

N-96-01
II-A-341

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TO THE PROBLEM AND AN
OUTLINE FOR FUTURE
LEGAL RESEARCH**

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REPRINTED FROM COLUMBIA LAW REVIEW
VOL. 70, PAGE 652 (APRIL 1970)
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ENVIRONMENTAL PROTECTION AGENCY
Office of Noise Abatement and Control

NOISE POLLUTION: AN INTRODUCTION TO THE
PROBLEM AND AN OUTLINE FOR FUTURE
LEGAL RESEARCH

JAMES L. HILDEBRAND*

I have long held the opinion that the amount of noise which anyone can bear undisturbed stands in inverse proportion to his mental capacity, and may therefore be regarded as a pretty fair measure of it. . . . Noise is a torture to all intellectual people.¹

INTRODUCTION

Noise is one of the scourges of the modern world. It is an unwanted product of our technological civilization, and is becoming an increasingly dangerous and disturbing environmental pollutant. There is a growing public awareness and even some progress in the fight against air and water pollution, but a third jeopardy—*noise pollution*—has only recently begun to gain attention. Since the industrial revolution the daily lives of people, particularly in urban environments, have been invaded by unwanted and disruptive sounds. Traffic noise, which has been generally accepted without complaint until recently, has become intolerably noticeable. Not only is the actual number of operating motor vehicles increasing annually (an increase of 11.5 million cars and trucks in 1969 alone),² but there is also an upward trend in speed and weight, plus an almost universal adoption of the diesel engine for commercial vehicle use. However, the greatest increase in the urban noise level has been brought about by the introduction of the turbojet engine into commercial airline operation. It can be argued that the antagonism evoked by aircraft noise has stimulated a more critical public attitude toward noise in general and has drawn attention to other sources of unwanted sound which were previously tolerated. The advent of the supersonic transport (SST) is creating a global dimension to what is already a major national noise problem.

Noise has always been with us, but it has never been so obvious, so intense, so varied, and so pervasive as it is today. Background noise³ has increased at a rate of one decibel⁴ a year on the A scale (a scale devised to

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The author is currently editing a selection of essays to be published in book form under the title *NOISE POLLUTION AND THE LAW* (J. Hildebrand ed.). All rights of future publication of this article are reserved by the author.

1. A. SCHOPENHAUER, *On Noise*, in 2 *THE WORLD AS WILL AND IDEA* 199 (H. Haldane & J. Kemp trans. 1844).

2. N.Y. Times, Jan. 11, 1970, § 12, at 18, col. 3. This figure is predicted to increase to 15 million annually by the end of the 1970's. *Id.* There are over 99.9 million motor vehicles in the United States today. See N.Y. Times, Apr. 26, 1970, § 1, at 22, col. 1.

3. See notes 28-31 and accompanying text *infra*.

4. The decibel is a unit measure of sound intensity and is calculated from the level at which sound becomes audible to the human ear. One decibel represents the lowest

give greater weight to high-pitched sounds, which are more annoying to the human ear than low-pitched sounds). If this increase continues at the same rate for the next 30 years as it has for the last 30, it could become lethal.⁵ Since the intensity of sounds doubles with every six decibels, it will take only six years to double the loudness of city noise. "The strength of the general noise background in some of our communities is now four times what it was in 1956, and 32 times what it was in 1938."⁶

Noise may affect one's health in subtle ways—both psychologically and physiologically. Dr. Samuel Rosen, clinical professor of otology (the science of the ear) at Mount Sinai School of Medicine and consulting ear surgeon at Mount Sinai Hospital in New York City, recently stated: "At an unexpected or unwanted noise, the pupils dilate, skin pales, mucous membranes dry; there are intestinal spasms and the adrenals explode secretions. The biological organism, in a word, is disturbed."⁷ Noise also causes a loss of nervous energy to the detriment of the health and well-being of the individual.

Moreover, noise pollution may be a major factor in creating individual cognitive dissonance as well as mass societal neuroses. As the noise level increases, man like other animals becomes more irritable and more prone to irrational and neurotic behavior.⁸ An interesting correlation might be made between our nation's increasing crime rate and increasing urban noise level. The problem has also become an economic one. The World Health Organization estimates that lowered efficiency and increased errors caused by noisy working environments result in a loss of \$4 billion per year to American industry.⁹ In 1961 a *Time* estimate placed the cost of noise to American

audible sound and each additional decibel represents a tenfold increase in volume. For a discussion of the physical properties and the measurement of sound see A. PETERSON & E. GROSS, JR., *HANDBOOK OF NOISE MEASUREMENT* (5th ed. 1963); W. BURNS, *NOISE AND MAN* 10-51 (1968); A. BELL, *NOISE: AN OCCUPATIONAL HAZARD AND PUBLIC NUISANCE* 58-61 (1966). The decibel measurement, however, cannot measure either the subjective impression of noise perceived or the degree of mental disturbance caused. For example, the 50 decibel change of intensity between the rustling of leaves and the sound of people talking is far less noticeable than the next 50 decibel increase from the sound of people talking to the roar of a jet plane. See generally notes 85-89 and accompanying text *infra*.

