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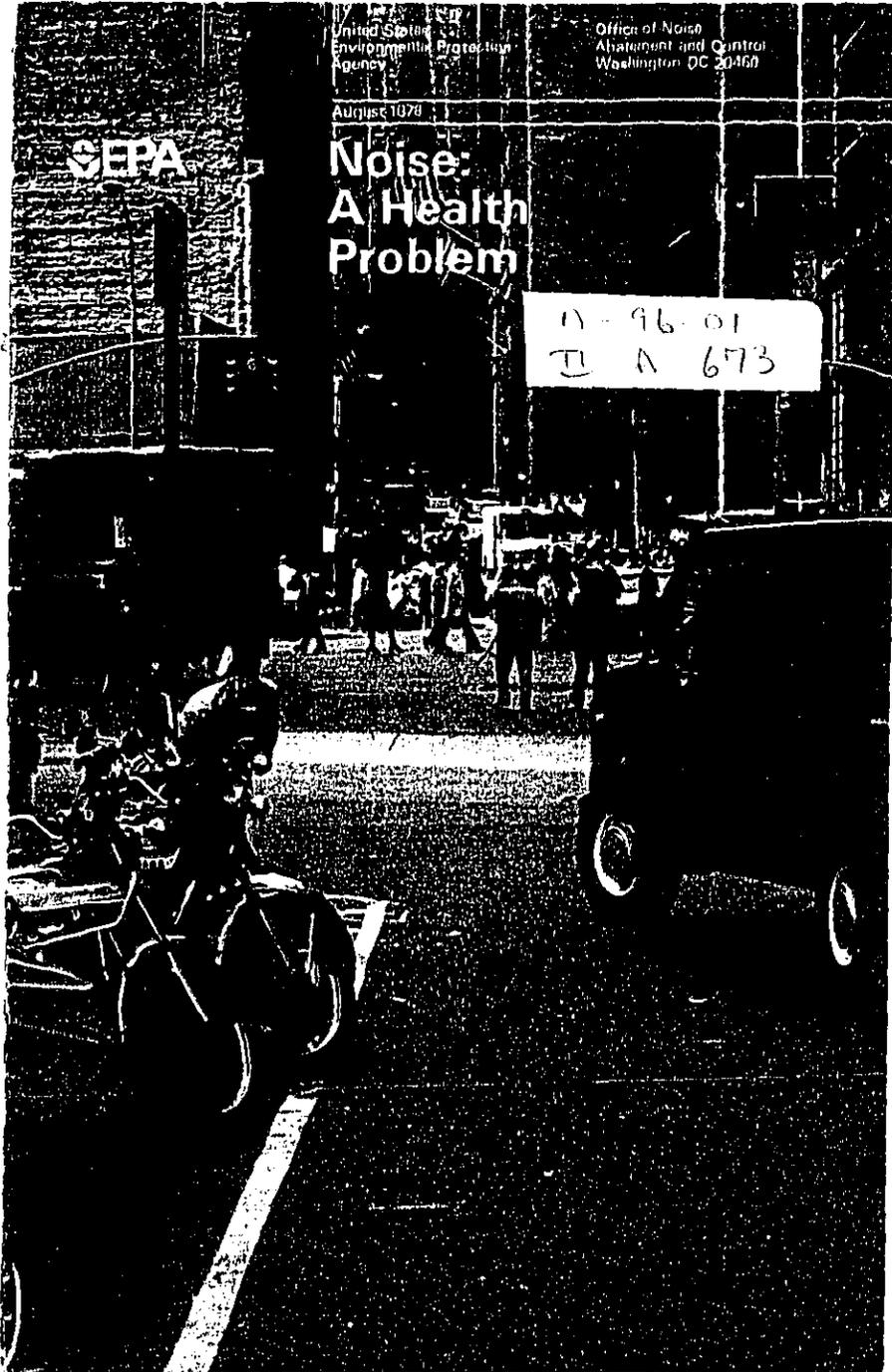
Office of Noise
Abatement and Control
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SEPA

Noise: A Health Problem

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**Noise:
A Health
Problem**

*"Health is a state of complete physical, mental and social well-being. Governments have a responsibility for the health of their people which can be fulfilled only by the provision of adequate health and social measures."*¹

World Health Organization

Introduction

Racket, din, clamor, noise. Whatever you want to call it, unwanted sound is America's most widespread nuisance.² But noise is more than just a nuisance. It constitutes a real and present danger to people's health. Day and night, at home, at work, and at play, noise can produce serious physical and psychological stress.³ No one is immune to this stress. Though we seem to adjust to noise by ignoring it, the ear, in fact, never closes and the body still responds — sometimes with extreme tension, as to a strange sound in the night.

The annoyance we feel when faced with noise is the most common outward symptom of the stress building up inside us. Indeed, because irritability is so apparent, legislators have made public annoyance the basis of many noise abatement programs. The more subtle and more serious health hazards associated with stress caused by noise traditionally have been given much less attention. Nonetheless, when we are annoyed or made irritable by noise, we should consider these symptoms fair warning that other things may be happening to us, some of which may be damaging to our health.⁴

Of the many health hazards related to noise, hearing loss is the most clearly observable and measurable by health professionals. The other hazards are harder to pin down. For many of us, there may be a risk that exposure to the stress of noise increases susceptibility to disease and infection. The more susceptible among us may experience noise as a complicating factor in heart problems and other diseases. Noise that causes annoyance and irritability in healthy persons may have serious consequences for those already ill in mind or body.

Noise affects us throughout our lives. For example, there are indications of effects on the unborn child when mothers are exposed to industrial and environmental noise. During infancy and childhood, youngsters exposed to high noise levels may experience learning difficulties and generally suffer poorer health. Later in life, the elderly may have trouble falling asleep and obtaining necessary amounts of rest.

Why, then, is there not greater alarm about these dangers? Perhaps it is because the link between noise and many disabilities or diseases has not yet been conclusively demonstrated. Perhaps it is because we tend to dismiss annoyance as a price to pay for living in the modern world. It may also be because we still think of hearing loss as only an occupational hazard.

The effects of noise on health are often misunderstood or unrecognized. Well-documented studies to clarify the role of noise as a public health hazard are still required, but we at least know from existing evidence that the danger is real. In the following nine sections, this booklet describes the ways that noise endangers our health and well-being:

Hearing Loss
Heart Disease
The Body's Other Reactions
Noise and the Unborn
Special Effects on Children
Intrusion at Home and Work
Sleep Disruption
Mental and Social Well-Being
Danger to Life and Limb

"Deafness, like poverty, stunts and deadens its victims." Helen Keller

Hearing Loss



Noise loud enough to cause hearing loss is virtually everywhere today. Our jobs, our entertainment and recreation, and our neighborhoods and homes are filled with potentially harmful levels of noise. It is no wonder then that 20 million or more Americans are estimated to be exposed daily to noise that is permanently damaging to their hearing.²

When hearing loss occurs, it is in most cases gradual, becoming worse with time. The first awareness of the damage usually begins with the loss of occasional words in general conversation and with difficulty understanding speech heard on the telephone. Unfortunately, this recognition

comes too late to recover what is lost. By then, the ability to hear the high frequency sounds of, for example, a flute or piccolo or even the soft rustling of leaves will have been permanently diminished. As hearing damage continues, it can become quite significant and handicapping. And there is no cure.³ Hearing aids do not restore noise-damaged hearing, although they can be of limited help to some people.⁴

People with partial deafness from exposure to noise do not necessarily live in a quieter world.⁵ The many sounds still audible to them are distorted in loudness, pitch, apparent location, or clarity. Consonants of speech, especially high frequency sounds such as "s" and "ch," are often lost or indistinguishable from other sounds. Speech frequently seems garbled, sounding as if the speaker has his or her "head in a barrel." When exposed to a very loud noise, people with partial hearing loss may experience discomfort and pain. They also frequently suffer from tinnitus — irritating ringing or roaring in the head.

There is even further pain the hard-of-hearing person faces: the emotional anguish caused, perhaps unintentionally, by friends and associates who become less willing to be partners in conversation or companions in other activities.⁶ Indeed, the inability to con-

verse normally makes it difficult for partially deaf people to participate in lectures, meetings, parties, and other public gatherings. For a person with hearing loss, listening to TV, radio, and the telephone — important activities of our lives — is difficult, if not impossible.⁷

As hearing diminishes, a severe sense of isolation can set in. The greater the hearing loss, the stronger the sense of being cut off from the rest of the world.⁸ What eventually may be lost is the ability to hear enough of the incidental sounds that maintain our feeling of being part of a living world.⁹ The emotional depression following such hearing loss is much the same, whether the impairment has been sudden or gradual.¹⁰

The idea that hearing loss is solely the result of industrial noise is dangerously erroneous. Noise levels in many places and in some of the transportation vehicles we use are well above the levels believed to cause hearing damage over prolonged periods. As a rule, whenever we need to raise our voices to be heard, the background noise may be too loud and should be avoided.¹¹

Noise can cause permanent hearing damage

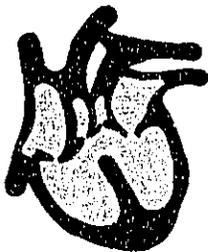
People with hearing loss suffer discomfort and social isolation

Hearing loss is not solely an occupational hazard



"We now have millions with heart disease, high blood pressure, and emotional illness who need protection from the additional stress of noise." Dr. Samuel Rosen, Mt. Sinai Hospital

Heart Disease



While no one has yet shown that noise inflicts any measurable damage to the heart itself, a growing body of evidence strongly suggests a link between exposure to noise and the development and aggravation of a number of heart disease problems. The explanation? Noise causes stress and the body reacts with increased adrenaline, changes in heart rate, and elevated blood pressure.²

Noise, however, is only one of several environmental causes of stress. For this reason, researchers cannot say with confidence that noise alone caused the heart and circulatory problems they

have observed. What they can point to is a statistical relationship apparent in several field and laboratory studies.³

The best available studies are those that have been conducted in industrial settings.⁴ For example, steel workers and machine shop operators laboring under the stress of high noise levels had a higher incidence of circulatory problems than did workers in quiet industries.⁵ A German study has documented a higher rate of heart disease in noisy industries.⁶ In Sweden, several researchers have noted more cases of high blood pressure among workers exposed to high levels of noise.⁷

Some laboratory tests have produced observable physical changes. In one instance, rabbits exposed for 10 weeks to noise levels common to very noisy industries developed a much higher level of blood cholesterol than did unexposed rabbits on the same diet.⁸

Similarly, a monkey subjected to a day-long tape recording of the normal street noises outside a hospital developed higher blood pressure and an increased heart rate.⁹ In a test on humans, people subjected to moderately loud noise during different states of sleep exhibited constriction of the outer blood vessels.¹⁰

Among the more serious recent findings in settings other than the laboratory or industry is the preliminary conclusion that

grade school children exposed to aircraft noise in school and at home had higher blood pressures than children in quieter areas.¹¹ The exact implications for these children's health are not known, but certainly this finding is cause for serious concern.

Because the danger of stress from noise is greater for those already suffering from heart disease, physicians frequently take measures to reduce the noise exposure of their patients.¹² For instance, a town in New Jersey moved a firehouse siren away from the home of a boy with congenital heart disease when his doctor warned that the sound of the siren could cause the boy to have a fatal spasm.¹³ Another doctor ordered a silencing device for the phone of a recuperating heart patient.¹⁴

As William Stewart, former Surgeon General of the United States, has pointed out, there are many incidents of heart disease occurring daily in the U.S. for which "the noise of twentieth century living is a major contributory cause."¹⁵ While the precise role of noise in causing or aggravating heart disease remains unclear, the illness is such a problem in our society that even a small increase in the percentage of heart problems caused by noise could prove debilitating to many thousands of Americans.¹⁶

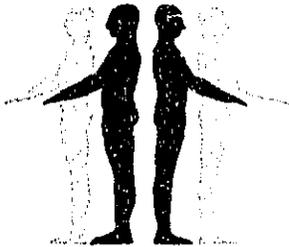
Noise may produce high blood pressure, faster heart rates, and increased adrenaline

Noise may contribute to heart and circulatory disease



"Loud noises once in a while probably cause no harm. But chronic noise situations must be pathological. Constant exposure to noise is negative to your health."
Dr. Gerd Jansen, Ruhr University

The Body's Other Reactions



In readiness for dangerous and harmful situations, our bodies make automatic and unconscious responses to sudden or loud sounds. Of course, most noise in our modern society does not signify such danger. However, our bodies still react as if these sounds were always a threat or warning.⁴

In effect, the body shifts gears. Blood pressure rises, heart rate

and breathing speed up, muscles tense, hormones are released into the bloodstream, and perspiration appears. These changes occur even during sleep.⁶

The idea that people get used to noise is a myth. Even when we think we have become accustomed to noise, biological changes still take place inside us, preparing us for physical activity if necessary.

