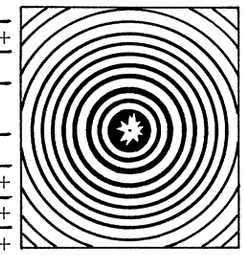
Physiological Effects of Audible Sound

AAAS Symposium

28–30 December 1969

Boston

	Decibels	
Large Pneumatic Riveter (3")	125+	Boiler Shop (Maximum Level)
Rock and Roll Band (peak)	120	
Overhead Jet Aircraft (500')	115+	
Loud Motorcycle	110	
Construction Noise (Hammers and Compressors) (10')	110	
Loud Outboard Motor	102	
Subway Train (20')	95+	
Train Whistles (500')	90+	
Heavy Truck (25')	90+	
	40+	Average Residence
	* 32	Room In a Quiet London Dwelling (at Midnight)



* "A" Scale, a modified form of decibel, weighted to emphasize the upper frequencies. All other figures are in the flat or "C" scale.

Compiled by Citizens for a Quieter City, Inc. from government documents, 1969.

Higher animals, including men, respond, both psychologically and physiologically, to their stimulus environment. In the truest sense, they and their environment are functionally inseparable.

If noise causes annoyance or other emotional reactions, the function of every system in the body is affected to some degree. Moreover, animals are physiologically responsive to sound even in their sleep and, indeed, even after their cerebral hemispheres have been removed.

Through its activating effect upon subcortical neuronal systems of the brain, sound, either continuous or intermittent, modifies the pacing by the brain of cardiovascular, endocrine, metabolic, reproductive, and neurological function. Since activating neuronal systems are themselves restrained by inhibitory neuronal systems with which they interact and which are also stimulated by sound, the reactivity of the organism to noise is modulated, both temporally and chronically, according to its past history of audiogenic stimulation.

With repeated exposure to sound, the organism may "learn," both behaviorally and physiologically, to partly "ignore" and, hence, to reduce the intensity of its response to sound. However, this does not mean that it does not respond, or that the response that it does make is unimportant. With different chronic levels of audiostimulation, different degrees of sonic influence are exerted by the brain upon peripheral physiological functions, and different levels of basal function are maintained. The most profound physiological effects are produced when individuals who are accustomed to low levels of sound are startled by unexpected noise. Since in many physiological systems disturbances are dampened only very gradually, the physiological effects of startle may persist for a considerable period of time after the startling event occurs.

While the stimulation is necessary for the development of the brain and for the development of every physiological system in the body, overstimulation may be harmful. Knowledge of optimal stimulus conditions and of the manner in which behavioral and physiological functions are linked to the stimulus environment is yet very meager; more knowledge is badly needed.

During the past two decades, most of the research on the physiological effects of sound has been conducted by audiologists who have been primarily concerned with the effects of sound upon the ability to hear. However, there is growing evidence that impairment of hearing ability may be only one of the important effects of environmental noise.

A symposium to run 2½ days on the Physiological Effects of Audible Sound (Extra-Auditory) has been organized for presentation at the AAAS Annual Meeting in Boston, 28–30 December 1969.

