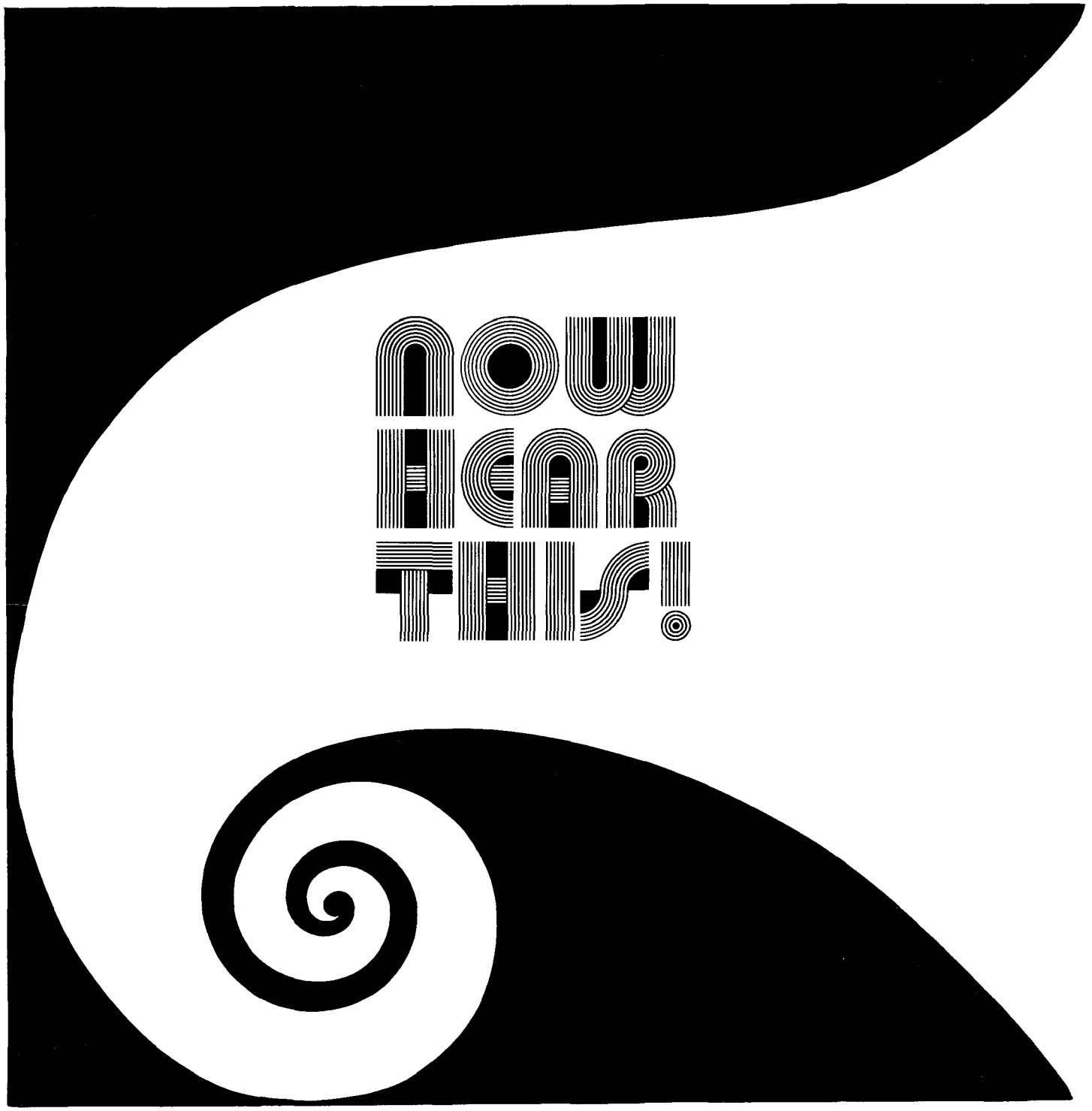
noise pollution


NOW
HEAR
THIS!

Sound, so vital a part of our existence, is growing to such disagreeable proportions within our environment that today it is a very real threat to our health.

So noisy, in fact, is America's urban environment that people living in congested sections of large cities may be hearing far less than they realize; many are developing severe hearing loss. Suburbanites will not fare much better. As noise levels in their communities continue to increase, they may be destined for the same fate.

The problem is not limited to the out-of-doors. Noise in our homes is beginning to reach harmful levels. We are using more tools and appliances and, as their power has increased, so has the noise. The combination of hi-fi equipment and the rock music which dominated the past decade, alone has probably affected the hearing of a whole generation of listeners.