Noise does not have to be loud to bring on these responses. Noise below the levels usually associated with hearing damage can cause regular and predictable changes in the body.⁹

What happens to the human body when confronted with ever-present noise? In a world where steady bombardment of noise is the rule rather than the exception, the cumulative effects of noise on our bodies may be quite extensive.¹⁰ It may be that our bodies are kept in a near-constant condition of agitation. Researchers debate whether the body's automatic responses build on each other, leading to what are called the "diseases of adaptation."¹¹ These diseases of stress include ulcers, asthma, high blood pressure, headaches, and colitis.¹²

In studies dating back to the

1930s, researchers noted that workers chronically exposed to noise developed marked digestive changes which were thought to lead to ulcers. Cases of ulcers in certain noisy industries have been found to be up to five times as numerous as what normally would be expected.¹³

Similar research has identified more clearly the contribution of noise to other physical disorders. A five-year study of two manufacturing firms in the United States found that workers in noisy plant areas showed greater numbers of diagnosed medical problems, including respiratory ailments, than did workers in quieter areas of the plants.¹⁴

From a study done with animals, researchers concluded that noise may be a risk factor in lowering people's resistance to disease and infection.¹⁵

To prevent aggravation of existing disease, doctors and health researchers agree that there is an absolute requirement for rest and relaxation at regular intervals to maintain adequate mental and physical health.¹⁶ Constant exposure to stress from noise frustrates this requirement. In doing so, it has a potentially harmful effect on our health and well-being.¹⁷

Noise can cause regular and predictable stress in the human body

People do not get used to noise — the body continues to react

Noise may aggravate existing disease



"There is ample evidence that environment has a role in shaping the physique, behavior and function of animals, including man, from conception and not merely from birth. The fetus is capable of perceiving sounds and responding to them by motor activity and cardiac rate change."

Lester W. Sontag, *The Fels Research Institute*¹

Noise and the Unborn



While still in its mother's womb, the developing child is responsive to sounds in the mother's environment. Particularly loud noises have been shown to stimulate the fetus directly, causing changes in heart rate.² Related work also has demonstrated that, late in pregnancy, the fetus can respond to noise with bodily movements such as kicking.³

Just as the fetus is not completely protected from environmental noise, the fetus is

not fully protected from its mother's response to stress, whether it be caused by noise or other factors. When her body reacts to noise, the physical changes she experiences may be transmitted to the fetus. And it is known that the fetus is capable of responding to some changes in the mother's body of the type produced by emotion, noise, or other forms of stress.⁴

In contrast to the more direct risk, this indirect fetal response may threaten fetal development if it occurs early in pregnancy. The most important period is about 14 to 60 days after conception. During this time, important developments in the central nervous system and vital organs are taking place.⁵ Unfortunately, women are often unaware that they are pregnant for much of this period, and are thus unlikely to take extra precautions.

While very little research has addressed these questions, due to the difficulties of studying humans in this respect, certain suggestive human research has been done.

A Japanese study of over 1,000 births produced evidence of a high proportion of low-weight babies in noisy areas.⁶ These birth weights were under 5½ pounds, the World Health Organization's

definition of prematurity. Low birth weights and noise were also associated with lower levels of certain hormones thought to affect fetal growth and to be a good indicator of protein production.⁷ The difference between the hormone levels of pregnant mothers in noisy versus quiet areas increased as birth approached.

Studies have also shown that stress causes constriction of the uterine blood vessels which supply nutrients and oxygen to the developing baby.⁸ Additional links between noise and birth defects have been noted in a recent preliminary study on people living near a major airport.⁹ The abnormalities suggested included harelips, cleft palates, and defects in the spine.

Taken together, this information points to the possibility of serious effects of noise on the growth and development of the unborn child. While it cannot be said at what level maternal exposures to industrial and environmental noise are dangerous to the fetus, these findings do create some concern. It is known that extreme stress of any type will certainly take a toll on the fetus, but, in the case of noise, it is not known how much is required to have an effect.¹⁰ Whatever the effect, the risk of even a slight increase in birth defects is considerably disturbing.

The fetus is not fully protected from noise

Noise may threaten fetal development

Noise has been linked to low birth weights



"Levels of noise which do not interfere with the perception of speech by adults may interfere significantly with the perception of speech by children as well as with the acquisition of speech, language, and language-related skills." National Academy of Sciences Report¹

Special Effects on Children



Good health includes the ability to function mentally as well as physically. This is especially true during growth and development.

Adults have worried about the effects of noise on children ever since the early 1900s when "quiet zones" were established around many of the nation's schools.² These protective areas were intended to increase educational efficiency by reducing the various levels of noise that were believed to interfere with children's learning and even hamper their thinking ability.³

Today's worries are little changed from those of the past. Researchers looking into the consequences of bringing up children in this less-than-quiet world have discovered that learning difficulties are likely byproducts of the noisy schools, play areas, and homes in which our children grow up. Two primary concerns are with language development and reading ability.⁴

Because they are just learning, children have more difficulty understanding language in the presence of noise than adults do. As a result, if children learn to speak and listen in a noisy environment, they may have great difficulty in developing such essential skills as distinguishing the sounds of speech.⁵ For example, against a background of noise, a child may confuse the sound of "v" in "very" with the "b" in "berry" and may not learn to tell them apart. Another symptom of this problem is the tendency to distort speech by dropping parts of words, especially their endings.

Reading ability also may be seriously impaired by noise.⁶ A study of reading scores of 54 youngsters, grades two through five, indicated that the noise levels in their four adjacent apartment buildings were detrimental to the children's reading development.⁷ The influence of noise in the home was found to be more important than even the

parents' educational background, the number of children in the family, and the grades the youngsters were in. The longer the children had lived in the noisy environment, the more pronounced the reading impairment.

Assuming a child arrives at school with language skills underdeveloped because of a noisy home, will he or she fare any better at school? Again, the answer may depend on how noisy the classroom is.⁹ In a school located next to an elevated railway, students whose classrooms faced the track did significantly worse on reading tests than did similar students whose classrooms were farther away.⁹ In Inglewood, California, the effects of aircraft noise on learning were so severe that several new and quieter schools had to be built.¹⁰ As a school official explained, the disruption of learning went beyond the time wasted waiting for noisy aircraft to pass over. Considerable time had to be spent after each flyover re-focusing students' attention on what was being done before the interruption.¹¹

But the problem may be well beyond the capacity of the schools to correct. Children who live in noisy homes and play in noisy areas may never develop the ability to listen well enough to

learn once they are of school age. To avoid this prospect, our concern for the health and welfare of the nation's children must be broadened to address the total environment in which they grow up.

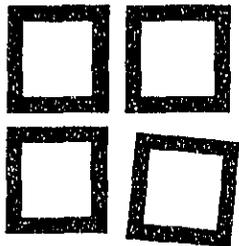
Noise may hinder the development of language skills in children

Noise disrupts the educational process



"Interference with speech communication by noise is among the most significant adverse effects of noise on people. Free and easy speech communication is probably essential for full development of individuals and social relations, and freedom of speech is but an empty phrase if one cannot be heard or understood because of noise." EPA Report 1

Intrusion At Home and Work



If there is one common denominator degrading the quality of all our lives, it may well be the almost constant intrusion of noise — in the home, at work, and in public areas.² One of the most bothersome aspects of this intrusion is its interference with conversation. We may not always be aware of it, but we frequently must speak up to be heard. Others

must often do the same to be understood by us.

Loss of the ability to speak at a normal level and be heard may be far more damaging than we realize. People who live in noisy places tend to adopt a lifestyle devoid of communication and social interaction.³ They stop talking, they change the content of the conversation, they talk only when absolutely necessary, and they frequently must repeat themselves.⁴ These reactions are probably familiar to all of us.

Interference with indoor conversation represents only a small part of the intrusion problem. Outdoors, the combination of continuous daytime noise caused by street traffic, construction equipment, and aircraft interrupts speech and can discourage conversation there as well.⁵ For millions of Americans residing in noisy urban areas, the use of outdoor areas for relaxed conversation is virtually impossible.⁶

Noise not only makes conversation difficult — indoors or out — it also seems to hinder work efficiency. In general, noise is more likely to reduce the accuracy of work rather than the total quantity. And it takes a greater toll on complex compared to simpler tasks.⁷ When noise is particularly loud or unpredictable, errors in people's observation tend to increase, perception of time may be distorted, and greater effort is required to remain alert.⁸ Loud noise also can increase the

variability of work, leading to breaks in concentration sometimes followed by changes in work rate.⁹

Even when noise does not interfere with the work at hand, work quality may suffer after the noise stops. Studies and reports from individuals also suggest that people who work in the midst of high noise levels during the day are more, rather than less, susceptible to frustration and aggravation after work.¹⁰ Relaxing at home after a noisy workday may not be an easy thing to do. When the home is noisy itself, the tired and irritated worker may never be able to work out the day's accumulated stress during the course of the evening.

Noise in industrial settings may have the most pronounced effects on human performance and employee health. A coal industry study indicated that intermittent noise conditions during mining have a great likelihood for causing distraction leading to poorer work.¹¹ Other studies have confirmed additional effects of noise exposure, including exhaustion, absentmindedness, mental strain, and absenteeism — all of which affect worker ef-

iciency.¹² In the words of Leonard Woodcock, former president of the United Auto Workers, "They (auto workers) find themselves unusually fatigued at the end of the day compared to their fellow workers who are not exposed to much noise. They complain of headaches and inability to sleep and they suffer from anxiety . . . Our members tell us that the continuous exposure to high levels of noise makes them tense, irritable, and upset."¹³

Noise interferes with conversation and social interaction

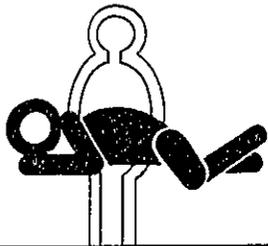
Noise hampers work efficiency



"The din of the modern city [includes] noises far above levels for optimum sleeping. Result: insomnia and instability."

Dr. Edward F. Crippen, Former Deputy Health Commissioner of Detroit

Sleep Disruption



Sleep is a restorative time of life, and a good night's sleep is probably crucial to good health. But everyday experience suggests that noise interferes with our sleep — in a number of ways. Noise can make it difficult to fall asleep, it can wake us, and it can cause shifts from deeper to lighter sleep stages.² If the noise interference with sleep becomes a chronic problem, it may take its toll on health.

Human response to noise before and during sleep varies widely among age groups. The elderly and the sick are particularly sensitive to disruptive noise.³ Compared to young people, the elderly are more easily awakened by noise and, once awake, have more difficulty returning to sleep.⁴ As a group, the elderly require special protection from the noises that interfere with their sleep.

Other age groups seem to be less affected by noise at bedtime and while asleep. But their apparent adjustment may simply be the result of failing to remember having awakened during the night. Sleep researchers have observed that their subjects often forget and underestimate the number of times they awaken during sleep.⁵ It may be that loud noises during the night continue to wake or rouse us when we sleep, but that as we become familiar with the sounds, we return to sleep more rapidly.⁶

Factors other than age can influence our sleep. Studies suggest that the more frequent noise is, the less likely a sleeper is to respond.⁷ Certain kinds of

noises can cause almost certain responses, however. A mother may wake immediately at the sound of a crying baby, but may tune out much louder traffic noise outside.

Disruption of sleep does not necessarily include awakening. Shifting in depths of sleep may be more frequent than awakening. For instance, recent studies have shown that shifts from deep to light sleep were more numerous because of noise, and that light sleep became lengthened at the expense of deep sleep.¹⁰

Studies have also been made of noise complaints and what kinds of annoyance led people to file them. Surveys taken in communities significantly affected by noise indicated that the interruption of rest, relaxation, and sleep was the underlying cause of many people's complaints.¹¹

When noise interferes with our sleep—whether by waking us or changing the depth of sleep—it makes demands on our bodies to adapt. The implications of these demands for our general health and performance are not well understood. Nonetheless, we need restful sleep and many of us are not getting it. As a result, for millions of Americans, trying to get a good night's sleep still means reaching for sleeping pills.¹²

Noise affects the quantity and quality of sleep

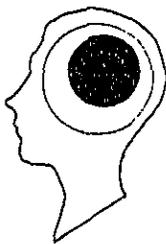
The elderly and sick are more sensitive to disruptive noise

When sleep is disturbed by noise, work efficiency and health may suffer



*"The Noise, The Noise. I just couldn't stand the Noise."
Suicide note left by a desperate homeowner. †*

Mental and Social Well-Being



The most obvious price we pay for living in an overly noisy world is the annoyance we frequently experience. Perhaps because annoyance is so commonplace, we tend to take our daily doses of it for granted — not realizing that the irritability that sometimes surfaces can be a symptom of potentially more serious distress inside us. When noise becomes sufficiently loud or unpredictable, or if the stress imposed is great enough, our initial annoyance can become transformed into more extreme emotional responses and behavior. When this happens, our tempers flare and we may "fly off

the handle" at the slightest provocation.²

Newspaper files and police records contain reports of incidents that point to noise as a trigger of extreme behavior. For instance, a night clerical worker, upset about noise outside his apartment, shot one of the boys causing the disturbance after he had shouted at them, to no avail, to "Stop the noise."³ As other examples, sanitation workers have been assaulted, construction foremen threatened, and motorboat operators shot at — all because of the noise they were producing.⁴

Such extreme actions are not the usual responses to noise and stress. Some people cope with loud noise by directing their anger and frustration inward, by blaming themselves for being upset, and by suffering in silence.⁵ Others resort to a denial of the problem altogether, considering themselves so tough that noise does not bother them.⁶ Still others deal with noise in a more direct manner: they take sleeping pills and wear ear plugs, increase their visits to doctors and keep their windows closed, rearrange their sleeping quarters and spend less time outdoors, and write letters of complaint to government officials.⁷

Most of the time these ways of contending with noise are not likely to eliminate the noise or any underlying annoyance. Short of taking extreme action — which is unlikely to solve the problem

either — most people who cannot cope with noise in these ways typically direct their anger and frustration at others and become more argumentative and moody, though not necessarily violent.⁸ This noise-induced, anti-social behavior may be far more prevalent than we realize.