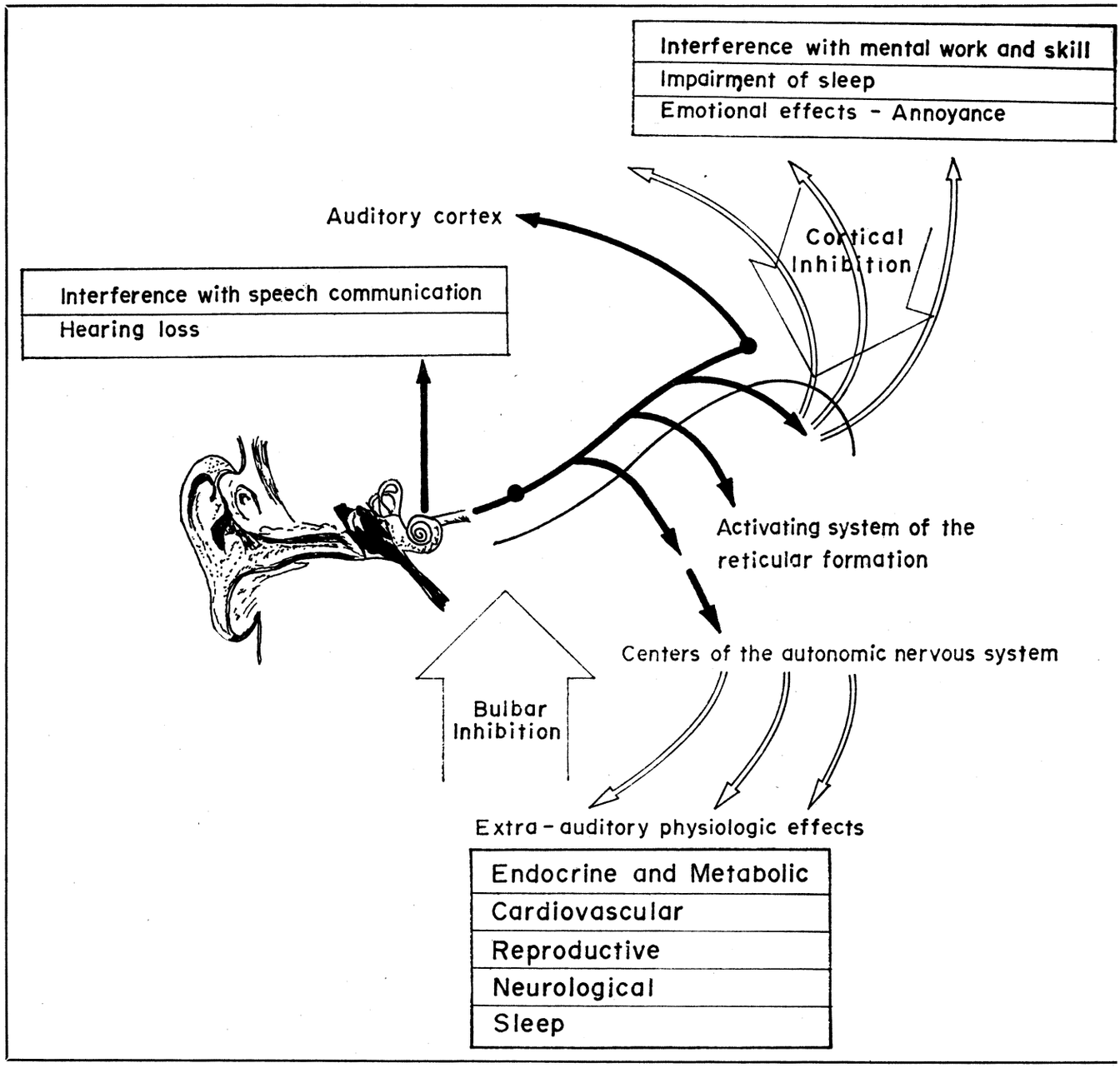
The primary objective of this symposium is to provide an overview of the current state of biomedical knowledge concerning the extra-auditory effects of audible sound. In order to allow reasonable coverage of the materials that will be discussed, considerations of the psychological and behavioral effects of noise, effects of noise upon hearing, and the effects of infrasonic and ultrasonic noise have been deliberately excluded. This will be the first time that such a synthesis has been attempted.

Scientists from the United States and from several other countries who have done leading research on the effects of sound upon neurological (including sleep), cardiovascular, endocrine, and reproductive function have agreed to participate in the technical sessions that will be held on the first 2 days of the symposium. These technical sessions will be of both theoretical and practical interest to scientists in many branches of biology, medicine, psychology, and public health.

In view of the increased interest that has been demonstrated in environmental quality issues by the public and by the executive and legislative branches of government during recent months, this symposium should be most timely.

A secondary objective of this symposium is to provide for critical discussion of the role of the basic biomedical sciences in the assessment and advance

Diagram above: Representative noise levels permitted in urban environment. [Permission of *Nation's Cities*]



The effects of sound upon the activating systems of the brain and, through them, upon various peripheral functions.

prediction of the effects of environmental change. To this end, the last half-day of the technical sessions will be devoted to a review of the experimental studies that thus far have been conducted for the purpose of assessing the effects of the sonic boom: the last half-day will be devoted to a panel discussion in which clinical and basic biomedical scientists, administrators of federal agencies primarily responsible for assessing the effects of aircraft noise, and an attorney will discuss "Using Basic Biomedical Science to Assess the Effects of Environmental Change."

Chauncey Leake (senior lecturer in pharmacology and experimental therapeutics, University of California Medical Center, San Francisco) will close the symposium with an "Overview and Perspective" of the symposium and of probable future developments in this and in other areas where there is a thin interface between basic science and important environmental problems.

The panel discussion and the closing comments will be of interest not only to basic scientists, but also to many citizens and public officials who are interested in encouraging the conduct of adequate advance assessments of ne technologies in order to minimize th harmful side effects and maximize t benefits that they may bring.

Papers based on the technical s sions of the symposium will be pu lished by Plenum Press. The volu should serve as the authoritative refe ence on this subject for several yea and serve as the point of departure f additional research on the extra-auc tory physiological effects of noise.

BRUCE L. WELC
Friends of Psychiatric Research, Baltimore, Maryland

Speakers and Topics

Arranged by: Joseph R. Anticaglia (U.S. Public Health Service, Cincinnati, Ohio); William F. Geber (University of Georgia School of Medicine, Augusta, Georgia); Benson E. Ginsburg (University of Connecticut, Storrs); Samuel Rosen (Mount Sinai Hospital, New York City); Annemarie S. Welch (State of Maryland Psychiatric Research Center, Baltimore, Maryland); and Bruce L. Welch (Friends of Psychiatric Research, Baltimore. *Chairman*, Organizing Committee).

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Part I: *Introduction to the Symposium*, Joseph R. Anticaglia.

