking psychology, speech and hearing, music, and acoustics. He was responsible for obtaining an Henrici harmonic analyzer, a mechanical Fourier analyzer manufactured in Switzerland, a special grant from the state legislature during Depression conditions provided the funding. It resides in the Department of Speech Pathology and Audiology at UI. The Grinnell College Physics Historical Museum houses a set of 18 Helmholtz resonators and a Savart bell and resonator. Apparatus at Iowa State University, the University of Northern Iowa, and other Iowa institutions will also be described. Pictures and diagrams as well as some actual apparatus will be exhibited.