Indeed, noise can strain relations between individuals, cause people to be less tolerant of frustration and ambiguity, and make people less willing to help others.⁹ One recent study, for example, found that, while a lawnmower was running nearby, people were less willing to help a person with a broken arm pick up a dropped armload of books.¹⁰

Another study of two groups of people playing a game found that the subjects playing under noisier conditions perceived their fellow players as more disagreeable, disorganized, and threatening.¹¹ Several industrial studies indicate that noise can heighten social conflicts both at work and at home.¹² And reports from individuals suggest that noise increases tensions between workers and their supervisors, resulting in additional grievances against the employer.¹³

Although no one would say that noise by itself brings on mental illness, there is evidence that noise-related stress can aggravate already existing emotional disorders.¹⁴ Research in the United

States and England points to higher rates of admission to psychiatric hospitals among people living close to airports.¹⁵ And studies of several industries show that prolonged noise exposure may lead to a larger number of psychological problems among workers.¹⁶

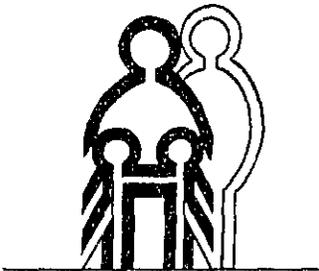
Noise can cause extreme emotions and behavior

Anti-social behavior caused by noise may be more prevalent than is realized



"Inability to hear auditory warning signals or shouts of caution because of noise has also been implicated in industrial accidents." Alexander Cohen, National Institute for Occupational Safety and Health¹

Danger to Life and Limb



Two people were killed when Senator Robert Kennedy's funeral train passed through Elizabeth, New Jersey. Because of the noise from Secret Service and news media helicopters, they did not hear the warning blasts from the train that hit them.²

Although the evidence is scanty, the inability to hear warning signals because of high background noise is thought to be the cause of many accidents each year. For example, traffic ac-

cidents occur and lives are lost because drivers are unable to hear the sirens from nearby or passing emergency vehicles.³ One study has estimated that when a fire truck or ambulance is in the process of passing a truck, the truck driver is able to detect the siren for only a very short time — three seconds or less. The rest of the time the truck's noise drowns out the siren, and the warning is undetected.⁴

Nowhere is the concern over preventable accidents greater than in industrial settings, where noise levels not only can interfere with concentration and can cause hearing loss, but can hinder communication between employees as well — particularly in times of emergency. A study of medical and accident records of workers in several industries found that a significantly higher number of reported accidents occurred in noisier plant areas.⁵ The Federal Railroad Administration is aware of this hazard and has identified "high noise-level conditions" as a possible contributor in 19 accidents causing deaths of 25 railroad employees, in a 22-month period.⁶

Reports from industrial officials also indicate that the effectiveness of warning signals and shouts in noisy areas is considerably diminished and that accidents and injuries are more fre-

quent. The effects of masking and speech interference can be dramatic, as in the case of an accident in an auto glass manufacturing plant.⁷ Noise levels were so high that a worker whose hand was caught in manufacturing equipment received no aid since no one heard the screams. As a result, the hand was lost. As additional examples, two press-room auto workers in Ohio were permanently disabled when they failed to hear approaching panel

racks or warning shouts.⁸

Thus it is an unfortunate result of high background noise levels that people cannot respond in life and death situations when they are unable to hear approaching hazards or shouts of alarm.

Noise can obscure warning signals, causing accidents to occur

Noise can interfere with shouts for help, preventing rescue attempts



*"It is truly a serious problem to
escape from noise."*
William Dean Howells, American
Author / ✓

A Final Word

When unwanted sounds intrude into our environment, noise exists. We have all experienced to varying degrees the annoyance and irritation caused by noise. Sometimes this annoyance is brought about by disruption of our sleep or difficulty in falling asleep. At other times, it may be because we have to raise our voices over background noise to be heard or because we are distracted from our activities.

Except for the serious problem of hearing loss, there is no human illness known to be directly caused by noise. But throughout dozens of studies, noise has been clearly identified as an important cause of physical and psychological stress, and stress has been directly linked with many of our most common health problems. Thus, noise can be associated with many of these disabilities and diseases, which include heart disease, high blood pressure, headaches, fatigue and irritability.

Noise is also suspected to interfere with children's learning and with normal development of the unborn child. Noise is reported to have triggered extremely hostile behavior among persons presumably suffering from emotional illness. It is suspected to lower our resistance, in some cases, to the onset of infection and disease.

However, most Americans are largely unaware that noise poses

such significant dangers to their health and welfare. The reasons for this lack of awareness are clear. Noise is one of many environmental causes of stress and cannot easily be identified as the source of a particular physical or mental ailment by the layman. Another reason is that biomedical and behavioral research is only now at the point where health hazards stemming from noise can actually be named, even though some specific links have yet to be found.

Dr. William H. Stewart, former Surgeon General, in his keynote address to the 1969 Conference on Noise as a Public Health Hazard, made the following point: "Must we wait until we prove every link in the chain of causation? I stand firmly with (Surgeon General) Burney's statement of 10 years ago. In protecting health, absolute proof comes late. To wait for it is to invite disaster or to prolong suffering unnecessarily. I submit that those things within man's power to control which impact upon the individual in a negative way, which infringe upon his sense of integrity, and interrupt his pursuit of fulfillment, are hazards to public health."² ✓

It is finally clear that noise is a significant hazard to public health. Truly, noise is more than just an annoyance.

While this booklet contains reliable and important information on Noise, it is not published in support of any specific EPA Noise Regulation. The technical supporting documentation for any specific EPA Noise regulation will be published in a background document which accompanies the regulation.

"Calling noise a nuisance is like calling smog an inconvenience. Noise must be considered a hazard to the health of people everywhere."

Dr. William H. Stewart, former U.S. Surgeon General

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INTRODUCTION

1. "Health is a state of complete physical, mental and social well-being and not merely an absence of disease and infirmity."

Quoted from: "Constitution of the World Health Organization," 1948, available from the WHO Office of Public Information, 1211 Geneva 27, Switzerland.

- 2a. "Thus, irrelevant or excessive sound is undesirable. Such unwanted sound is noise. The definition of noise includes a value judgment, and for a society to brand some sounds as noises requires an agreement among the members of that society. Sometimes such agreements can be achieved readily. Other times considerable analysis and debate is required before agreement can be reached."

Quoted from: James D. Miller, "Effects of Noise on People," in the Journal of the Acoustical Society of America, 56, No. 3 (Sept. 1974), p. 730.

Note: Mr. Miller's paper was supported by a contract between the Office of Noise Abatement and Control of the U. S. Environmental Protection Agency and the Central Institute for the Deaf and by a Public Service grant from the National Institute of Neurological Diseases and Stroke to the Central Institute for the Deaf. As a wide-ranging review of relatively current scientific studies in the field of noise effects, the paper is the basis of many of the statements made in the Noise Effects booklet. Therefore, citations from it appear frequently in this document.

- 2b. "Noise is the most frequently cited of annoyances in neighborhoods. In a 1973 national survey of housing conditions, street noise was cited by 34 percent of the 60,000 respondents as a 'condition existing in this neighborhood'; 60 percent of those reporting its presence felt that the street noise was 'disturbing, harmful, or dangerous'; and 18 percent of those reporting the condition felt that 'it is so objectionable' that they would 'like to move.' In addition, 20 percent of the respondents listed airplane noise among the conditions characterizing their neighborhood, of whom 34 percent were disturbed by it and 6 percent wished to move because of it."

Quoted from: "Noise Abatement: Policy alternatives for transportation," a report to the U. S. Environmental Protection Agency from the Committee on Appraisal of Societal Consequences of Transportation Noise Abatement, with the Assembly of Behavioral and Social Sciences and the National Research Council (Washington, D.C.: National Academy of Sciences, 1977), p. 63.

Survey cited is: 1973 Bureau of the Census (1975) Annual Housing Survey; United States and Regions: Part B. Indicators of Housing and Neighborhood Quality. Prepared in cooperation with Department of Housing and Urban Development. Series H-150-73. Washington, DC: U.S. Government Printing Office.

- 3a. "Noise exposure can be presumed to cause general stress by itself or in conjunction with other stressors. Neither the relationship between noise exposure and stress nor the noise level or duration at which stress may appear have been resolved."

Quoted from: "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With an Adequate Margin of Safety," prepared by the U. S. Environmental Protection Agency (550/9-74-004, March, 1974), p. E-4. (Document is available from the U. S. Printing Office, Washington, DC, price \$2.10).

- 3b. "As mentioned earlier, general psychological distress produced by noise can add to the overall stress of life and in this way may contribute to the incidence of non-auditory disease. At this time, however, one cannot evaluate the contribution of noise-induced distress in relation to those other sources of stress we all encounter in our daily activities."

Quoted from: Miller, "Effects of Noise on People, JASA, p. 761.

Note: The relationship of noise and stress is further discussed in the booklet's section on the human body's other reactions to noise-induced stress.

- 4a. "Annoyance is defined as a feeling of displeasure or a general adverse attitude against a factor in the environment which could adversely affect man's health or subjective feeling of well-being".

Quoted from: WHO Draft Criteria Document, 1977.

- 4b. "It is unfortunate for us that we become gradually used to noise of any kind that at first was very disturbing, and that we do not actually recognize its damaging and insidious effects until it has undermined our health."

Quote is used in: Raymond W. Smilor, "Cacophony at 34th and 6th: The Noise Problem in America, 1900-1930," unpublished research paper in American Studies 28, University of Texas (Austin) History Department (Spring, 1977) p. 28-29.

Mr. Smilor's paper cites quote from: Report of the Committee Investigating the elimination of Excess Noise, Proceedings of the National Safety Council, Fourteenth Annual Safety Congress, Part 1, Cleveland, Ohio, Sept. 28-Oct. 2, 1925, pp. 192-199.

HEARING LOSS

1. "Deafness, like poverty, stunts and deadens its victims."

Helen Keller, cited in: Baron, The Tyranny of Noise, p. 109.

2. "It is estimated that as many as 20 million people are exposed to noises of duration and intensity sufficient to cause a permanent reduction in their ability to hear. Of these, approximately 9 million are production workers in industry, 1 million are operators of transportation equipment, 2 million are passengers, and 8 million are operators or passengers of recreational equipment and other equipment for personal use."

Quoted from: "Noise Abatement: Policy Alternatives for Transportation," report to the EPA (Washington, DC: National Academy of Sciences, 1977), p. 63.

Report cites three supporting studies:

Bolt, Beranek and Newman, Inc. (1976), Economic Impact Analysis of Proposed Noise Control Regulation. Prepared in cooperation with Abt Associates, Inc. for the Technical Data Center, Occupational Safety and Health Administration, U.S. Department of Labor, BBN Report 3246. Washington, DC; U.S. Occupational Safety and Health Administration; PB-258 841. Springfield, VA: National Technical Information Service.

Galloway, W.J., Kenneth M. Eldred, and M. A. Simpson (1974), Population Distribution of the United States as a Function of Outdoor Noise Level. Office of Noise Abatement and Control. Prepared by Bolt, Beranek and Newman, Inc. for the Office of Noise Abatement and Control, EPA-550/9-74-009. Arlington, VA: U. S. Environmental Protection Agency; PB-235 0222/1. Springfield, VA: National Technical Information Service.

U. S. Environmental Protection Agency (1972), The Economics of Clean Air. Annual Report of the Administrator of the Environmental Protection Agency to the Congress of the United States in compliance with Public Law 91-604, the Clean Air Act, as Amended. Washington, DC: U. S. Government Printing Office.

- 3a. "This loss is referred to as a noise-induced permanent threshold shift . . . A PTS causes irreversible damage to the inner ear. There are no known ameliorative agents either to inhibit or to cure this type of hearing loss."

Quoted from: Bragdon, Noise Pollution: The Unquiet Crisis, p. 76.

- 3b. "No matter what theory is eventually found to be correct, certain facts are established beyond doubt. Excessive

exposure to noise leads to the destruction of the primary auditory receptor cells, the hair cells. There can be other injuries to the organ of Corti that can range from mild distortion of its structure to collapse or complete degeneration. The auditory neurons may also degenerate. All of these cells are highly specialized. Once these cells are destroyed, they do not regenerate and cannot be simulated to regenerate; they are lost forever."

Quoted from: Miller, JASA, p. 732.

- 4a. "While a hearing aid sometimes can be useful to a person with noise-induced hearing loss, the results are not always satisfactory. The modern hearing aid can amplify sound and make it audible, but it cannot correct for the distortions that often accompany injury to the organ of Corti."

Quoted from: Miller, JASA, p. 739.

- 4b. "No hearing aid can ever compensate completely for a hearing loss. Everyone who is thinking of getting a hearing aid should realize at the outset that there are limits to what any hearing aid can possibly do."

Quoted from: S. R. Silverman, S. Gordon Taylor, and Hallowell Davis, "Hearing Aids," in Hearing and Deafness, ed. Hallowell Davis, rev. ed. (New York: Holt, Rinehart, and Winston, 1966), p. 265.

- 5a. "People with partial deafness from exposure to noise do not live in an auditory world that is simply 'muffled.' Even those sounds that are heard may be distorted in loudness, pitch, apparent location, or clarity.

Quoted from: Miller, JASA, p. 739.

- 6a. "The man with severe hearing loss will save himself much pain if he will realize that, although the difficulties imposed by deafness are now receiving recognition, he must not expect the general public to understand the problems of adjustment that are involved."

Quoted from: S. R. Silverman and Hallowell Davis, Hearing and Deafness, 2nd ed. (New York: Holt, Rinehart and Winston), p. 445.

- 6b. "A person having a hearing loss may to others appear to be aggressive, out of place, or annoying due to his louder than normal conversational voice."

Quoted from: Bragdon, The Unquiet Crisis, p. 86.