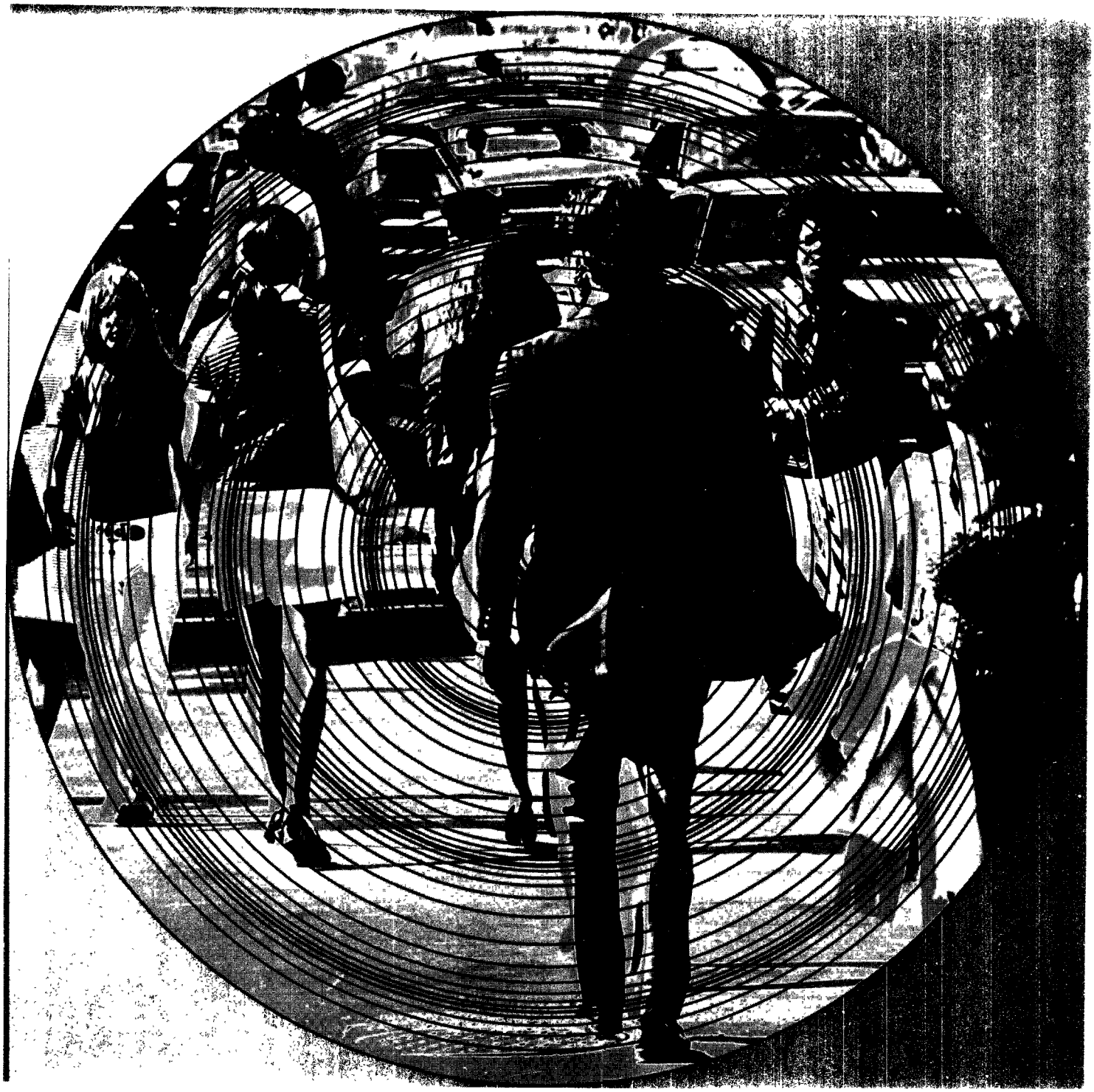
If these statements seem scary, they should. They are not exaggerations. Noise pollution is a growing menace, not just to boilermakers and jackhammer operators, but to all of us. The noise level we experience daily has increased so gradually that we fail to recognize its danger. But noise is a danger. It can result in a hearing loss that not only can be a handicap, but what is worse, a hearing loss that cannot be restored.

Unless controlled, noise pollution will exact an increasingly heavy toll on society. Already an estimated 16 million people in the United States suffer from some degree of hearing loss directly caused by noise. Such hearing loss, in fact, is a major cause of industrial injury. Compensation to its victims annually runs into millions of dollars.

Although definitive research has yet to be done, some recent studies suggest that existing noise levels may be a cause in the rising rates of heart disease, ulcers and mental illness and may even adversely affect the unborn child.

The danger from noise is very real.

u.s. environmental protection agency



UNWANTED SOUND

WHAT IS NOISE?

Sound moves through the air somewhat like waves move in the ocean. In sound, the waves are alternate rings of compressed, and then rarefied air moving away from a central source at a constant speed. As each wave—first a compression, then a rarefaction—encounters an object, it exerts a force—a push, then a pull—on the object. This is why sound can break a glass or cause a window screen to vibrate.

For humans, sound has two significant characteristics: pitch and loudness. In terms of affecting people, pitch is generally an annoyance—the sound of chalk scraped over a blackboard surface. Pitch is the height or depth of a tone or sound depending on the relative rapidity of the vibrations by which it is produced. In low-pitched sounds, the vibrations are relatively far apart. In high-pitched sounds, they are squeezed closer together.