Part II: *Experimental Studies, Cardiovascular*

Noise, Hearing, and Cardiovascular Function, Samuel Rosen.

Cardiovascular and Biochemical Effects of Chronic Intermittent Neurogenic Stimulation, Joseph P. Buckley (University of Pittsburgh).

Cardiovascular and Teratogenic Effects of Chronic Intermittent Noise Stress, William F. Geber.

Part III: *Experimental Studies, Sleep Auditory Stimulation, Sleep Loss, and the EEG Stages of Sleep*, Harold L. Williams (University of Oklahoma Medical Center).

Sleep and Depression, J. Mendels (University of Pennsylvania).

Psychological Effects on Noise During Sleep, G. J. Thiessen (National Research Council of Canada).

Part IV: *Experimental Studies, Reproductive*

Effect of Noise During Pregnancy Upon Foetal Viability and Development, A. Arvay (University of Debrecen, Hungary).

Audiogenic Stimulation and Reproductive Function, I. Tamari (Hebrew University, Jerusalem, Israel).

Effects of Noise During Pregnancy Upon Foetal and Subsequent Adult Behavior, Lester W. Sontag (Fels Research Institute, Yellow Springs, Ohio).

Part V: *Experimental Studies, CNS Biochemistry and Pharmacology*

Psychopharmacology of the Response to Noise, With Special Reference to Audiogenic Seizures in Mice, Alice G. Lehmann (Laboratoire de Physiologie Acoustique, Domaine de Vilvert, Jouy-en-Josas, France).

Neurochemical and Neurophysiological Factors in Audiogenic Seizure Susceptibility, Kurt Schlesinger and William Boggan (University of Colorado, Boulder).

Some Effects Upon Brain Biochemistry of Audiogenic Stimulation and Seizure, Paul Y. Sze (University of Connecticut, Storrs).

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Part VI: *Experimental Studies, Neurological*

Genetic and Environmental Factors in Audiogenic Seizure Susceptibility, John L. Fuller (Jackson Laboratory, Bar Harbor, Maine).

Early Exposure to Intense Acoustic Stimuli and Susceptibility to Audiogenic Seizures, Kenneth R. Henry and Robert E. Bowman (University of Wisconsin, Madison).

Effects of Noise on Audiogenic Seizures Susceptibility and Growth of Mice, Gregory B. Fink and Ben Iturrian (Oregon State University and University of Georgia, Athens).

Developmental Genetics of Seizure Susceptibility, Benson E. Ginsburg.

Human Studies on Epileptic Seizures Induced by Sound and the Conditioned Extinction, Francis M. Forster (University of Wisconsin).

Functional State of the Brain During Audiogenic Stimulation, L. V. Krushinsky, L. N. Molodkina, D. A. Fless, L. P. Dobrohotova, A. P. Steshenko, A. F. Semiokhina, Z. A. Zorina and L. G. Romanova (Moscow University, Moscow, U.S.S.R.).

Part VII: *Experimental Studies, Endocrine and Metabolic*

Audiogenic Stress and Susceptibility to Infection, A. F. Rasmussen (University of California, Los Angeles).

Effects of Sound Upon Endocrine Function and Electrolyte Excretion, Mary F. Lockett (University of Western Australia, Nedlands).

Endocrine and Metabolic Effects of Noise in Normal, Hypertensive and Psychotic Humans, Amilcar E. Argüelles (Hospital Aeronautico, Buenos Aires, Argentina).

Part VIII: *Experimental Studies, Assessment of Sonic Boom Effects*

Awakening Effects of Simulated Sonic Boom and Subsonic Jet Noise, Jerome S. Lukas and Karl Kryter (Stanford Research Institute).

Effects of Noise on the Physiology and Behavior of Farm Animals and Farm-raised Mink, James Bond (U.S. Department of Agriculture, Beltsville, Maryland).

Effects of Sonic Booms on the Hatchability of Chicken Eggs, Jack M. Heinemann (Kelly Air Force Base, Texas).

Human Response to the Sonic Boom, Charles W. Nixon (Wright-Patterson Air Force Base, Ohio).

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Part IX: *Transition to the Panel Discussion*, Bruce L. Welch.

Part X: *Panel Discussion, Using Basic Biomedical Science to Assess the Effects of Environmental Change*

A New Approach to the Study of Congenital Effects of Environment upon Health. Claude E. Forkner (Cornell University Medical Center, New York City).

Laboratory Animal Research for Assessing the Long-Term Effects of Environmental Change, William I. Gay (National Institute of General Medical Sciences, Bethesda, Maryland).

Medical Research Policy of the Federal Aviation Administration, Peter V. Siegel (Federal Aviation Administration, Washington, D.C.).

Basic Biological Research in Determining Animal Response, Ralph E. Hodgson (U.S. Department of Agriculture, Beltsville, Maryland).

Legal Responsibility for Anticipating Effects, Arthur S. Miller (George Washington University, Washington, D.C.).

Part XI: *Closing Remarks*

Overview and Perspectives, Chauncey Leake (University of California Medical Center, San Francisco).