7. "...a hearing loss today is far more handicapping than it was before TV, radio, and the telephone began to play such major roles in education, leisure, and the business world. Today, the inability to understand on a telephone is indeed a major handicap for the vast majority of people."

Quoted from: George Bugliarello, Noise Pollution: A Review of Its Techno-Sociological and Health Aspects (Biotechnology Program: Carnegie-Mellon University, February 1968), p. 75.

Quotation is from: Joseph Sataloff and John A. Zapp, "The Environment in Relation to Otologic Disease," in Archives of Environmental Health, 18, No. 6, June 1969.

8. "It was the constant reiteration, by hard-of-hearing patients at Deshon Army Hospital, of the statement that the world seemed dead which led to the investigation of this third level of hearing and of the psychological effect of its loss upon the deaf."

Quoted from: Bugliarello, p. 74.

9. "These incidental noises maintain our feeling of being part of a living world and contribute to our own sense of being alive."

Quoted from: Silverman and Davis, 2nd ed., p. 437.

- 10a. "The depressive reaction is much the same whether the impairment in hearing has been sudden or gradual."

Quoted from: Ibid., p. 439.

- 10b. "The extent of the psychological consequences of deafening may be measured by their scores on the Minnesota Multiphasic Psychiatric Index where 64% of males and 56% of females score high on the depression scale, about 54% of both sexes high on the paranoia scale, 64% of males and 55% of females high on the schizophrenia scale and 57% of males and 50% of females high on the hypomania scale."

Quoted from: W. Hausman, "Noise and Mental Health -- An Overview," In Proceedings of the International Congress on Noise as a Public Health Problem, 13-18 May 1973, Dubrovnik, Yugoslavia (Washington, D.C.: U.S. Environmental Protection Agency), p. 594. (Document available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.)

11. "Avoid situations where you have to raise your voice to converse with anyone..."

Quoted from: Raymond D. Berendt and Edith L.R. Corliss "Quieting: A Practical Guide to Noise Control" (National Bureau of Standards, National Science Foundation: Washington, D.C. July 1976), p. 9-11.

HEART DISEASE

1. "We now have millions with heart disease, high blood pressure...who need protection from the additional stress of noise.' In 1969 he told the Acoustical Society of America, 'If a disorder such as atherosclerosis or coronary heart disease is present, (excessive) noise exposure could endanger health...'"

Quoted from: Baron, The Tyranny of Noise, p. 55.

Note: No citations for Dr. Rosen's remarks are given by Baron.

- 2a. "In response to brief sounds, there is a general constriction in the peripheral blood vessels, with a reduction in peripheral blood flow. There may be acceleration or deceleration of heart rate..."

Quoted from: Report to the President and Congress on Noise, report of the Administrator of the Environmental Protection Agency, in compliance with Title IV of Public Law 91-604: The Clean Air Act Amendments of 1970 (Washington, D.C.: U.S. EPA, February 1972), p. 1-27.

- 2b. "According to Rosen, adrenaline increase, if chronic, could elevate blood pressure. Noise, hypertension, and heart disease thus make for a vicious circle: noise can elevate the blood pressure, elevated blood pressure can contribute to heart disease, and heart disease can be a cause of high blood pressure."

Quoted from: Baron, The Tyranny of Noise, p. 56.

- 2c. "Noise proved to be an important stressing agent capable of causing disturbances in cardiovascular and psychotic subjects."

Quoted from: A. E. Arguelles, M. A. Martinez, and Eva Pucciarelli, "Endocrine and Metabolic Effects of Noise in Normal, Hypertensive, and Psychotic Subjects," in Physiological Effects of Noise, ed. by Welch and Welch, p. 54.

3. "In summary, one might say that although a great deal more scientific work will be needed before it can be said that workplace noise definitely contributes to cardiovascular disease, a relationship between the two is entirely plausible."

Quoted from: "Some Considerations in Choosing an Occupational Noise Exposure Regulation," prepared by the Center for Policy Alternatives, Massachusetts Institute of Technology (Washington, D.C.: U.S. Environmental Protection Agency, February 1976), p. 2-40.

4. "Empirical evidence about the relationships of noise to cardiovascular disease is scanty. The best available studies, those by Jansen (1959, 1969), were conducted in an industrial setting and indicate that even when control differences are taken into account, workers in noisy industries have a significantly higher rate of cardiovascular disease than those in quiet industries."

Quoted from: Hattis, D., N.A. Ashford, G.R. Heaton, and J.I. Katz, EPA "Some Considerations in Choosing an Occupational Noise Exposure Regulation," prepared by the Center for Policy Alternatives, Massachusetts Institute of Technology for the Office of Noise Abatement and Control, EPA-550/9-76-007. (Washington, D.C.: U.S. Environmental Protection Agency: PB-251 408/1GA, 1977), pp. 118.

Jansen studies are from:

Gerd Jansen, "On the Origination of Vegetative Functional Disturbances Due to Noise Effect," (Archiv fur Gewerbepathologie und Gewerbehygiene, 1959).

Gerd Jansen, "Effects of Noise on Physiological State," Noise as a Public Health Hazard, Proceedings edited by W.D. Ward and J.E. Fricke, ASHA Report No. 4, (Washington, D.C.: American Speech and Hearing Association, 1969), pp. 89-98.

5. "Although there are reports that a higher incidence of circulatory problems exists in noise-exposed steel workers and machine shop operators, it cannot be said with confidence that noise alone caused the circulatory problems in these populations."

Quoted from: Public Health and Welfare Criteria for Noise (U.S. EPA), p. 7-11.

Studies cited are:

G. Jansen, "Adverse Effects of Noise on Iron and Steel Workers," in Stahl. Eisen., 81 (1961), pp. 217-220.

A. Andriukin, "Influence of Sound on the Development of Hypertension," (cited also in Kryter, 1970), Cor. Et Vasa, 3 (1961), pp. 285-93.

6. "There is evidence that workers exposed to high levels of noise have a higher incidence of cardiovascular disorders; ear, nose, and throat problems; and equilibrium disorders than do workers exposed to lower levels of noise (Andriukin, 1961; Jansen, 1959, 1969; Kryter et al., 1971)."

Kryter citation is from:

K.D. Kryter, G. Jansen, D. Parker, H.O. Parrack, G. Thiessen, and H.L. Williams, "Non-Auditory Effects of Noise," Rep. of WG-63, NAS-NRC Com. on Hear. Bioacoust. Biomech. (Washington, D.C., 1971).

- 7a. A. Jonsson and L. Hansson, "Prolonged Exposure to a Stressful Stimulus as a Cause of Raised Blood Pressure in Man, in The Lancet, 1, (Jan. 8, 1977), pp. 86-87.

Abstract of study:

A survey of 196 male automobile factory workers was conducted to see if there was a permanent blood pressure increase in people exposed to noise levels high enough to induce permanent hearing damage. Audiograms and blood pressure readings were conducted as part of a routine exam. Out of 196 subjects, 44 had a noise-induced hearing loss (greater than 65 dB at 3000, 4000, or 6000 Hz) and 74 subjects of the same age had normal hearing. The workers with noise induced hearing loss were found to have a significantly higher incidence of high blood pressure than the group with normal hearing. Also the group with noise-induced hearing loss had more hypertensive individuals. The investigators believe that repeated exposure to severe noise causes repeated rises in blood pressure, which in turn causes structural adaptation of the heart and resistance vessels, resulting in permanent rise in blood pressure. They conclude that severe and prolonged exposure to noise could be a cardiovascular risk factor.

- 7b. "In epidemiological studies, several authors report an increased incidence of hypertension in workers exposed to high noise levels."

Quoted from: "Proceedings of the International Congress on Noise as a Public Health Problem," Dubrovnik, Yugoslavia. (Washington, D.C.: U.S. EPA, 13-18 May 1973), p. 480.

Studies cited are from:

Gosta Carlestan and Lennart Levi, "Urban Conglomerates as Psychosocial Human Stressors (Stockholm: Royal Ministry for Foreign Affairs, 1971).

A.L. Mjasnikow, "The Pathogenesis of Essential Hypertension," in the Proceedings of the Prague Symposium (1970), pp. 153-162.

N.N. Shatalov, A.O. Saitanov, and K.V. Glatova, "On the State of the Cardiovascular System Under Conditions of Exposure to Continuous Noise," Report T-411-R, N65-15577 (Toronto: Defense Research Board, 1962).

M.V. Ratner, R.A. Medved, A.P. Filin, W.I. Shok, W.F. Rodenkow, and N.A. Makarenkow, "Thesen des Berichtes der allunionswissenschaftlichen Tagung über methodische Probleme der Lärmwirkung auf den Organismus," Institut für Arbeitshygiene und Berufskrankheiten, AMW, USSR (1963).

8. "Rabbits exposed to 102 dB of white noise for 10 weeks showed a much higher level of blood cholesterol than non-noise-exposed animals although diet was identical in both groups. Noise-exposed animals developed a greater degree of aortic atherosclerosis with higher cholesterol content than control animals not exposed to noise."

Quoted from: Samuel Rosen, "Noise, Hearing and Cardiovascular Function," in Physiological Effects of Noise, ed. by Bruce L. Welch (New York: Plenum Press, 1970), p. 61.

Study cited is from:

M. Friedman, S.O. Byers, and A.E. Broun, "Plasma Lipid Response of Rats and Rabbits to an Auditory Stimulus," in the American Journal of Physiology, No. 212 (1967), pp. 1171-1178.

- 9a. "A rhesus monkey named Mars recently spent 12 hours a day for 30 days being buffeted by the sounds any passerby might hear at noon outside Jackson Memorial Hospital in Miami.

"Her experience is part of a research project on "acoustical physiology" now being conducted at the University of Miami Medical School with financial help from the Office of Noise Abatement and Control of the Environmental Protection Agency. The experiments reflect sharply rising concern that noise may pose a serious general health hazard, though an insidious one often unrecognized even by its victims. Noise, experts say, not only damages hearing but may create psychological troubles and contribute to such diverse physical ailments as heart disease and cancer.

"It was like the original white-knuckle flight," Dr. Ernest A. Peterson, a psychologist, says of the experiments with Mars. "For the first three or four days, the poor animal just gripped the arms of her chair, refusing to look away from the noise source. Her blood pressure and heart rate shot up to about 30 percent above normal and stayed there, during the noise periods, for the whole 30 days. For the first two weeks or so, the rates stayed high even at night with the noise off." But Dr. Peterson and his colleague Dr. Jeffrey Augenstein, a physician, do not yet know whether or not Mars has been permanently harmed."

Quoted from: "Noise: Physical Harm Is Only Part of It," by Evan Jenkins, The New York Times, April 24, 1977.

- 9b. "Quantitative criteria for the effects of noise on the cardiovascular system are needed in order to protect the health and welfare of the American Public from adverse effects of noise. Research on the non-auditory physiological effects of noise has been identified as a particularly pressing need. This project will help fill this gap by generating data on the presence (or absence) and degree of significant cardiovascular adjustments as a result of protracted noise exposure... Preliminary results show that prolonged exposure to moderate noise levels, such as urban traffic noise, caused significant increases in heart rate in a female monkey. The heart rate had still failed to return to normal 4 months after the noise had stopped."

Quoted from: "Protracted Noise Exposure and Cardiovascular Function," From Federal Noise Research in Noise Effects, Report of the Second Federal Interagency Noise Effects Research Panel (Washington, D.C.: U.S. EPA, March 1978), p. B-37.

10. "We gave sound stimuli of the low intensity of 55 dB during the different (sleep) stages and were able to produce vasoconstriction in all (subjects)."

Quote from: G. Jansen, "Adverse Effects of Noise on Iron and Steel Workers," in Stahl. Eisen., 81 (1961), pp. 217-220.

11. Personal Communication with Dr. Sheldon Cohen, Assistant Professor, Department of Psychology, University of Oregon, March 1978.
12. "If there is already present somatic disease like atherosclerosis or coronary heart disease such noise exposure (to white noise of 90 dB or more just once, or even a few times) could endanger health and aggravate the pathology by adding insult to injury. This could happen with even less intense noise and shorter exposure time." Dr. Samuel Rosen.

Quoted from: Welch and Welch, "Physiological Effects of Noise," p. 58.

13. "A town in New Jersey moved a firehouse siren away from the adjacent home of a boy with congenital heart disease after his doctor warned that the noise could throw him into a spasm that could be fatal."

Quoted from: Baron, p. 56-57.

14. "Dr. Christian Barnard, the heart transplant pioneer, noted the relationship between recuperation and noise in the home when he made arrangements for a silencing device for Dr. Blaiberg's family telephone."

Quoted from: Baron, p. 58.

15. "Donora incidents occur daily in communities across the U.S. Not in terms of specific numbers of deaths attributable to excessive noise exposure, but in terms of many more than 20 cardiovascular problems... for which the noises of twentieth century living are a major contributory factor." Dr. William H. Stewart, former Surgeon General of the U.S. Public Health Service.

Quoted from: Baron, p. 54

16. "Nonetheless, because, in particular, cardiovascular diseases are such a massive problem in our society, even if noise were to increase their frequency or severity by a small percentage in the exposed population, this would be a very substantial adverse impact. Major cardiovascular diseases account for well over half of all deaths in the United States, currently somewhat over a million people per year. They are also, by far, the most frequent cause of permanent total disability in those under 65, as measured by Social Security awards."

Quoted from: Hattis, "Some Considerations," p. 2-31.

THE BODY'S OTHER REACTIONS

1. "Loud noises once in awhile probably cause no harm. But chronic noise situations must be pathological. Constant exposure to noise is negative to your health. Except for hearing loss, there is no noise illness, per se...But noise has to be a complicating factor. It is a stress applied to your body without your being aware of it." - Gerd Jansen.

