**I6. The Precision of Reverberant Sound-Power Measurements.** DAVID LUBMAN, *D. Lubman & Associates, Woodland Hills, California 91364.*—Determination of sound power in a reverberation room is subject to a random error whose size can be estimated and controlled by the knowledgeable laboratory manager. Under ideal measurement conditions the random error can be expressed as a product of three factors: a *frequency-averaging factor* governed by spectrum shape and room reverberation time, a *spatial-averaging factor* determined by the number and separation of fixed microphones or the path shape and size for a traversing microphone, and a *rotating-diffuser factor* depending on the size and shape of the rotating diffuser in relation to room size and reverberation time. Continuing progress in this field is teaching us to incorporate nonideal measurement conditions into our error estimates. In particular, we report progress in understanding the effects on random error due to (1) finite averaging time, (2) presence of a direct field component, and (3) insufficient modal overlap at low frequency.

**I7. Effective Modal Density in a Reverberant Sound Field for Finite Sized Sources.** BEN H. SHARP AND KENNETH M. ELDRED, *Wyle Laboratories, El Segundo, California 90245.*—Much of the theory concerning the formation of sound fields in reverberant rooms and the measurement of the sound levels produced by these fields has emphasized the statistical aspects. A previous paper [K. M. Eldred, B. H. Sharp, and F. M. Murray, "The Coupling of Finite Sized Sources to a Modal Reverberant Sound Field," presented at the 76th Meeting of the Acoustical Society of America (Nov. 1968), J. Acoust. Soc. Amer. 45, 338 (A) (1969)] discussed the coupling of finite sized sources to a reverberant sound field and showed that there is a strong dependence between sound level and source configuration in certain frequency ranges. This paper will briefly review these findings and extend the work to examine the relationship between the effective modal density and the calculated modal density as a function of source configuration. On the basis of this relationship, the relevance of statistical methods as applied to reverberant sound fields with finite sized sources will be discussed.

**I8. Summary of Papers and Open Discsusion.** UNO INGARD, *Massachusetts Institute of Technology, Cambridge, Massachusetts 02139.*—Dr. Ingard will lead the summary and open discussion of the papers presented in this session. Questions and points deserving further discussion will be directed to individual authors, after which questions will be accepted from the floor.

TUESDAY, 18 APRIL 1972 EMBASSY ROOM, 2:00 P.M.

## Session J. Psychological and Physiological Acoustics: Temporary and Permanent Threshold Shift

R. CARHART, *Chairman*

*Northwestern University, Evanston, Illinois 60201*

### *Contributed Papers (12 minutes)*

*2:00*

**J1. Influence of External Ear Acoustics on an Impulse Arriving at the Ear Drum.** G. RICHARD PRICE, *Human Engineering Laboratory, Aberdeen Proving Ground, Maryland 21005.*—The effectiveness of acoustic impulses in producing changes in hearing sensitivity varies greatly as a function of pulse characteristics. In the hope of determining why this is so, an ear model of simple geometry [R. Teranishi and E. A. G. Shaw, J. Acoust. Soc. Amer. 44, 257–263 (1968)] was constructed and instrumented with a microphone at the ear-drum position. Impulses from a gunfire simulator, measured in the free field, were compared with the same impulses arriving at the ear-drum position. At the ear-drum position, the pulses demonstrated an increased peak pressure, a much longer rise time and a greatly increased duration. A Fourier analysis of the pulses revealed a shift of maximum energy from about 500 Hz in the free field to about 3.0 kHz at the ear-drum position, which is the reasonant frequency of the external ear. Damage-risk criteria for impulses should probably reflect the frequency content of the impulses and the transformation produced by the acoustics of the external ear.

*2:15*

**J2. The Acoustical Impedance of the Guinea-Pig Middle Ear and the Effects of the Middle-Ear Muscles.** W. R. J. FUNNELL AND CHARLES A. LASZLO, *BioMedical Engineering Unit, McGill University, Montréal 110, Québec, Canada.*—The acoustical input impedance of the guinea-pig middle ear was measured in the frequency range 100–10 000 Hz, using a high-impedance volume–velocity source and a probe-tube microphone. The impedance was measured both in the normal ear and with the tympanic membrane removed; the latter measurement permits accurate characterization of the middle-ear cavities themselves. The data was compared to a slightly modified version of the middle-ear model of Zwislocki [J. Acoust. Soc. Amer. 35, 1034–1040 (1963)], and new parameter values were calculated to match the present data. We also measured the time courses of transient impedance changes caused by spontaneous contractions of the middle-ear muscles of the anesthetized animals. These transient changes were compared to the middle-ear-muscle effects predicted by the model. [Supported by the Medical Research Council of Canada.]