

were measured for impulses presented at levels between 88- and 147-dB peak. This included the impulses used in the previous injury study. While nonlinearities were noted at the higher intensities, there was a remarkable preservation of the pressure-time histories. In addition to these impulse stimuli, intracochlear pressures were measured using brief tone pips whose envelope was Gaussian. Frequencies of 700, 1375, 2000, 2700, and 4100 Hz were chosen to span the frequency response of the speaker. With these stimuli, nonlinearities appeared as both harmonic and subharmonic distortion as the intensities increased.

11:05

ZZ10. Changes in frequency selectivity in the chinchilla following a noise induced permanent threshold shift. Robert I. Davis, William A. Ahroon, and Roger P. Hamernik (Auditory Research Laboratory, SUNY at Plattsburgh, Plattsburgh, NY 12901)

Evoked-potential tuning curves (TC) were obtained on 106 chinchillas before and after acoustic overstimulation in order to assess the effects of the magnitude of hearing loss on frequency selectivity. Pre- and postexposure measures of auditory thresholds and masked thresholds (simultaneous tone-on-tone paradigm) were obtained in each animal at 0.5, 1, 2, 4, 8, and 11.2 kHz, using the evoked auditory response recorded from the inferior colliculus. Three TC variables (Q -10 dB, tail-tip difference, and the high-frequency slope) and sensory cell losses were compared to the amount of noise-induced permanent threshold shift (PTS) produced by a variety of noise exposures. Based upon large sample averages, frequencies showing $PTS > 20$ dB also showed statistically significant differences between pre- and postexposure measures of all three TC variables. For $10 < PTS < 20$ dB only the tail-tip difference showed a statistically significant change, while for $PTS < 10$ dB there were no measurable changes in

the TC variables. The percentage of outer hair cell loss showed an orderly and systematic increase as PTS increased and as TC variables changed across the entire range of test frequencies. The inner hair cells were essentially unaffected. These results show that there is a systematic change in the TC variables that define the quality of tuning as hearing loss progressively increases and that these changes are clearly related to outer hair cell losses. [Research supported by NIOSH and DOD.]

11:20

ZZ11. "Enhanced" evoked response amplitudes in the chinchilla following acoustic trauma. R. Salvi, S. Saunders, N. Powers, and M. A. Gratton (Department of Communication Disorders and Sciences, 109 Park Hall, SUNY University of Buffalo, Buffalo, NY 14214)

The amplitudes of auditory-evoked responses recorded from chronic electrodes in the inferior colliculus of the chinchilla were measured before and after acoustic trauma. Acoustic trauma was induced using a 2-kHz continuous tone that resulted in either 30–40 dB of TTS or PTS between 2–8 kHz. The high-intensity exposures resulted in systematic changes in the input/output functions of the evoked response. The most striking change was an increase in the maximum amplitude ("enhanced") of the evoked response at frequencies below and at the low-frequency edge of the hearing loss (0.5 and 2 kHz). By contrast, the maximum amplitude seen at frequencies near the middle of the hearing loss or its high-frequency border (4 and 8 kHz) was generally depressed. In addition to the change in maximum amplitude, there were also changes in the slope of the evoked response input/output functions. The results will be related to the pattern of hair cell loss as well as to possible underlying neural mechanisms. [Work supported by NIH R01 NS16761 and NS23894.]

FRIDAY MORNING, 20 MAY 1988

WEST BALLROOM B, 8:30 A.M. TO 12:05 P.M.

Session AAA. Underwater Acoustics VIII: Underwater Propagation

Kenneth E. Gilbert, Chairman

The National Center for Physical Acoustics, University of Mississippi, University, Mississippi 38677

Chairman's Introduction—8:30

Contributed Papers

8:35

AAA1. PARQUES: A range-dependent environment propagation loss model. Bruno Grandvullemin (DCAN Toulon-GERDSM, Six-Fours les Plages 83140, France)

A proposal to solve the Helmholtz's equation by means of the parabolic approximation in a two-dimensional range-dependent environment will be given. It will make clear the solution for a quadratic development of the propagation operator that allows the consideration of a larger angular aperture of the source. The numerical solution is given by an algorithm of finite difference using the Crank-Nicholson method. The problem of rectilinear, horizontal, and oblique interfaces between two fluid media is solved. The problem of a range variable sound velocity profile is treated by conditions of continuity between two media with the given profiles. The regressive wave is also computed. The results of numerical simulations executed on the array processor FPS 164 are presented. Also are shown comparisons between theoretical computation and experimental data for range-independent and range-dependent environment.

8:50

AAA2. Adaptation of a three-dimensional ray tracing code for use with gridded input oceanographic models. J. Dougherty, A. E. Newhall, J. F. Lynch (Department of Ocean Engineering, Woods Hole Oceanographic Institution, Woods Hole, MA 02543), and C. S. Chiu (Institute for Naval Oceanography, NSTL, MS 39529)

In order to be able to adapt the Hamiltonian ray tracing program (HARPO) developed by NOAA's Wave Propagation Laboratory for use with gridded numerical oceanographic models, three different approaches have been employed. The first method employs using a 3-D Fourier decomposition of the sound-speed field, giving one the ability to use fast Fourier techniques and spatially filter input data but being limited to a constant grid with mesh determined by the highest spatial frequency along a given coordinate. The second technique employs an empirical orthogonal function analysis of the sound-speed field, the coefficients of which are splined to ensure the continuity requirements of the ray trace. This method allows one to: (1) simply filter the field by mode energy; (2) project easily on oceanographic modes; and (3) vary the sampling to meet