Quoted from: Berland, The Fight for Quiet, p. 98

2. "It appears that some aspects of noise exposure (noise bursts, startling sounds, etc.) result in a form of automatic response in that one's attitude about the exposure conditions tends to have little or no effect upon the internal, bodily reactivity to the noise stimulus."

Quoted from: Public Health and Welfare Criteria for Noise (Washington, D.C.: U.S. Environmental Protection Agency, 27 July 1973), p. 7-7.

3. "It is conceivable that in the dawn of the history of mankind, noise very often was a signal of danger or else a situation requiring muscular activity. In order to survive, the human organism had to prepare itself for activity, interalia by the non-specific adaptation pattern defined as stress. More often than not, noise in today's industrialized societies has a meaning very different from what it had during the stone age. Yet, according to one hypothesis, our genetically determined psychobiological programming still makes one react as if muscular activity would be an adequate reaction to any sudden, unexpected or annoying noise stimulus."

Quoted from: Gosta Carlestan, Claes-Goran Karlsson and Lennart Levi, "Stress and Disease in Response to Exposure to Noise -- A Review," in Proceedings of the International Congress on Noise as a Public Health Problem, Dubrovnik, Yugoslavia, 13-18 May 1973 (Washington, D.C.: U.S. Environmental Protection Agency), p. 479.

4. "The role of sound and hearing in man's life can be best understood in evolutionary terms. The ear, the auditory nervous system, and their relations with the remainder of man's bodily and behavioral functions developed to meet the demands of adaptation to the environment. But the pace of genetic change is slow compared to the rapid environmental change brought on by technology. Our genes prepare us for the environment of the past, and it will be knowledge of that preparation which will allow us to specify a compatible environment. Each of the adverse effects on people of

excess or unwanted sounds can be linked either to positive, adaptative effects of sound or to the absence of protective mechanisms that were not previously required...Hearing evolved to play a role in both individual and social adaptation to the environment. For individual efforts at survival, hearing is indeed the "sentinel of our senses, always on the alert." By hearing, man can detect a sound-making object or event, day or night. Often man can localize the direction of an object or event and sometimes identify it by its sound alone. To increase the chances of identifying objects or events and to insure appropriate preparation for response, evolution has closely tied hearing to man's activating and arousal systems. These systems energize us. In addition, specific auditory-muscular reflexes cause one to orient his head and eyes in an appropriate direction to aid recognition and identification of the sound-making object or event."

Quoted from: Miller, JASA, p. 729.

- 5a. "It is known that loud noise causes a number of reactions in the human body which the recipient cannot control, in addition to the psychic shock. The blood vessels constrict, the skin pales, the pupils dilate, the eyes close, one winces, holds the breath, and the voluntary and involuntary muscles tense. Gastric secretion diminishes and the diastolic pressure increases. Adrenalin is suddenly injected into the blood stream, which increases neuro-muscular tension, nervousness, irritability and anxiety." - Dr. Samuel Rosen, consultant to the Mount Sinai School of Medicine and the New York Eye and Ear Infirmary.

Quoted from: Welch and Welch, Physiological Effects of Noise, p. 57.

- 5b. "In response to brief sounds...there may be...changes in resistance of the skin to electrical current (an indication of activation of the peripheral visceral nervous system), changes in breathing pattern, changes in the motility of the gastrointestinal tract, and changes in the secretion of saliva and gastric juice. These responses are obvious when the noise level exceeds 70 dBA."

Quoted from: Report to the President and Congress on Noise, (EPA, February 1972), p. 1-27.

6. "The body is physiologically responsive to stimulation of the auditory nerve by sound even during sleep, under anaesthesia and indeed, even after the cerebral hemispheres have been removed."

Quoted from: Welch and Welch, Physiological Effects of Noise, p. 5.

7. "...an adaptation made by a person to noise is done at the intellectual, not physiological, level. You can become accustomed to noise, but your body can never adapt to noise." - Dr. Gerd Jansen.

Quoted from: Berland, Fight for Quiet, p. 97.

8. "The response to stress is called the general adaptation syndrome (Selye, 1956). It consists of three stages: an alarm reaction, a stage of resistance, and a stage of exhaustion. If a stressor is very severe and is maintained for prolonged periods of time, an organism passes in succession through the stages of the alarm reaction, resistance, and exhaustion. In the extreme case, the end result is a breakdown of bodily function and death."

Quoted from: Miller, JASA, p. 761

9. "Noise of lesser amplitude than that traditionally identified for the protection of hearing causes regular and dependable physiological changes in humans. Similar noise-induced physiological changes in sensitive animals regularly lead to the development of stress-related disease. The implications of generalizing from these animal studies to humans is not clear."

Quoted from: Levels Document (EPA, March 1974), p. E-1.

10. "Short and infrequent periods of stress are usually innocuous by virtue of there being an opportunity for the relevant opposing forces of the body to regain their balance within a brief period after exposure. Long-term stress is regarded as posing a potential danger to the health of an individual, this attitude being largely developed from extensive work on experimental animals."

Quoted from: Public Health and Welfare Criteria for Noise (Washington, D.C.: U.S. Environmental Protection Agency, 27 July 1973), p. 7-7.

11. "A major question that does not appear to have been resolved is with regard to the point at which a noise becomes a stressing agent in man, and what amount of exposure is necessary to cause long-lasting or permanent physiological changes."

Quoted from: Public Health and Welfare Criteria for Noise (U.S. EPA), p. 7-7.

- 12a. "In a less severe case, there may be a price to be paid in the stage of resistance. This price may include lowered resistance to infection, and perhaps, specific diseases known as the diseases of adaptation. These may include, among others, some types of gastro-intestinal ulcers, some types of high blood pressure, and some types of arthritis. Many medical authorities do not accept the theory that there are diseases of adaptation. Rather, they theorize that each disease has its own special set of causes."

Quoted from: Miller, JASA, p. 761.

- 12b. "It has been proposed that frequent repetition of these responses might lead to persistent pathological changes in nonauditory bodily functions (Jansen, 1959, 1969). Also it has been proposed that frequent repetition of these transient physiological responses might aggravate known disease conditions, and evidence consistent with this proposal has been gathered (Kryter et al., 1971; von Gierke, 1965)."

Quoted from: Miller, JASA, p. 761

- 13a. H. Pilawska, et. al., "The Effect of the Acoustic Microclimate in the Shipyard on Disturbances in the Workers State of Health," Medycyna Pracy XXVIII, (1977), p. 5.

Abstract:

The effects of noise on a large group of shipyard workers were studied in Poland. The workers were divided into 2 groups according to their noise exposure on the job. Group A - exposed to high level of noise - 85 Lgm and greater (approx. Leq 84-92) included 1826 of the 7,651 shipyard workers. Group B included workers exposed to acceptable noise levels - 75 dB and below. The medical records of Group A and Group B were compared to determine what medical disorders might be related to noise exposure. Age and length of service were also taken into account.

Results:

In examining the medical records it was found that workers in Group A had 22 times more hearing disorders, 5 times more stomach and intestinal ulcers, and 2 times as many cases of high blood pressure. Group A workers were also found to have slightly more psychological disturbances.

- 13b. Z.J. Cieslewicz, "Attempt to Evaluate the Extra-Auditory Effects of Noise on Weaving Mill Workers in a Textile Industry Factory," Medycyna Pracy XXVII, (1977), p. 5.

The incidence of high blood pressure, neurosis, and gastric ailments was studied in two groups of workers in a weaving mill factory and a spinning mill factory and related to occupational factors. The workers in the weaving mill were exposed to noise levels of 96-116 dB. The workers in the spinning mills were exposed to noise levels of 84-90 dB. The investigator found that the weaving mill workers had a significantly higher incidence of high blood pressure, ulcers, and psychiatric problems.

14. "Entries in medical, attendance, and accident files for over 500 workers situated in noisy plant areas (95 dBA or higher) were compared with 500 others in quieter workplaces (80 dBA or less)

gathered over a 5-year period in two plant complexes. . . . Workers subjected to the high workplace noise here showed greater numbers of diagnosed medical problems, absences for illness, and job related accidents than were noted for workers in the quieter areas of the same plant. Medical diagnostic categories showing significant differences between high and low noise level jobs were respiratory . . . and non-specific allergic, musculoskeletal, cardiovascular and gastrointestinal disturbances." Alexander Cohen.

Quoted from: Alexander Cohen, "Industrial Noise and Medical Absence, and Accident Record Data on Exposed Workers," in the Proceedings of the Dubrovnik Conference (Environmental Protection Agency 1973), p. 451.

- 15a. "Related to the action of noise as a stressor, various effects on the immune system are to be expected and have been observed. Various stressors including intense noise induce a biphasic secretion of corticosteroids known to depress some kinds of immunological activity. Jensen and Rasmussen monitored peripheral white blood cell levels in mice in response to 3-hour exposures to 123 dB an 800 Hz tone. During the noise there was a pronounced drop in white blood cell count, followed by an equally pronounced rise for several hours immediately following exposure. In a companion paper Jensen and Rasmussen inoculated mice with vesicular stomatitis virus immediately before or immediately after the exposure. As one might expect from the white blood cell response, it was found that the mice inoculated before exposure were appreciably more sensitive, and mice inoculated after were less sensitive to infection than control mice."

Quoted from: Hattis, "Some Considerations in Choosing an Occupational Noise Exposure Regulation" (Washington, D.C.: U.S. Environmental Protection Agency, February 1976), p. 2-41.

- 15b. "The significance in potential shifts in immunological capabilities is large, as the immune system is of course our major bulwark against all manner of infectious diseases that exact a large toll of sickness and restricted activity every year. Available information is far from adequate to assess the likely magnitude of any noise-induced immunological effects, but data of Cohen to be published shortly are said to suggest that absenteeism from many disparate causes is increased in noise-exposed workers. If true, this could be of substantial economic and human importance."

Quoted from: Ibid., p. 2-41.

16. "Most competent medical practitioners, as well as those engaged in health research, agree that there is an absolute requirement

for rest and recreational activities at regular intervals in order to maintain adequate mental and physical health. . . . Since the home environment is considered to be the principal haven for most persons to obtain such needed rest, the impact of noise thereon is a major consideration."

Quoted from: Report to the President and Congress on Noise, (EPA), p. 1-42.

17. "The most appropriate interpretation of the data is to realize that inordinately great exposure to noise has a potentially deleterious effect upon vital physiological processes and must be avoided if one is to remain free of the types of disturbances such exposure might cause."

Quoted from: Public Health and Welfare Criteria for Noise (EPA, 1973), p. 7-12.

NOISE AND THE UNBORN

1. "There is ample evidence that environment has a role in shaping the physique, behavior and function of animals, including man, from conception and not merely from birth. The fetus is capable of perceiving sounds and responding to them by motor activity and cardiac rate change."

Quoted from: Lester W. Sontag, "Effect of Noise During Pregnancy Upon Foetal and Subsequent Adult Behavior," in Physiological Effects of Noise, ed. by Bruce L. Welch and Annemarie S. Welch (New York: Plenum Press, 1970), p. 139.

2. It is of interest that studies of human fetal responses to acoustic stimuli transmitted through the maternal abdominal walls revealed increased fetal heart and pulse rates as noted by Tanaka and Arayama (39). Similarly, alterations have been reported in the encephalogram of stressed fetal guinea pigs when mothers were exposed to sound stimuli of 132 decibels as reported by Scibetta and Rosen (38).

Quoted from: A. Stanley Weltman, statement before Public Hearing on Physiological and Psychological Effects of Noise, Boston (28-29 October, 1971), p. 123.

Studies cited are:

Y. Tanaka and T. Arayama, in Practica: Oto-Phino-Larygo-Logica, 31 (1969), p. 269.

J. J. Scibetta and M. G. Rosen, in Amer. J. Obstet. Gynec., 33 (1969), p. 830.

3. "Peiper, in 1925, reported increased kicking and body movement of the fetus during late months of pregnancy in response to loud sound applied to the mother's abdomen."

Quote from: Ibid., p. 134.

Study cited is: A. Peiper, "Sinnesempfindungen des Kindes vor seiner Geburt," Monatschrift fur Kinderheilkunde, 29 (1925), pp. 236-241.

- 4a. Extreme maternal anguish produces greatly increased motor activity of the fetus. Emotion-inducing music causes a change in the fetal heart rate. Emotional or mood differences created in laboratory animals by frequent handling and petting produce off-spring which, at maturity, function better and are "less anxious" than those of mothers isolated from human beings during pregnancy.

Human beings in severe emotional states in the later months of pregnancy produce hyperkinetic, uncomfortable and poorly functioning infants. Hyperkinetic fetuses later exhibit a pattern of apprehension in peer situations at the age of two or three years. Such evidence, and more, suggests that we must be concerned about the advent of the sonic boom as a daily occurrence in the lives of pregnant women because of its possible damaging effect upon the fetus through alteration of the maternal environment and its possible consequent alteration of the total behavior and adjustment pattern in latter life.

Quoted from: Sontag, in Welch and Welch, pp. 138-39.

- 4b. Until quite recently, stated Dr. Dubos in an interview, "it was the custom to regard the fetal and neonatal states as relatively uninvolved in the external environment except for such instances as teratogenesis, overt infection or other obvious threat. But we now know that subtle variations in the biological environment, factors germane to the environment of the mother, can profoundly affect growth, development, and the personality of the child."

Quoted from: Sontag, in Welch and Welch, p. 132.

Note: Dubos quotation cited:

Rene Dubos, "Neonatal deprivations can be permanent," in the Journal of the American Medical Association, No. 205 (1968), pp. 34-35.