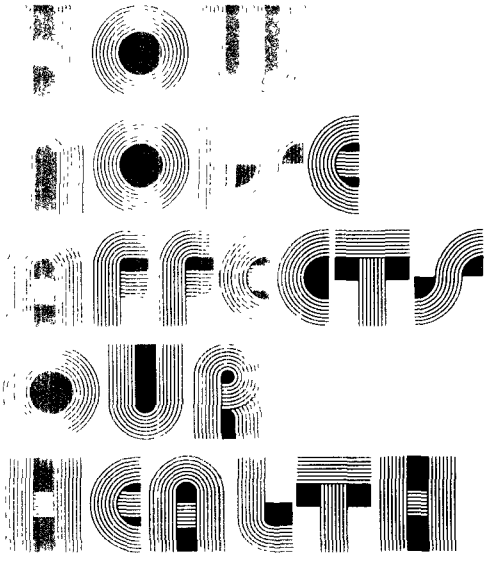
Loudness, on the other hand, can affect our ability to hear. It is the intensity of the sound waves combined with the reception characteristics of the ear. The intensity of a sound wave may be compared with the height of an ocean wave. In terms of sound's affect, this intensity is how hard a sound wave hits an object, a characteristic which can be measured precisely with instruments. But the loudness heard by a human ear is slightly different from the purely physical values. Our ears hear sound at intermediate frequencies better than sound at very low or very high frequencies.

Sound is measured by decibels. The zero on the decibel scale is based on the lowest sound level that the healthy, unimpaired human ear can detect.

Decibels are not linear units like miles or pounds. Rather, they are representative points on a sharply rising curve. Thus, while 10 decibels is 10 times more intense than one decibel, 20 decibels is 100 times more intense (10 x 10), 30 decibels is 1,000 times more intense (10 x 10 x 10) and so on. One hundred decibels, therefore, is 10 billion times as intense (that is, represents 10 billion times as much acoustic energy) as one decibel. The reason for such a complicated scale is simply that the human ear detects a wide range of acoustic energy.

Sound levels are measured at their source; thus their decibel rating decreases as the distance from that source increases. These ratings should, therefore, be regarded as averages and should be used primarily for comparative purposes.

The gentle rustle of leaves, for example, is rated at 10 decibels, while a typical office has about 50 decibels of background noise. Moderate traffic noise ranges around 70 decibels; a police whistle hits 80. Subways and elevated trains rank just below thunder at 100 decibels. At just above 120 decibels the ear begins to feel pain.



Pain occurs as the ear unsuccessfully attempts to protect itself through a mechanism physicians call "the acoustic reflex." When sound enters the ear, the waves pass through the ear canal to the eardrum which vibrates. The eardrum conducts these vibrations to three tiny bones called ossicles — the three tiniest bones in the body. It is here that the acoustic reflex occurs. The ossicles change the loudness of sound before it enters the inner ear. Normal action of the ossicles may amplify soft sounds or dampen loud sounds as their tiny muscles contract to decrease the pressure of the sound waves.

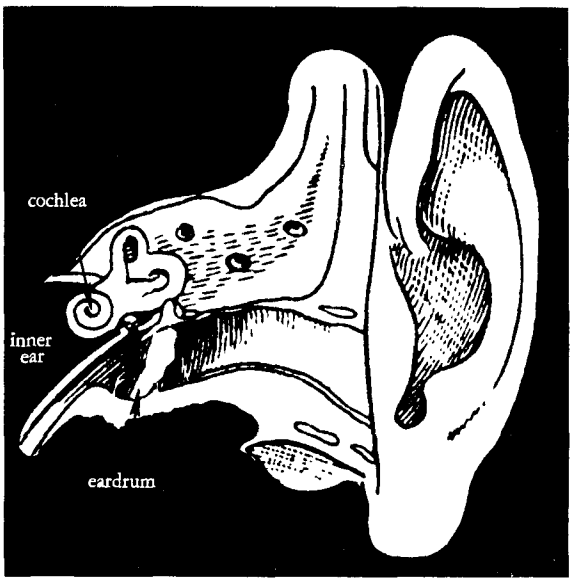
The acoustic reflex protects the inner ear from extra loud sounds by reducing them, just as the eye protects itself from extra bright light by contracting the pupil. The ear is not completely successful in this task. The reason is twofold: first, the reflex occurs on command from the brain a few hundredths of a second after the loud sound is first sensed. Thus, at least some of the sound at full loudness gets through to the delicate inner ear before the reflex goes into operation. Second, muscles cannot contract indefinitely so their sound-dampening capacity is limited. Thus, if the loud sound is sustained, the inner ear may still be bombarded with excessive sound pressure even after the reflex has had a chance to work. In the case of impulse sounds such as a gunshot, the reflex is virtually useless as a defense.

