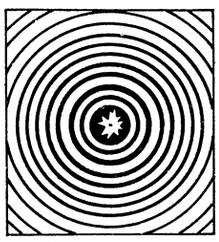
Noise: Polluting the environment

The cacophony of modern life takes a biological toll on men and animals

by Barbara J. Culliton

	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.

A scale of threatening sounds from trucks to riveters.

Arthur Conan Doyle once described Sherlock Holmes plucking his violin for a fly trapped under an upturned tumbler. Holmes's experiment, to observe the effects of sound on a living organism, has a powerful analogy in the modern world. We are all flies, trapped among the noisy resonances of industrialized society. And whether Holmes understood or only suspected it, sound does have an effect on living creatures.

Like a drug that produces measurable effects when it enters the body, noise is being found to induce physiological changes that are suspected of having a relation to disease.

"Noise is a stress, an environmental pollutant, an insult," says Dr. Chauncey Leake of the University of California Medical Center at San Francisco. "It affects the nervous, endocrine and reproductive systems. It may damage unborn children."

According to Dr. Bruce Welch of the Friends of Psychiatric Research in Baltimore, "The physiological effects of sound are measurable at as low as 70 decibels. They are all-pervasive, most threatening to the young and yet difficult to spell out in man because problems arise from long-term, chronic exposure." Dr. Welch was chairman of a three-day symposium on the physiological effects of sound at the recent meeting of the American Association for the Advancement of Science in Boston.

Says Dr. Samuel Rosen, "Any loud noise, whether we like it or not, constricts blood vessels. Eventually, this could cause permanent damage." In addition to constricted vessels, says Dr. Rosen, a consulting physician at the New York Eye and Ear Infirmary and the Mount Sinai School of Medicine, there are other physiological reactions to noise: The skin pales, pupils dilate, eyes close and the voluntary and involuntary muscles tense. Gastric secretions diminish and adrenalin is suddenly injected into the blood stream.

"These changes," says Dr. Rosen, "occur via the vegetative nervous system, which plays a role in regulating the changing caliber of blood vessels." Constriction occurs irrespective of whether an individual likes or dislikes a given noise. And it occurs regardless of whether a person has been exposed to that sound in the past. However, the severity of response appears to be clearly related to some degree to prior exposure and to an individual's general state of health and life style.

Dr. Rosen and his colleagues have conducted comparative studies on the effects of noise on urban dwellers in the German city of Dortmund, on New Yorkers and on the primitive Mabaans, an African tribe living in southeast Sudan. The urbanites came from an environment in which loud noise is commonplace. Their diets were rich in meat, butter and other animal fats. Coronary disease and hypertension are not uncommon among them. The Mabaans, on the other hand, live in virtual silence, are mainly vegetarians and rarely, if ever, have high blood pressure.

When exposed to noise at 90 and 95 decibels, the noise level of a heavy truck, blood vessels constricted both in primitive tribesmen and individuals from industrial societies. Among tribesmen, however, constriction and relaxation of vessels were rapid, showing both quick response to and quick recovery from the stress of sound. Among the Westerners, vessels remained constricted for longer periods, indicating a lesser degree of elasticity in their blood vessels and a diminished capacity to recover from the effects of noise.

"If there is already present somatic disease like atherosclerosis or coronary heart disease, continued noise exposure could endanger health and aggravate the pathology by adding insult to injury," Dr. Rosen suggests.

Noise, in experimental animals at least, also affects kidney function through its action on hormones. In 1964, Australian pharmacologist Dr. Mary F. Lockett was conducting tests on endocrine activity in rats when a violent thunderstorm occurred in Perth. "The next morning," she recounts, "the animals were badly out of salt and water balance." Subsequently, she exposed the rats to recorded thunderclaps of 100 decibels at a low frequency of 150 cycles per second. The noise stimulated the release of a hormone, oxytocin, from the pituitary gland. Oxytocin, in turn, stimulated the kidney, resulting in enhanced excretion of salt and water. High-frequency sounds had another effect. They stimulated adrenalin secretion up to 20 times normal levels and caused water retention, rather than excretion, because adrenalin inhibits synthesis of antidiuretic hormone, which inhibits the excretion of fluids.