- 4c. The fetus is capable of undergoing conditioning in the late months of pregnancy, anticipating from one stimulus a second had been applied. Its physiological system is capable of responding to physiological changes in the mother, changes induced by a variety of sounds or emotions and mediated through the placental interchange."

Quoted from: Sontag, in Welch and Welch, p. 139.

5. "Together the facts of variation in blood flow in different anatomic areas of the uterus, and the prolonged fetal response to a given stress suggest that alteration of blood flow (both maternal and fetal) could account for abnormal fetal development, particularly if it occurred during critical periods of fetal organogenesis."

Quoted from: William F. Geber, "Cardiovascular and Teratogenic Effects of Chronic Intermittent Noise Stress," in Welch and Welch, Physiological Effects of Noise, p. 86.

- 6a. "The manner in which babies react to aircraft noise during their sleep as a function of the length of stay in a noisy area has been investigated by a statistical survey. It was found that babies born to mothers who moved to the noise area before or during the first five months of pregnancy showed little or no reaction to the noise. After the introduction of regular jet plane services, it was observed that the average birth weight of babies in the noise area (which surrounded an international airport) was clearly less than that from other neighboring quiet areas. The incidence of low birth weight babies increased as the noise level increased. It has been suggested that such noise could be a possible cause of toxemia of pregnancy."

Quoted from: Y. Ando and H. Hattori, "Effects of Noise on Human Placental Lactogen (HPL) Levels in Maternal Plasma," in the British Journal of Obstetrics and Gynecology, 84 (February 1977) p. 115.

Specific Studies cited are: Y. Ando and H. Hattori, in Journal of the Acoustical Society of America, 47 (1970), p. 1128.

Y. Ando and H. Hattori, in Journal of Sound and Vibration, 27 (1973), p. 101.

Y. Ando and H. Hattori, in Practica Otologica, Kyoto, 67 (1974), p. 129.

- 6b. "Their (Ando and Hattori's) results must be regarded as suggestive because a lack of information about procedures and measures makes it impossible to evaluate the report fully. They find, however, that even with demographic variables controlled, mothers experienced ill effects in noisy areas (with effects starting at levels of 75 dB) at twice the rate of those in quiet areas. In addition, the entire distribution of birth weights was somewhat lower for the noisy areas: for example, a 50 percent increase in the proportion of infants under 2500 grams at birth in the noisy areas. It is difficult to project the results of this one study to produce a cross-cultural prediction for the United States, but, if correct, it has implications for fetal and neonatal care. The number of infants with low birth weight is an extremely serious matter. In the United States, which uses the same criterion of low birth weight (less than 2500 grams), there are more than 250,000 such infants born each year. This figure includes both premature infants and those carried the full 37-week term. Of these infants, 45 percent die in the first month of life. As a group they account for between 60 and 75 percent of all first-year infant deaths in the United States. Those that do survive show residual effects of their neonatal susceptibility to hypoglycemia, acidosis, renal compensation, hyperbilirubinemia, response to infection and many other diseases (National Institute of Child Health and Human Development 1972, 1975). In later life, children whose

birth weight was low are still subject to a higher mortality risk and are more likely to have physical defects or to be mentally retarded. It is clear that there would be significant benefits from even a marginal reduction in the incidence of low birth weight babies that might result from decreased noise."

Quoted from: Noise Abatement: Policy Alternatives for Transportation, Report to the U.S. Environmental Protection Agency (1977), p. 118-19.

7. "We now report HPL (Human Placental Lactogen) levels in maternal serum in a noise area and a quiet reference area.

This study shows that the HPL levels of subjects in the noise area tended to be lower than those in the reference area. The difference was particularly distinctive for the HPL levels measured after the 36th week of pregnancy. Furthermore, the percentage of mothers with HPL levels of 4 mg/ml or less, a measure of fetal danger, tended to be higher in the noise area than in the reference area."

Quoted from: Ando and Hattori, 1977, p. 117.

8. Personal telephone conversation with Dr. Ernest A. Peterson, University of Miami, March 1978.
9. Ibid.
10. Jones, F. Nowell and Judy Tauscher, Residence under an Airport Landing Pattern as a Factor in Teratism. Archives of Environmental Health, Jan-Feb., 1978, 10-12.
11. "Other investigators have also observed that noise stress combined with other variables applied during the pregnancy can effect embryological and offspring development. Geber, using intermittent audiovisual stress given for a period of 6 minutes/hour/day up to the 16th day of pregnancy, observed cases of complete resorption of litters, reduced litter sizes and developmental abnormalities in embryos removed at the 16th-20th days of pregnancy. Geber, also exposing animals to maternal stress produced by noises of moderate intensity (range 73/93 dB; average 83dB), observed smaller litter weights in rats and rabbits and marked increases in the number of fetuses exhibiting subnormal body weights. Peters reported cleft palates in offspring of mice exposed to noise levels of 103 dB and hunger stress. Behaviorally, Morra reported that exposure of rats during the 10th-17th days of pregnancy caused significant decreases in the locomotor and body activity of the offspring at 30 and 45 days of age.

Recently, Ward et al, exposing pregnant mice to the intermittent noise stress of a motorcycle horn at sound levels of 82-85 dB

(320-580 c.p.s.) with the noise applied for approximately 60-75 percent of each hour for 2 days during pregnancy, reported resorption of fetuses, reductions in fetal weights as well as various cranial and limb defects in developing embryos."

Quoted from: Weltman, Public Hearing testimony, pp. 122-23.

SPECIAL EFFECTS ON CHILDREN

1. "Levels of noise which do not interfere with the perception of speech by adults may interfere significantly with the perception of speech by children as well as with the acquisition of speech, language, and language-related skills."

Quoted from: John H. Mills, "Noise and Children: A Review of Literature," in the Journal of the Acoustical Society of America, 58, No. 4 (October, 1975), pp. 767-89.

Note: Quotation is one of eight major conclusions drawn from review. The review was the first step in a "programmatic" research effort by the National Institute of Neurological and Communicative Disorders and Stroke (NINCDS). The manuscript was prepared under the auspices of the NAS-NRC Committee on Hearing, Bioacoustics and Biomechanics (Working Group 76) through the Office of Naval Research as funded by NINCDS.

2. "The first objectives of anti-noise organizations were the defense of the ill and the protection of children as they demanded quiet zones around hospitals and schools. The Society for the Suppression of Unnecessary Noise successfully established hospital and school zones in New York by 1912. Pressure from like groups forced other cities to follow example. Quiet zones represented 'protective circles.'"

Quoted from: Raymond W. Smilor, "Cacophony at 34th and 6th: The Noise Problem in America, 1900-1930", p. 31.

3. "As teachers closed windows to shut out street din, they learned that noise undermined the health of the child and exposed it to the risk of infection through impure and contaminated air. Educators banded together. They reported that noise materially increased their nervous tension and seriously hindered their work. Decrying the clamor from cobblestone and rough pavement, whistles, street vendors, garages, car-barns, factories, junk shops and stoveworks, Mrs. Rice exclaimed, and anti-noise women agreed: 'And these are the conditions under which we force our children to study - to our shame be it said.' This kind of racket caused a loss of time in school and lowered efficiency. More disturbing was the worry that noise damaged the thinking of children. The Medical Subcommittee on Noise Abatement in New York City feared that 'Children may sit all day in the noisy schoolroom never learning how to focus this searchlight (conscious mind) upon the facts before them. They may finish their full years of schooling and have no clear pictures in their memory - only a hazy vision of the field of

knowledge as seen through a fog.' The New York Commissioner of Health learned that in schoolrooms facing busy streets teachers conducted class recitation to take all possible advantage of the jerky quiet of traffic lulls. He wondered, 'Will this create in the children jerky mental habits - a sort of syncopated thinking where the mind jumps from one subject to another without completing its train of thought?'

Quoted from: Smilor, p. 31.

Quotations cited: Mrs. Isaac L. Rice, "Quiet Zones for Schools," Forum, 46 (December, 1911), pp. 731-42.

John L. Rice, M.D., "Report of the Medical Sub-Committee on Noise Abatement to the New York City Noise Abatement Commission, undated (probably 1929; copy available from the Haven Emerson Public Health Library in New York City).

4. "The results of these studies suggest that children with mild-to-moderate hearing losses perform less well on tests of language and language-related measures than do children with normal hearing."

Quoted from: Mills, "Noise and Children", JASA, p.771.

- 5a. "For very young children, there may be an additional problem. They gradually induce their knowledge of language and its subtleties from the speech to which they are exposed. Also, previously stated, because their knowledge of language is still developing, children probably have more difficulty understanding speech in noise than do adults. Because noise can reduce the amount of speech used at home, in the yard, or on the playground - and because noise can make speech difficult to understand - it is possible, though unproven, that the language development of early childhood might be adversely affected. From this, difficulty in learning language and learning to read may ensue."

Quoted from: Mills, JASA, p. 771.

- 5b. "Children have less precise speech than do adults, and their relative lack of knowledge of language often makes them less able to "hear" speech when some of the cues in the speech stream are lost. Thus adequate speech communication with children requires lower noise levels than are required for adults."

Quoted from: Public Health and Welfare Criteria for Noise, p. 6-7.

6. "Although substantially more research is required, some results suggest that exposure to sufficient levels of urban noise for extended periods or during critical developmental periods may have deleterious

effects on auditory discrimination and possibly reading skills of children. It is not clear if these possible deficits in listening and in reading are temporary and will be overcome by maturation and schooling, or whether these effects are permanent and not amenable to remedial measures."

Quoted from: Mills, JASA, p. 776.

- 7a. Cohen et al. present evidence that the noisier the home background of the child, at least at high levels of noise, the less likely the child is to discriminate phonemes. This inability to discriminate was related to reading level in the school, and children from noisier homes performed more poorly on standardized reading tests.

Quoted from: Noise Abatement: Policy Alternatives for Transportation, NRC-NAS Report (EDA, 1977), p. 123.

Study cited is: S. Cohen, D.C. Glass, and J. E. Singer, "Apartment Noise, auditory discrimination, and reading ability in children," in Journal of Experimental and Social Psychology, 9, No. 5 (1973), pp. 407-422.

- 7b. "54 children, 2nd to 5th grade, living in four 32-floor apartment buildings adjacent to a heavily traveled expressway. Tested for auditory discrimination and reading level. Windows closed, 51 to 70 dBA L50. Significant correlation for children living there at least four years. 'Noise levels emerged as the most significant variable.' (among them educational attainment of the parents, number of children in the family, and grade level)."

Quoted and paraphrased from: Mills, JASA, p. 772.

8. "The extent to which noise poses a threat to the development of speech, language, and listening skills depends upon the levels of noise found in homes, playgrounds, and schools. According to a recent noise survey of the United States, about 10 million people of all ages reside in areas where noise levels in the external environment exceed 60-70 Ldn, and about 5 million reside where levels exceed 70-80 Ldn. Levels inside the dwellings are lower, ranging from about 45 to 65 Ldn, depending upon the season of the year (windows open, windows closed.)"

Quoted from: Mills, JASA, p. 171.

9. "Bronzafit and McCarthy studied a school situated next to an elevated railroad. Students whose classrooms were adjacent to the train tracks did significantly worse in reading, than similar students whose classrooms were on the other, quiet side of the

building. Since the effects reported by Cohen, et al. were ascribed to noisy homes and those of Bronzaft and McCarthy were attributed to a noisy school, the locations of both schools and homes are relevant."

Quoted from: Ibid., p. 123.

Study cited is: A. L. Bronzaft and D. P. McCarthy, "The effect of elevated train noise on reading ability," in Environment and Behavior, 7, No. 4 (1975), pp 517-527.

10. "Recent studies concerned with aircraft noise in the community of Inglewood, CA, provided an example. In the local churches, it was indicated that the conduct of meaningful services was virtually impossible. The effects on several schools were so severe that new schools had to be built to serve the community."

Quoted from: "The Social Impact of Noise," GPA report (December 1971), p. 20.

11. "The result of such disruption (jet aircraft flyovers) goes beyond the actual time involved in the passage of the aircraft and each class must again have its attention focused on what was being done before the interruption. Our teachers tell us that as the number of jet planes increases they find classroom instruction increasingly difficult and it is their feeling that considerable loss in the educational program results." - The Superintendent of Schools of Inglewood, CA, before a Congressional Subcommittee.

Quoted from: "The Social Impact of Noise," EPA report (December 1971), p. 20.

INTRUSION AT HOME AND WORK

1. "Interference with speech communication by noise is among the most significant adverse effects of noise on people. Free and easy speech communication is probably essential for full development of individual and social relations, and freedom of speech is but an empty phrase if one cannot be heard or understood because of noise."

Quoted from: Report to the President and Congress on Noise, (February 1972), p. 1-14.

2. "Thus, not including the contribution of appliances, noise appears to affect at least 80 million people, or 40 percent of the population. Roughly one-half of the total impact of noise represents a potential health hazard (in terms of hearing impairment potential alone), and the remaining half represent an infringement on the ability to converse in the home."

Quoted from: Report to the President and Congress on Noise, p. 2-134.

3. "Those who work in high levels of background noise claim that they 'get used to it.' There is evidence, however, that they adopt a 'noncommunicating life style' and increase their use of nonverbal communication through gestures, posture, and facial expression (Kryter, 1970). Even though nonverbal communication is important, it is unlikely that it is nearly as important as verbal communication. Many subtleties of life are lost when verbal communication is restricted."

Quoted from: James D. Miller, "Effects of Noise on People," in JASA, 56, No. 3 (September 1974), p. 743.