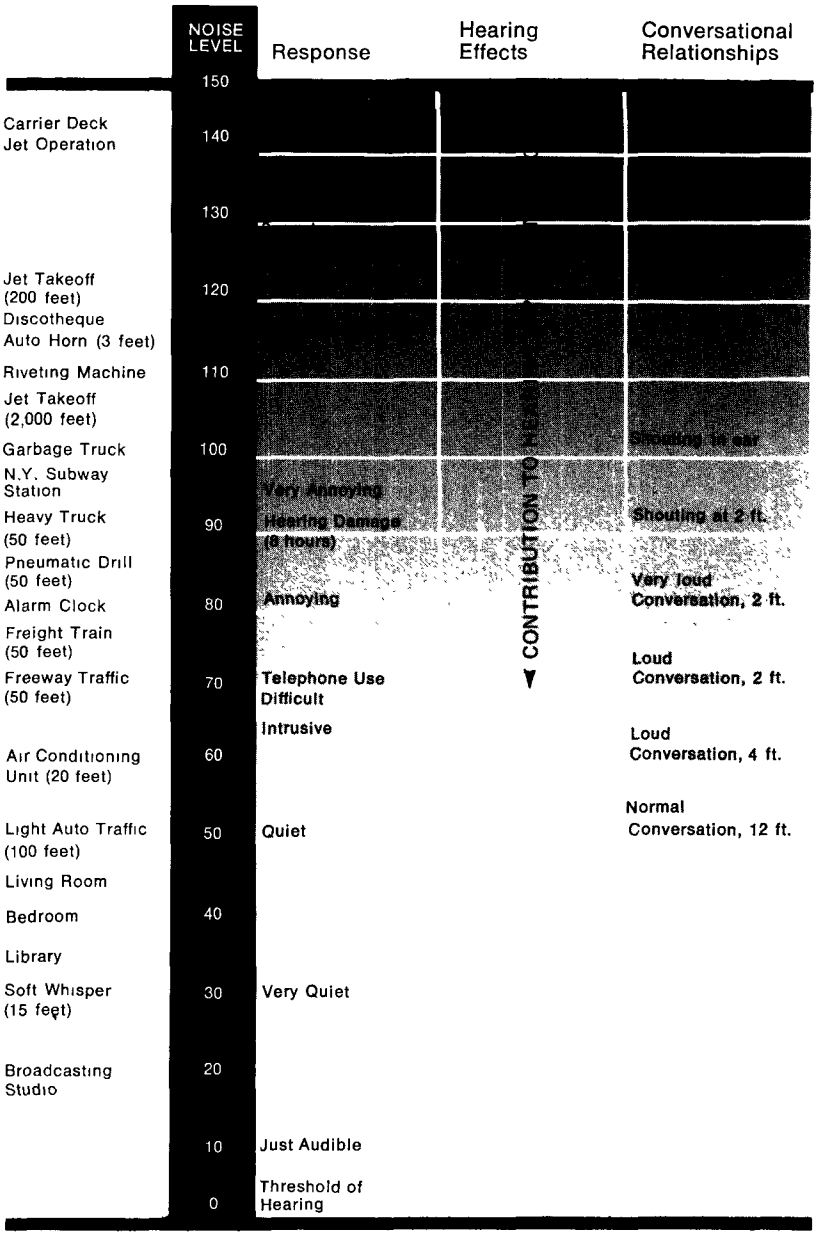
What happens when loud sounds enter the inner ear? The ossicles transmit the vibrations to a fluid contained in a tiny, snail-shaped structure called the cochlea. Within the cochlea are microscopic hair cells that move back and forth in response to the sound waves just as seaweed on the ocean floor undulates in response to wave action in the ocean. It is the energy impulses created by the movement of these crucial hair cells that go to the brain where they are interpreted as sound. But just as the seaweed can be torn and ripped by violent wave action in the ocean, so too, can hair cells be damaged by too intense sound waves.

damage to hearing

When intense sound waves occur only briefly, the damage may be temporary. But if loud noises are frequent or sustained, the damage may be permanent, and such noise-induced hearing loss cannot be restored either through surgical procedures or hearing aids.

Sound Levels and Human Response





Permanent loss, however, occurs only in certain frequencies because different hair cells respond differently to various frequencies. Unfortunately, the hair cells that seem to be the most susceptible to damage are those that respond to the high frequency.

This selective damage can severely impair the understanding of human speech. It may be even more insidious than a broad-range hearing loss because it may not be readily recognized. Recent studies of young school children, thought to be "slow learners" revealed that at least some of them simply could not hear everything that was being said in the classroom. Once adjustments were made, these children were able to match the scholastic performance of their classmates. Similar undetected hearing difficulties may be the cause of unexplained performance impairment among adults.

Obviously, noise may accelerate the progressive loss of hearing we all suffer as we grow older. To learn just how much, scientists visited an isolated area in Africa to examine the hearing acuity of a large number of elderly tribesmen and their youthful counterparts. Their findings: men in their 70s and 80s had hearing sensitivity nearly equal to that of the young boys and equivalent to that of Americans 30 to 40 years their junior!