Dr. John L. Fuller of the Jackson Laboratories in Bar Harbor, Me., sees animals' response to noise as a valuable laboratory model for studying the biology of stress and the chemistry of the brain as it affects the nervous system. With Dr. Robert L. Collins, he has been looking at sound-induced seizures in inbred strains of mice. The genetic makeup of a mouse influences its response to noise. "Not all strains will convulse when stimulated by sound," Dr. Fuller

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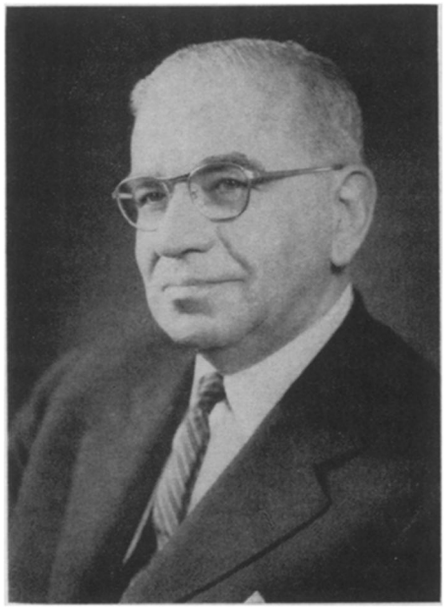
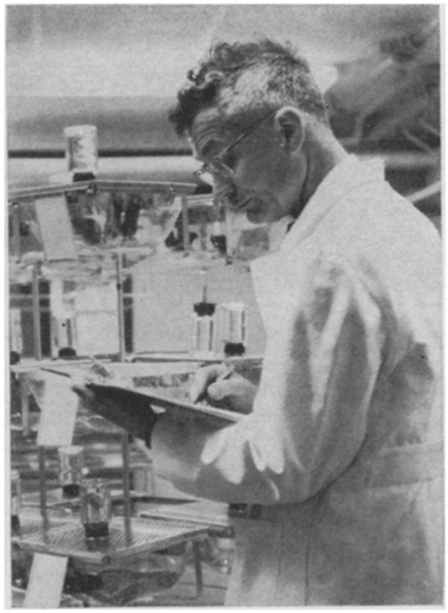
Inbred mice are tools for observing the physiological effects of sound.



Fabian Bachrach

Dr. Rosen: Noise constricts vessels.



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Dr. Fuller: The insidious effects.

explains, "but some are clearly more susceptible than others."

However, though genes play a role in this mouse syndrome, which has no exact counterpart in human medicine (except for rare cases of musicogenic epilepsy), Dr. Fuller has shown that environmental stress at the right time can convert a theoretically unsusceptible mouse into a convulsive one. If a mouse from a genetically resistant strain is subjected to loud sounds—95 decibels or more—on about the sixteenth day of life, subsequent noises will drive it into convulsions.

"Roughly speaking," Dr. Fuller comments, "16 days in a mouse's life are equivalent to between two and four years in a child's life. There is no direct evidence that noise actually harms human young, but the effects of sound are insidious and not easily detectable. While there is no reason to believe it causes seizures in man, sound could be related to behavior—to aggression or passivity." Genetically resistant strains of mice stressed by noise at an older age generally do not become convulsive.

In spite of the fact that researchers have yet to accumulate all of the data on the subject they would like, they agree that it is reasonable to postulate that the greatest threat is to unborn and very young children. Presumably, the developing fetus, whose organs and tissues are taking form, is the most sensitive of biological systems. Sound constricting a mother's blood vessels could certainly take its toll on an unborn child.

According to Dr. William Geber of the University of Georgia School of Medicine in Augusta, decreased blood flow in the uterine and placental vessels probably results in varying degrees of disruption of the normal interchange of oxygen, carbon dioxide, nutrients and waste products between maternal and fetal tissues. Therefore, it is possible to create permanently both gross anatomical abnormalities and more subtle deviations in such diverse systems as brain function or metabolic pathways.

To eliminate the potentially adverse effects of noise, prevention appears to be the only certain, but obviously elusive, method. Drug studies, however, indicate there is one experimental compound that acts to reduce the effects of loud sounds, though it is of interest primarily as a tool for approaching biological investigations, not as a general prophylactic.

Surprisingly the administration of ordinary tranquilizers such as reserpine and chlorpromazine not only fails to block the stress of noise but actually enhances its physiologic effects, in some cases leading to an animal's death.

Dr. Joseph P. Buckley of the University of Pittsburgh explains that this occurs because of a resulting overstimulation of the adrenal cortex followed by an insufficiency of adrenal hormones.

But he reports that a compound used experimentally in late stages of human hypertension does protect rats from adverse reactions to noise. Alpha-methyl-para-tyrosine decreases brain levels of noradrenalin, a neurotransmitter active in the process of blood vessel constriction, causing a decrease, rather than increase, in blood pressure.

"This compound has been rather unsuccessful in clinical trials involving patients with advanced hypertension," Dr. Buckley observes, "probably because in these cases a clear kidney disorder has developed and become a primary factor in the disease. But alpha-methyl-para-tyrosine, it now appears, may be useful in treating patients in early stages of hypertension." The drug has Food and Drug Administration approval for experimental use only.

While certain effects of noise can be observed in man, and while these effects can be more clearly defined in experimental animals in controlled circumstances, it is also apparent that in assessing its effects on man in relation to environmental disease, other factors, including genetics, the general health of the cardiovascular system and routine noise levels, must be considered. Says Dr. Rosen, "To separate these factors is like trying to restore a scrambled egg into a single white and yolk, placed neatly in the original shell." □