The Kryter citation in Miller is: K. D. Kryter and C. E. Williams, The Effects of Noise on Man (New York: Academic Press, 1970), p. 459.

4. "Everyday experience and anecdotal evidence show that talkers do not shout for very long, however. They stop talking, they change the content of the conversation, they talk only when absolutely necessary, and they frequently repeat messages. In other words, noise of sufficient intensity probably discourages conversation."

Quoted from: John H. Mills, "Noise and children: A review of literature," in JASA, 58, No. 4 (October 1975), p. 771.

- 5a. "Thus, the combination of continuous daytime noise caused by traffic on city streets, major arterial streets, and freeways impairs the utility of the patios, porches and yards of approximately 7 to 15 percent of the total population, while at any one time the noise from construction similarly affects another 10 percent."

Quoted from: Ibid, p. 2-130.

- 5b. "It has been shown that noises in the home outnumbered all other disturbances . . . Among the major causes of complaint, the following have been cited most frequently: traffic, aircraft, industrial plants, construction, and neighborhood related sources such as dogs and powered lawn mowers."

Quoted from: Report to the President and Congress on Noise, p. 1-43.

- 6a. "Thus the use of outdoor spaces for relaxed conversation is effectively denied to an estimated 5 to 10 million people who reside in very noisy urban areas."

Quoted from: Report to the President and Congress on Noise, p. 2-124.

- 6b. "This fact, that people are more disturbed by traffic noises at home than elsewhere, would suggest that their needs for peace and quiet are unmet."

Quoted from: Alexander Cohen, "Effects of Noise on Psychological State," in Proceedings of the Conference on Noise as a Public Health Hazard (ASHA, 1969), p. 84.

Study cited is: A. H. Wilson, "Noise," Final Report of the Committee on the Problem of Noise Control: H. M. Stationery Office, 1963).

- 6c. "The home has traditionally served the function of providing a haven for the individual and the family. Ironically, in the case of noise, the characteristics associated with a haven are subverted in two major ways, the "outside world" cannot be shut out and the "inside world" cannot be confined within."

Quoted from: "The Social Impact of Noise," EPA Report, p. 13.

7. "A number of general conclusions, however, have emerged:

1. Noise is more likely to reduce the accuracy of work than to reduce the total quantity of work.
2. Complex or demanding tasks are more likely to be adversely influenced by noise than simple tasks."

Quoted from: Public Health and Welfare Criteria for Noise, p. 8-20.

- 8a. "When noise begins to be above 90 decibels, tasks are altered in three ways. Output usually remains fairly constant, but errors in observations increase. Judgments of time intervals

become somewhat distorted. Lastly, a greater effort is necessary to remain alert."

Quoted from: Bragdon, Noise Pollution: The Unquiet Crisis, p. 82.

- 8b. "Glass and Singer recently reported on 24 studies done over a period of 5 years in which detrimental after effects were noticed on such performance tasks as proofreading, difficult graphic puzzles, and competitive response tasks. They concluded that these after effects could be produced by noise of high intensity, and especially by noise of low predictability and low controllability."

Quoted from: Public Health and Welfare Criteria, p. 8-36, 8-40.

- 8c. "Just as unpredictable noise had a greater impact on certain types of complex tasks during actual exposure, post-noise behavior also showed greater impairment if the noise had been unpredictable rather than predictable."

Quoted from: D. C. Glass and J. G. Singer, Urban Stress: Experiments on Noise and Social Stressors (New York: Academic Press, 1972), pp. 156-57.

9. "Noise usually does not influence the overall rate of work, but high levels of noise may increase the variability of the work rate. There may be 'noise pauses' or gaps in response, sometimes followed by compensating increases in work rate."

Quoted from: Hattis, "Some Considerations in Choosing an Occupational Noise Exposure Regulation (Washington, D.C.: U. S. Environmental Protection Agency, February 1976), p. 2-45.

Reference cited in quotation:

A. Carpenter, "Effects of Noise on Performance and Productivity," in Control of Noise, Symposium No. 12 (Her Majesty's Stationery Office: London, 1962), pp. 297-310.

10. "Even when a person maintains high performance in noise as opposed to quiet, there may be a cost. This cost might include reduced psychological or physiological capacity to react to additional demands and increased fatigue after completion of the task."

Quoted from: Miller, "Effects of Noise on People, JASA, 56, No. 3 (September 1974), p. 757.

Supporting references cited in Miller:

J. M. Finkelman and D. C. Glass, "Reappraisal of the Relationship

Between Noise and Human Performance by Means of a Subsidiary Task Measure," in the Journal of Applied Psychology, 54, pp. 211-13.

D. C. Glass, J. E. Singer, and L. N. Friedman, "Psychic Cost of Adaptation to an Environmental Stressor," in the Journal of Personality and Social Psychology, 12, No. 3, pp. 200-210.

11. "The high level, intermittent noise conditions typical of coal mining 'have the greatest likelihood for causing distraction and performance error,' Bridbord reported."

Quoted from: Noise Regulation Reporter, No. 93 (5 December 1977), p. A-21.

Note: Dr. Bridbord's remarks were made before the Committee on Health and Economic Effects of Increased Coal Utilization. Dr. Bridbord is Director of Extra-mural Coordination and Special Projects of the National Institute for Occupational Safety and Health (NIOSH). His remarks were based partly on a NIOSH survey presented by Terry Henderson, of NIOSH, to the Coal Mine Health Resources Advisory Committee on March 26, 1976.

- 12a. "The larger sample data taken from the pressure vessel fabrication plant revealed significantly greater numbers of accidents, health disturbances, and absences in the high versus the low noise exposed worker groups in acknowledging the debilitating effects of noise. The smaller sample of data from the electronics plant showed similar but less pronounced differences with respect to increased accidents and more absenteeism among the high noise group and failed to observe significant differences in medical entries for the high and low noise group."

Quoted from: "Industrial Noise and Worker Medical, Attendance and Accident Records," U. S. Department of Health, Education, and Welfare, the Public Health Service, and the National Institute for Occupational Safety and Health, (June 1972), abstract, p. 2.

The study compared the medical, accident, and attendance records of 520 workers exposed to high-level occupational noise with those of 514 workers who were exposed to low-level noise. The period of study was five years.

- 12b. "For speech communication to take place at 3 feet with reasonable comfort, industrial noise levels should be about 65 dBA. Communication with raised voice can take place in levels of 70 to 75 dBA and shouted speech can be understood in a background of 85 dBA.

Specific commands can be understood in higher levels of noise if the semantic content is fairly predictable and if the speaker and

listener are closer than 3 feet. However, conversations with normal vocal effort are impossible. The difficulties of conversing in such high levels of noise can add to a worker's feeling of isolation as well as produce vocal fatigue or hoarseness."

Quoted from: "Statement of EPA's Liaison Member to OSHA's Standards Advisory Committee on Noise," September 24, 1973, EPA Scientific Staff files.

13. Woodcock quotation is from testimony before the U. S. Department of Labor on July 1975 on the Occupational Safety and Health Administration's proposed occupational noise exposure standard.

Leonard Woodcock, "It Destroys More Than Your Hearing," available from the Public Relations and Publications Department of the United Auto Workers' International Union, 8000 East Jefferson Avenue, Detroit, Michigan 48214.

SLEEP DISRUPTION

1. "The din of the modern city (includes) noises far above the levels for optimum sleeping. Result: insomnia and instability." — Dr. Edward F. Crippen, former Deputy Health Commissioner of Detroit, at the 95th annual meeting of the American Public Health Association.

Quoted from: Baron, Tyranny of Noise, p. 61.

2. "Everyday observations suggest that noise can and does interfere with sleep, and research, both in the laboratory and the field, confirms these observations."

Quoted from: Report to the President and Congress on Noise, p. 1-15.

3. "There exists evidence that noise may interfere with sleep. At high noise levels, noise may arouse a person from sleep and/or prevent the person from falling asleep. At sub-arousal levels, noise may shift a person's sleep from a deep, dreamless stage to a lighter stage of sleep."

Quoted from: Public Health and Welfare Criteria for Noise, p. 7-13.

- 4a. "The psychological and social consequences of sleep-disturbing stimuli are greater for middle-aged and older persons, for daytime sleepers, for the physically and mentally ill, and for other special groups than they are for the young male volunteers usually studied in sleep laboratories."

Quoted from: Harold L. Williams, "Auditory Stimulation, Sleep Loss and the EEG Stages of Sleep," in Welch and Welch, Physiological Effects of Noise, p. 277.

- 4b. "Lukas and Kryter have found that older persons are much more sensitive, particularly with respect to behavioral awakening, to simulated sonic booms and recorded subsonic aircraft noise than are younger persons."

Quoted from: Kryter, The Effects of Noise on Man, p. 524.

5. Elderly people are much more easily awakened by noises than are middle-aged people and children; and once awakened, elderly people have more difficulty returning to sleep than do younger people. These differences with age are large and dramatic."

Quoted from: Report to the President, p. 1-16.

6. "The most significant and surprising finding has been that adaptation, even in behavioral waking, has been absent or slight. The adaptation that seems apparent from everyday experience may be the result of (1) changes in the motivation to wake; and (2) amnesia for having been awake. The last point is supported by the observation of sleep researchers that subjects in their laboratories often cannot remember and often underestimate the number of times that they awake during a sleep period."

Quoted from: Miller, "Effects of Noise on People," JASA, p. 748.

7. "It may be that loud noises continue to awaken or arouse a sleeping person, but as he becomes familiar with the sounds he returns to sleep more rapidly."

Quoted from: Report to the President and Congress on Noise, p. 1-17.

8. "There is some question about the effect of the frequency of noises on the response frequencies. Schieber et al. reported that traffic noises averaging about 1.8 auto and truck passages per minute at 61 dBA disturbed sleep more than traffic noise averaging about 4.3 passages per minute at 70 dBA. They also found that 32 jet takeoff and flyover noises per night caused more sleep disturbance than 16 noises."

Quoted from: Jerome S. Lukas, "Measures of Noise Level: Their Relative Accuracy in Predicting Objective and Subjective Responses to Noise During Sleep" (Washington, D. C.: Office of Health and Ecological Effects, U. S. Environmental Protection Agency, February 1977), p. 10.

Schieber study cited: J. P. Schieber et al., "Etude analytique on laboratoire de l'influence du bruit sur le sommeil," Centre d'Etudes Bioclimatiques du CNRS (Strasbourg, France, April 1968).

The Lukas report is available through the National Technical Information Service, Springfield, Virginia 22161.

9. "There is clear evidence that inherently meaningful sounds, such as one's name, or sounds that acquire meaning, such as by instructions or conditioning, can awaken the sleeper at intensities lower than those required for meaningless or neutral sounds. To some extent the amount of change in threshold for awakening is dependent upon the subject's motivation; motivation can be altered by instructions, conditioning, or financial inducements."

Quoted from: Jerome S. Lukas (U. S. EPA), p. 12.

10. "For instance, a recent study has shown that during nights with airplane noise, the changes of stage were more numerous than during

calm nights, and that the stages of light sleep became lengthened to the detriment of those of deep sleep."

Quoted from: Bugliarello, The Impact of Noise Pollution, p. 52.

- 11a. "For example, surveys of communities impacted by significant subsonic and supersonic aircraft fly-over noise have found that the interruption of rest, relaxation, and sleep are the major underlying causes of registered complaints."

Quoted from: Alexander Cohen, "Effects of Noise on Psychological State," in ASHA Proceedings, p. 84.

- 11b. "Further, we also know that survey data indicate that sleep disturbance is often the principal reason given for noise annoyance."

Quoted from: Public Health and Welfare Criteria on Noise, p. 7-17.

- 12a. "The use of, and addiction to sleep-inducing pills has become a psychiatric problem of our modern times." Dr. H. R. Richter, a Swiss medical researcher.

Quoted from: Baron, Tyranny of Noise, p. 61.

- 12b. "In fact, doctors administer barbiturates to some 20 million patients each year, and our drug companies produce about 6 to 10 billion barbiturate capsules a year. These sleep compounds, tranquilizers, and stimulants are prescribed to patients who complain of sleep disturbance.

Quoted from: Williams, in Welch and Welch, p. 280.

MENTAL AND SOCIAL WELL-BEING

1. "The Noise, The Noise. I just couldn't stand the Noise." Suicide note left by a desperate homeowner.

Quoted from: Bugliarello, The Impact of Noise Pollution, p. 67.

2. "As Lieber suggests, 'Any person who is exposed to a high noise level to which he is not accustomed will at first only suffer a mild discomfort, but after a time he will be subjected to changes of mood. Emotional responses may become more extreme, and it is not uncommon to fly off the handle at the slightest provocation.'"

Quoted from: Bragdon, Noise Pollution: The Unquiet Crisis, p. 85.

3. "Innis's Son, 13, killed in Bronx" "A man leaned from his second-floor apartment and called: 'Stop the noise.' When the boys failed to heed the warning, the police said, the man came downstairs with a pistol and, as the boys started to run, fired a shot that struck young Innis in the back." New York Times, 16 April 1968.

Quoted from: Berland, The Fight for Quiet, p. 49.

4. "Several examples of bizarre, violent reactions, apparently to noise stress, have been reported in the press. The violent reaction is usually directed at whomever the noise 'victim' sees as the cause of the noise."
 - o A man upended a sanitation worker into a trash barrel.
 - o A woman threatened the foreman of a construction site with a shotgun.
 - o In August of 1974, two men in a boat towing a water skier were struck by shotgun pellets fired at their boat on the Maumee River in Ohio. The assailant on shore was the chief executive of a large company.
 - o A man in South America shot pedestrians in city streets who were playing transistor radios."