Undetected hearing loss is a clear danger to each of us. We are dependent on a wide variety of audible signals, many of them for our safety. Consider the danger to a driver or pedestrian who cannot hear the siren of a fire engine, or the construction worker who does not hear the warning whistle before an explosive charge is detonated.

other physical effects

Selective hearing loss, however, is only one of the ways excessive noise takes its toll. At sound levels above 35-45 decibels, noise disturbs a sleeping person. At levels above 50-60, it disturbs conversation. All across this range people experience annoyance and disruption of their activities. And at levels of 85 decibels or above, stress reactions can be expected.

When the brain perceives noise, it reacts. Most of us automatically interpret unexpected noise as danger, a signal to prepare to fight or run. It may be a subconscious reaction, but it is clearly indicated by the physical changes that take place in response to noise. Even a sound of moderate volume and short duration such as a heavy truck passing on the other side of the street (rated about 80 decibels), produces a remarkable number of these physical changes. Blood vessels in the brain dilate while blood vessels in other parts of the body constrict. Blood pressure rises, and the heart rhythm changes. The pupils of the eyes dilate. The blood cholesterol level rises. Various endocrine glands pour additional hormones into the blood. Even the stomach changes its rate of acid secretion. While most of these reactions are only temporary, the modern environment presents such ever-changing noise levels that some of these "temporary" effects become chronic.

We may not be immediately aware of these changes since they are functions of the so-called involuntary or automatic nervous system. Yet this dramatic reaction to noise occurs in our bodies many times each day as we encounter the clamor of modern Twentieth-century living. Traffic, machinery, household appliances, lawnmowers, telephones, typewriters, barking dogs and shouting people all contribute. The effect on each of us can be profound.

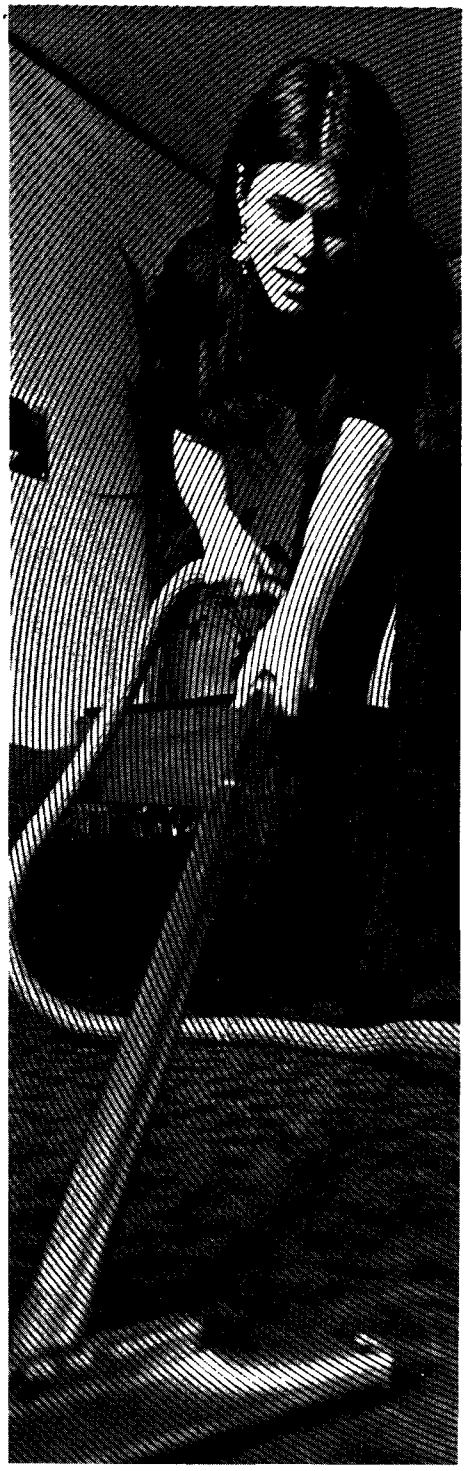
Ulcers, indigestion, "heartburn", gastro-intestinal malfunctions, heart disease, all are connected to stress in general and since noise is interpreted by the body as a stress, noise may also be a contributing factor in the rate of occurrence of these disease conditions.