Source: Information Sheet on Noise-Induced, Anti-Social Behavior, Office of Noise Abatement and Control, U. S. Environmental Protection Agency. Scientific Advisory Staff.

5. "Little is known about the behavioral and cognitive strategies people use to cope with noise. Growing numbers of people appear unwilling and may be unable to adapt. People appear to cope with noise in many ways

such as by increased use of sleeping pills and ear plugs, increased visits to doctors, keeping their windows closed, spending less time outdoors, and expressing more frequent desires to move from their homes. . . . Coping may be by direct action (writing letters of complaint, closing windows, rearranging sleeping quarters, taking sleeping pills), but these are unlikely to eliminate the noise problem. Intrapsychic modes of coping (denial, vigilance, projection) may occur with or without direct action. Denial is used as a defense mechanism. Where direct actions are not productive, the goal is to stop paying attention to the noise and to stop responding emotionally to the noise. In those situations, denial may be more effective than vigilance in promoting adaptation. Cognitive reinterpretations that change the message carried by the noise can also aid in adjustment . . . Coping can occur by changing the noise (planting trees or complaining to authorities), by trying to change their own responses (giving themselves pep talks about how they will get used to the situation or telling themselves that everything possible was done to minimize the noise), or by feeling there is nothing they can do and suffering in silence. There are people who feel angry and direct the anger outward, those who feel angry and blame themselves for the situation and for being upset, and those who feel general unfocused distress . . . In a telephone conversation with Weinstein on February 2, 1978, he stated that they are in the middle of their work with no results as yet. He pointed out that they are also looking at the idea that in anticipation of the noise problem, people start to develop negative attitudes toward other things associated with the project. They feel that negative feelings toward the noise aspects of the project will be transferred to expected benefits such as traffic flow and economic boosts to the area. People will have a lower expectation of these benefits than if the noise were not anticipated."

Source: Information sheet on adaptation, coping behavior in the office of the Scientific Advisory Staff of the Office of Noise Abatement and Control, U.S. Environmental Protection Agency. Information taken from personal phone call and:

Neil D. Weinstein, "Personal and Family Adjustment to Urban Noise." Dr. Weinstein is in the Department of Human Ecology and Social Sciences, Cook College, Rutgers University, Brunswick, N.J. Paper was completed, May 1, 1976.

6. Ibid.
7. Ibid
8. Ibid

- 9a. "Socially relevant behaviors can be affected by noise. In a noise environment, tolerance for ambiguity decreases, anxiety increases and perception of others assumes negative dimensions. Further, frustration tolerance decreases following stimulation with unpredictable noise. Although the organism may physiologically adapt, there appears to be a psychological cost of noise exposure.

Quoted from: Lawrence F. Sharp, John F. Swiney, and Mickey R. Dansby, Behavioral and Physiological Correlates of Varying Noise Environments: Annotated Bibliography (Washington, D.C.: Office of Health and Ecological Effects, U.S. Environmental Protection Agency, December 1976), p. 2. (Document available from National Technical Information Service, Springfield, Virginia 22161.)

- 9b. "But all the facts of speech interference, hearing loss, noisiness, annoyance, and arousal and distraction previously recited clearly support the contention that noises can act as a source of psychological distress, either because of responses directly to the noise itself or because of responses to irrelevant "messages" carried by the sound. Psychological distress in turn can contribute to the unpleasant symptoms listed above." (Nausea, headaches, instability, argumentativeness, sexual impotency, changes in general mood, general anxiety, and others).

Quoted from: Miller, "The Effects of Noise on People, p. 758.

10. "In a coordinated laboratory and field study, the effects of noise on altruism or voluntary helping behavior were studied. In the laboratory situation, an experimental confederate dropped an arm-load of books. The subject was less likely to help pick them up when ambient noise levels were relatively high than when they were relatively low. In a field replication, the confederate dropped an arm-load of books when walking past a lawn mower. Subjects were considerably more likely to pick up the books when the lawn mower was turned off than when it was operating at a level of 84 dB(A). These effects are but two of a class of normative rules likely to be disrupted by noise: types of behavior influenced by modeling and imitation. One occurrence of noise-influenced aggression may set the model of behavior for many others and one instance in which helpfulness or altruism was inhibited may serve as a standard for future acts. Thus, a small number of direct events may affect large numbers of people."

Quoted from: Noise Abatement, Policy Alternatives for Transportation, (NRC-NAS, EPA Report, 1977), p. 129.

Study cited is: K. E. Matthews and L. K. Canon, "Environmental Noise Level as a determinant of helping behavior," in Journal of Personalities and Social Psychology 32, No. 4 (1975) pp. 571-78.

11. "Three independent groups of subjects participated in the simulation game Starpower while they were exposed to different levels of environmental noise: Quiet, Very Noisy. The results indicate that relatively low levels of noise induced anxiety in subjects engaged in social interaction . . . Subjects who played Starpower under noisier conditions perceived other players as more disagreeable, disorganized, and threatening."

Quoted from: Richard D. Edsell, "The effect of noise on some inter-relationships between social interaction and anxiety," Dissertation Abstracts International, 33(8-1B) (1976), p. 3976.

Above source contained in:

Lawrence F. Sharp, John F. Swiney, and Mickey R. Dansby, *Behavioral and Physiological Correlates of Varying Noise Environments: Annotated Bibliography (Washington, D.C., Office of Health and Ecological Effects, U.S. Environmental Protection Agency, December 1976, pp. 186-187. (Document available from National Technical Information Service, Springfield, Virginia 22161.)

- 12a. Thousand workers in 16 German steel factories: Higher noise workers had more than twice as many family problems as did lower-noise workers — 12 percent versus 5 percent. Dr. Gerd Jansen, West Germany.

Quoted from: Berland, The Fight for Quiet, p. 80.

- 12b. "In excessive noise, formal education in schools, occupational efficiency, family life styles, the quality of relaxation, and the enjoyment of life can all be adversely affected.

Quoted from: Report to the President and Congress on Noise, p. 1-12.

13. "Noise heightens tensions between workers and their supervisors and thus results in additional grievances against the employer. Noise in a number of cases has been a problem in arriving at local union settlements after national agreements have been made with the employers on major "economic and related issues . . . Noise is therefore a factor in productivity, in maintaining a decent workplace and in achieving satisfactory employer-employee relations in collective bargaining . . . In a similar manner noise affects the relationships between workers themselves and between workers and their families. We wonder how much better the public mental health would be if the plants were made quiet."

Quoted from: Leonard Woodcock, "It Destroys More than Just Your Hearing," Testimony before U.S. Department of Labor (7 July 1975), p. 2.

- 14a. "Granted that noise causes annoyance, might not mental or nervous illness result or be aggravated from prolonged or recurring types of noise exposure? Presently, sketchy and inconsistent findings do not permit an answer to this question."

Quoted from: Cohen, "Effects of Noise on the Psychological State, in ASHA Proceedings, p. 81.

- 14b. "'In disease states such as anxieties, duodenal ulcers, and other so-called tension ills, the additive deleterious effect of noise is real and immediate. Any disease which may be associated with an emotional change requires as part of the therapy a calm, relaxed, quiet environment. This is particularly true of disturbed emotional states'."

Quoted from: "The Social Impact of Noise," EPA Report, p. 8.

Quotation cited is from: L. E. Farr, "Medical consequences of environmental home noises," in the Journal of the American Medical Association, 202 (1967).

- 14c. "The psychiatric profession estimates that approximately 10 percent of our population is in need of or could benefit from mental health care. With this population, health problems may well appear below 95 dB."

Quoted from: Bragdon, Noise Pollution: The Unquiet Crisis, p. 84.

15. "In England, a retrospective study of admissions to a psychiatric hospital for the years 1966 to 1968 showed that there was a significantly higher rate of admission from areas near Heathrow subject to noise of about 100 PndB than from nearby areas subject to considerably less noise. This difference was particularly marked in older women not living with their husbands and suffering from neurotic or organic mental illness."

Quoted from: "An Assessment of Noise Concerns in Other Nations, EPA Report, p. 128.

16. Z. J. Cieslewicz, "Attempt to Evaluate the Extra-Auditory Effects of Noise on Weaving Mill Workers in a Textile Industry Factory," Medycyna Pracy XXVII, 1977.

Pilawska, H. et al. "The Effect of the Acoustic Microclimate in the Shipyard on Disturbances in the Workers' State of Health," Medycyna, Pracy, XXVIII, 1977, vol. 5.

DANGER TO LIFE AND LIMB

1. "Inability to hear auditory warning signals or shouts of caution because of noise has also been implicated in industrial accidents."

Quoted from: Cohen, "Effects of Noise on Psychological State,"
ASHA Proceedings, p. 74.

2. "The two people who were killed when Senator Robert Kennedy's funeral train was passing through Elizabeth, N.J. — killed because the noise from the low-flying Secret Service and news media helicopters masked out the warning horn blasts of the approaching train that hit them."

Quoted from: "Bragdon, Noise Pollution: The Unquiet Crisis, p. 65.

Article from: "Helicopter noise blamed in part of 2 deaths at Kennedy train," New York Times, October 30, 1968.

3. "Many vehicular accidents occur because the driver is unable to hear an emergency vehicle signal. The siren's warning is masked by the noises heard inside a car or truck."

Quoted from: Bragdon, p. 65.

4. "When an emergency vehicle is in the process of passing a truck, the driver can detect the siren's warning for only a very short period, three seconds or less. During the remaining time, truck noise drowns out the signal, and sound messages go by undetected."

Quoted from: Ibid., p. 65.

Study cited is: Paul S. Veneklasen, "Community Noise Control," in Noise as a Public Health Hazard (Washington, D.C.: American Speech and Hearing Association, 1969), p. 361.

5. "The larger sample data taken from the pressure vessel fabrication plant revealed significantly greater numbers of accidents, health disturbances and absences in the high versus the low noise exposed worker groups in acknowledging the debilitating effects of noise . . . In general, the results were interpreted as adding strong support to the hypothesis that prolonged exposure to high-intensity noise increases the incidence of various medical, accident and attendance problems.

Quoted from: "Industrial Noise and Worker Medical, Attendance and Accident Records," (Raytheon Service Company: National

Institute for Occupational Safety and Health, June 1972) abstract, p. ii.

6. "In November 1972, the FRA began to investigate all railroad accidents resulting in fatal injury to on-duty railroad employees, regardless of their crafts. Between that date and August 31, 1974, the FRA investigated 190 such accidents, which resulted in a total of 214 fatalities. In 19 of these accidents, 25 M.W. & S. employees (22 trackmen, 2 signal maintainers, and 1 bridge and building (B&B) carpenters were fatally injured as a result of being struck by locomotives, trains, or cars. A common factor in the 25 fatalities appears to have been the unawareness of the M.W.&S. employees of the approach of the rail equipment that struck them. Significantly, many of these employees had been working under high noise-level conditions, poor visibility or weather conditions, or double- or multiple-track operations."

Quoted from: Federal Railroad Administration, Advanced Notice of Proposed Rulemaking, "Protection of Railroad Maintenance-of-Way-and-Structure Employees," Federal Register, vol. 40, No. 76, April 18, 1975, p. 17265-66.

7. "The effects of masking and speech interference can be dramatic as in the case of an accident about 3 years ago in an auto glass manufacturing plant. Noise levels were so high that a worker whose hand was caught in manufacturing equipment received no aid since no one heard the screams. As a result, the hand was lost."

Quoted from: "Statement of EPA's Liaison Member to OSHA's Standards Advisory Committee on Noise," September 24, 1973, EPA Scientific Staff files.

8. "Unable to concentrate, (workers exposed to high noise levels) may be unusually accident-prone. They may also run a serious risk of injury because they cannot hear warning shouts or signals. Tom Bixler, health-and-safety rep for UAW Local 549 (Fisher Body) in Mansfield, Ohio, cites two cases in which press-room workers were permanently disabled when they failed to hear approaching panel racks or warning shouts."

Quoted from: "Noise," Solidarity (official publication of the United States Auto Workers), 21, No. 2 (February 20, 1978), p. 12.

9. "When a 13-year-old New Jersey girl was found beaten and strangled to death 75 feet from the back door of a neighbor's home, the neighbor's son told reporters: "My father heard nothing. None of us heard anything. We had the air conditioning running all night."

Quoted from: Baron, The Tyranny of Noise, p. 101.

A FINAL WORD

1. "To relieve taut nerves and gain respite from racket, urbanites looked longingly to the countryside. Their first answer to the noise problem was simply to escape. One reason the rural dweller apparently enjoyed greater endurance and longer life than the city man was because the ceaseless noises of the city did not keep his nerves constantly on edge. But this image of quiet pastoral fields did not last long. William Dean Howells, who became vice president of the Society for Suppression of Unnecessary Noise, admitted, 'It is truly a serious problem to escape from noise.' People fled the city only to discover that the country offered no sanctuary from din. For the summer fugitives from the noise of the city, there seemed 'no repose in automobiles or subways, nor relaxation anywhere within the range of a throbbing that is swifter than nature.' Reluctantly, city dwellers concluded that 'the silence of the green fields' was not possible for them."

Quoted from: Raymond W. Smilor, "Cacophony at 34th and 6th: The Noise Problem in America, 1900-1930," p. 29.

Howells quote is from the New York Times, December 23, 1906. Smilor adds: "Howells bewailed the amount of noise at his summer house in Kittery Point and maintained that in parts of New York City the noise was so offensive that it seemed 'like a crushing weight upon the head.'"

2. William H. Stewart, Keynote Address, Proceedings of the Conference on Noise as a Public Health Hazard (Washington, D.C.: The American Speech and Hearing Association, February 1969), p. 8.