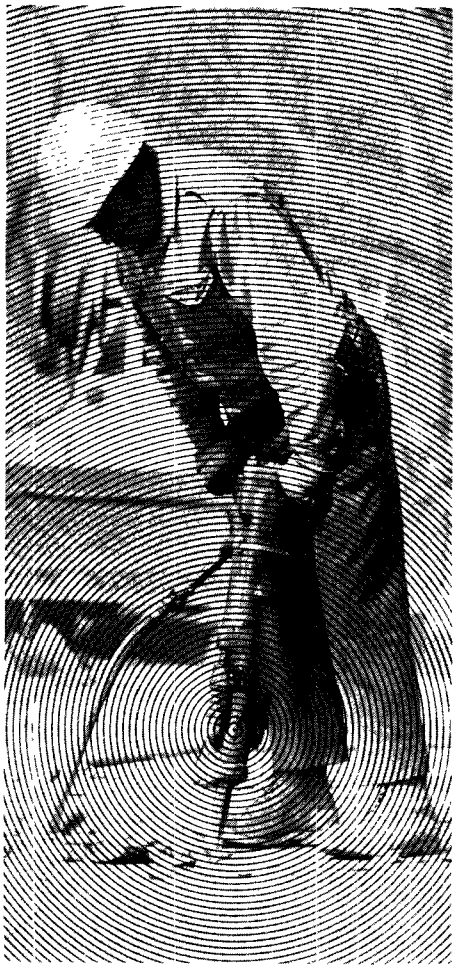
psychological effects

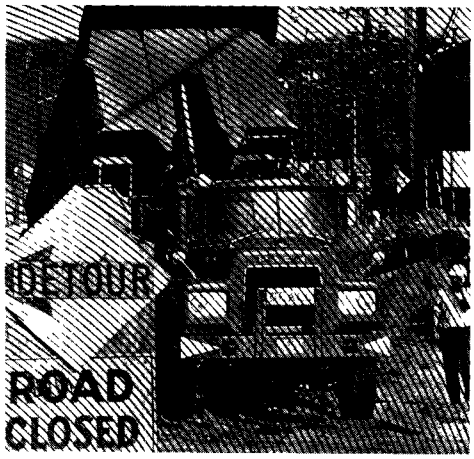
Stress also is a factor in mental illness, which may be defined as a reaction to a person's inability to cope with the many tensions of daily living. Mental illness develops when individuals are literally overwhelmed by the onslaught of stress and mentally retreat to escape. While environmental noise alone probably does not produce mental illness, the continual bombardment of noise on an already depressed person cannot be helpful. Certainly it interferes with sleep, producing irritability and other tensions. Definitive research has not been done in this area, but one 1969 study in England provides strong supporting evidence. Comparative studies of persons living adjacent to London's Heathrow Airport with others living in a quieter environment revealed that among those living in the noisy environment there was a significantly higher rate of admission to mental hospitals.

Another recent medical discovery is the effect of noise on unborn babies. Previously they were thought to be insulated from the noise stress of the outside world, but now physicians believe that external noises can and do trigger changes in fetuses.

Even when we do not suffer from these extreme and tragic consequences, we are victims of noise. It is well known that noise causes headaches in a variety of ways. Because the brain interprets it as a danger signal, noise interrupts thought and mental concentration. This, in turn, not only lowers the working efficiency of people doing exacting or predominantly mental work, but the constant distraction of noise makes them more nervous, irritable and generally unsettled. It affects others in a similar manner. One study of steelworkers indicates that those working in a noisy environment are more agressive, distrustful and irritable than workers in a quieter environment.






DETOUR
ROAD
CLOSED

noise in our daily life

Scientists now tend to agree that the noise level for potential hearing loss begins at about 70 decibels. Some of them are deeply concerned because our normal daily life regularly exposes us to noise levels of about 70 decibels even inside our homes.

The kitchen is usually the noisiest room in the house. The combination of garbage disposals, mixers, blenders, dishwashers and non-sound-absorbent walls can drive the kitchen din up to the 80 to 90 decibel range, equivalent to the noise level right outside a major jetport. In the living room, the vacuum cleaner may put out 80 decibels; the television set, 70-80 and, if there is a hi-fi in the house, the levels can run upwards of 100. Outside in traffic, 70 decibels is a typical level; cars, trucks roar along at some 90 to 100 decibels with motorcycles topping the noise parade at more than 100.

At work, a noisy office can approach 50 decibels; a busy factory can average 85; a print shop, 95; a construction site, 100; a riveting shop, 110; a boiler factory, 118; a lumbering site, 125 and a jet runway, 130.

spreading pattern

Cities have always been noisy, but noise is now spreading to areas that were relatively quiet just a few years ago. Noise levels in average communities are now running at about 70 decibels and up.

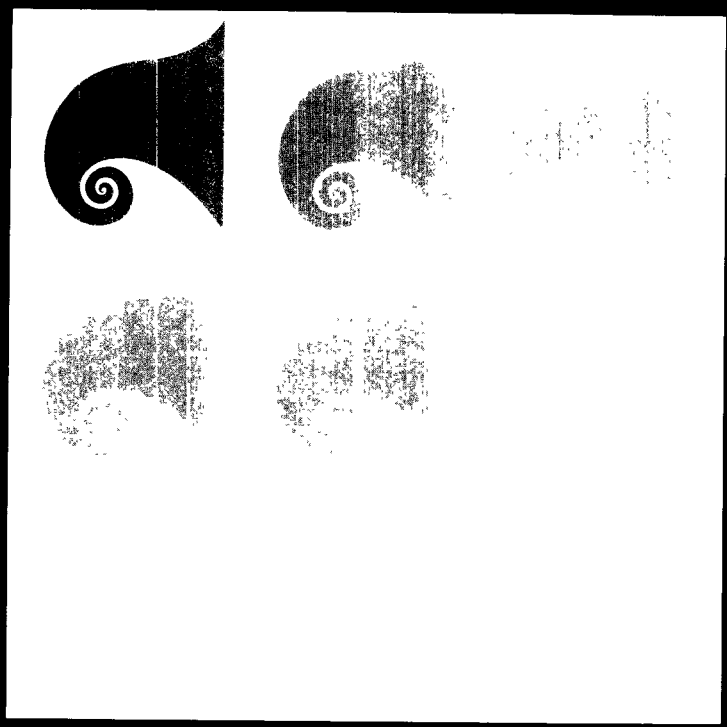
Clearly, something must be done soon or we will seriously and permanently maim our population with pure noise. Fortunately, the knowledge and technology to control noise already exist. As a matter of fact, this is one instance where the knowledge of control techniques exceeds the knowledge about the effects on human life and on the environment.

We have two practical means for control: (1) reduction of noise at its source such as making the sound-producer quieter and (2) alteration of the sound path by distance or by shielding, such as building better walls between apartments.

The second approach is being used more frequently today as people become more aware of the annoyance of noise. New building codes require better sound insulation in homes and apartments. More and more communities are adopting zoning ordinances that attempt to segregate noisy factories or airports from residential areas. Sound-absorbent materials and construction designed to intercept sound paths are slowly coming into wider use in offices and homes. New highways are being constructed in below-grade "cuts" so as to redirect traffic noise up and away from adjacent areas. Aircraft increasingly are being required to use reduced-power, noise-abatement maneuvers around airports.

There are many examples of available noise control technology that are not being utilized. More flexible building codes would permit the use of quieter kinds of plumbing pipes. Sound-absorbing, vibration-damping materials can curtail the noise of motors and engines. Power generators can be quieted with baffles, exhaust silencers and sound-absorbers. Truck tires can be made with quieter treads. The list goes on and on. In many cases, the cost of building quieter machines is the same or only slightly higher than that of the current noisy ones. Even though the new equipment may cost more, it can prove more profitable in the long run. The jumbo jets, for example, are quieter than the older ones, yet they are more powerful and carry twice as many passengers.

All of these methods are only partial measures as noise levels continue to rise. Most specialists in the field agree that much of the solution must come from eliminating some of the noise at its source.



The key is attacking noise pollution in the design stage. It is much easier to design noise out of a machine before it is built than to absorb or deaden the noise afterwards.

If noise is relatively easy to eliminate, why has it not been done?

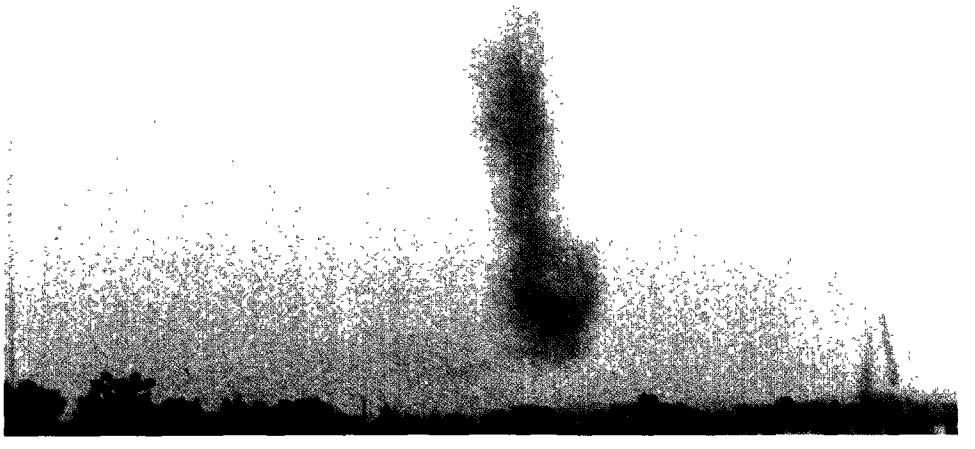
Why has our environment become so noisy?

The answer is that we have permitted it. In fact, in some situations the American public actually asks for more noise. How? One example is the problem a power lawnmower manufacturer ran into when he designed and marketed a substantially quieter mower. Sales were poor and to add to the problem, purchasers began returning the mowers, complaining that they were "underpowered." The mowers were, in fact just as powerful as competing mowers, but too many Americans equate noise with power—"the noisier it is, the more powerful it must be." Since this mower was so quiet, they concluded, it had to be underpowered. The same psychology applies when people customize or "hop up" their automobiles. One of the most popular changes is a modification of the original exhaust system with special mufflers and echo chambers that sharply increase the exhaust noise.

Another peculiarity in human psychology and noise is the use of construction machinery in urban environments. Some of this equipment puts out noise in excess of 120 decibels—almost at the pain threshold. But oddly enough, it elicits few complaints. Why? Psychologists explain that people tend to tolerate these noisy intrusions because of their "temporary" nature. Subconsciously, they tell themselves that this insult will soon go away. The fault in this thinking is that, at the typical rate of urban construction and redevelopment, one project usually follows another and one temporary annoyance after another adds up to a permanent noise fixture. Construction, of course, could be halted, but a more practical alternative would be to quiet equipment and perhaps regulate the hours that it can be operated.

This alternative and similar ones, however, will not be pursued until the public demands it. Since both government and industry respond only to public demands, the only real solution to the overall noise problem is a rising public awareness of the dangers of noise and a demand for quiet. Only when the public expresses a preference for quieter machines, will industry begin to compete on the basis of how quiet their machines can be built. What can we do about it?

making objectives heard



One of the first steps which the public can take towards quieting the environment is to make "noise" about noise. No laws will be passed, no regulations promulgated, no standards set unless the public wants them and lets its elected officials know it.

As part of that public, don't underestimate the influence you, as an individual, can have in effecting change. Not long ago, a mild little old lady walked firmly out to the street and right up to the foreman of a crew which was ripping up her street with ear-hurting jackhammers. The noise, she told him, was unbearable and was

disturbing everyone on the block. The foreman turned to his crew and told them to pack up and leave. His instructions, he explained, were to keep working until someone on the block complained.

In London, a noise-battered citizen finally had enough and began the Noise Abatement League which later convinced the Queen to set up a royal commission to look into Great Britain's noise problems. As a result, that nation now has a Noise Abatement Act.

When the Sixth Avenue subway was noisily being constructed some irritated New Yorkers banded together to form the Citizens for a Quieter City, Inc. The group succeeded in getting the mayor to set up a Task Force on Noise Control which recommended specific changes in the city's noise ordinance.

In Chicago, Citizens Against Noise (CAN) persuaded the City Council to pass the effective 1971 anti-noise ordinance. CAN then expanded its activities to help other noise-bothered citizens throughout the country.

In Boston, a physicist was so bothered by sonic booms that he gathered some fellow sufferers and started the Citizens League Against the Sonic Boom which exposed this as a threat from supersonic transports.

It is the American way of life for citizens to petition government for the redress of grievances. Certainly noise is a grievance, and for relief you can petition government at the appropriate levels. You also can join with other citizens and complain as an organization —many voices are always louder than one.

The Federal government responded to the public's early efforts for less noise by establishing the Office of Noise Abatement and Control in the Environmental Protection Agency. This Agency has the responsibility for determining the extent of noise pollution problems and for establishing standards for control measures.

To help build public awareness and to help individuals express their preferences, products soon will be labeled as to the levels of noise they generate when in use. Limitations will also be set on the maximum amount of noise some types of products—such as construction, transportation and other equipment powered by the internal combustion engine—may generate.

steps to take

It is the state and local governments which have the responsibility to take the steps necessary to create a quieter environment. Since petitions or complaints are much more effective if you have all the facts, first make sure you have the correct official or agency to whom they should be sent. Just locating someone who will admit responsibility for making things quieter may be a problem since noise control has not yet become a high priority environmental issue in many places.

A next step is to examine local laws and regulations. It may be, for example, that a city ordinance already exists which requires a motor vehicle to have a "muffler in good working order." Such laws have been on the books since the advent of the automobile. More effective laws—such as Chicago has—state specific decibel limits for noise, just as speed laws limit the miles-per-hour for vehicles.

The problem with many "muffler laws" and nuisance regulations, however, is that they are so vague they are practically unenforceable and, pending enactment of a workable legal scheme, the best alternative for citizens to get relief may be by a legal suit. For instance, a worker who loses his hearing on a noisy job may sue his employer for compensation. Every city has a building code. The better ones (such as New York's) specify limits of the noise which walls and floors may transmit. If your home or office is bothered by noise from a neighbor, you should investigate, it may be that a building code provision has been violated.

You may not have to fight a legal battle alone. Today, a growing number of public interest law firms specialize in environmental issues. University law students, while not able to represent you in court, can be helpful in preparing your case.

The press, radio and television also can be good allies. A letter to the editor can sometimes accomplish more than a petition with a thousand signatures. Be sure your case is well presented, however, or you may set back the cause by being considered just a "crank."

Finally, as a quiet-loving citizen, you have a responsibility not to offend your neighbors and fellow man with your own noise. You can quiet your home with drapes or wall hangings, carpets, acoustic tile and soft furniture. You can listen to your stereo on a headset instead of blasting everyone with powerful wall speakers. You can replace a raucous lawnmower with a quiet one and you can make sure your auto's muffler is in good shape. You should appreciate that noise does not mean power.

You can express your concern for noise, too, by refusing to buy noisy appliances. Be sure you tell the salesman why you won't buy the appliance, and write your opinion to the manufacturer. By practicing quiet in your personal life and by making "noise" about noise, you can help make our environment less noise-polluted.

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