5. *Noises Takes Toll, Says Experts*, *TODAY'S HEALTH*, Oct. 1967, at 87, col. 1; see also Conn., *Our Noise*, *AMERICAN LEGION MAGAZINE*, Feb. 1968, at 30; Bailey, *The Sound of Madness: "Noise is a Slow Agent of Death"*, *N.Y. Times*, Nov. 23, 1969, § 6 (Magazine), at 46.

6. Conn. *supra* note 5, at 30. Many noise levels encountered in urban areas today exceed standards found injurious in industry. Dougherty & Welsh, *Community Noise and Hearing Loss*, 275 *NEW ENGLAND J. MEDICINE* 759 (1966); See DEP'T HOUSING AND URBAN DEVELOPMENT, *Noise in Urban and Suburban Areas*, *TECHNICAL STUDIES PROGRAM OF FEDERAL HOUSING ADMINISTRATION* (1969); Ostergaard & Donley, *Background Noise Levels in Suburban Communities*, 36 *J. ACOUST. SOC. AM.* 409 (1964); Stevens, *Community Noise and City Planning*, in *HANDBOOK ON NOISE CONTROL* 35-1 (D. Harris ed. 1957).

7. *Noise Takes Toll, Say Experts*, *TODAY'S HEALTH*, Oct. 1967, at 87, col. 1.

8. See notes 28-49 and accompanying text *infra*.

9. Mecklin, *It's Time to Turn Down All That Noise*, *FORTUNE*, Oct. 1969, at 133. For a discussion of one company's early attempts at combating industrial noise, see Scholtz, *Combating the Traumatic Effects of Industrial Noise*, 7 *CLEV. MAR. L. REV.* 260 (1958). See also Miller, *Case Histories of Machine and Shop Quieting*, in *Noise*

industry—for compensation, lost hours, and decreased efficiency—at \$2 million a day.¹⁰

The present state of affairs leaves little room for man to be sanguine. But how did we get into such a situation? The primary reason is the same as in other areas of environmental pollution—social and legal measures were not taken to prevent it, and for the failure to act in time the public authorities bear the major responsibility. The increase in noise has been accepted as a natural process, as a price to be paid for our technological progress. Law, justice, and public authorities all have capitulated to technology.

Yet, it is perhaps unfair to make modern technology the scapegoat of all our social and ecological ills. The pessimistic attitude—that technology has become an end in itself, that it subjects man to its demands rather than serves human needs, that it is inherently destructive of personal freedom, and that it will make the world totally uninhabitable or at least deprive it of all hope and beauty—is based upon a vast oversimplification. The converse—that technology is a universal solvent which has not only liberated Western man from the bondage of poverty and disease but will assure global prosperity and universal happiness for future generations if only applied vigorously—is likewise simplistic.¹¹ There is a more rational and balanced attitude somewhere between the two extremes:

Between these two extremes lies the view of those who recognize that benefit and injury alike may flow from technology, which, after all, is nothing more than a systematic way of altering the environment. They recognize that the quality of life has been greatly improved by technological advance and would deteriorate rapidly in a period of technological stagnation; that a technological culture, already adopted by one third of the human race and eagerly sought by much of the remaining two thirds, could be abandoned only at the cost of relegating hundreds of millions of human beings to suffering and death. The choice, from this perspective, is not between the abandonment of technology as a tool of human aspiration and the uncontrolled pursuit of technology as though more tools invariably meant a better life. *The choice, rather, is between technological advance that proceeds without adequate consideration of its consequences and technological change that is influenced by a deeper concern for the interaction between man's tools and the human environment in which they do their work.*¹²

REDUCTION, 571-98 (L. Beranek ed. 1960); Karplus & Bonvallet, *A Noise Survey of Manufacturing Industries*, 14 AM. INDUS. HYG. ASS'N Q. 235 (1953).

10. TIME, Jan. 2, 1961, at 29.

11. HOUSE COMM. ON SCIENCE AND ASTRONAUTICS, TECHNOLOGY: PROCESSES OF ASSESSMENT AND CHOICE, REPORT OF THE NATIONAL ACADEMY OF SCIENCES 2 (July 1969). For a discussion of these and other oversimplified views about technology, see Mesthene, *The Rule of Technology in Society: Some General Implications of the Program's Research*, in HARVARD UNIVERSITY PROGRAM ON TECHNOLOGY AND SOCIETY, FOURTH ANNUAL REPORT 1967-1968, at 41-43 (1968). See generally E. MESTHENE, TECHNOLOGICAL CHANGE: ITS IMPACT ON MAN AND SOCIETY (1970).

12. TECHNOLOGY: PROCESSES OF ASSESSMENT AND CHOICE, *supra* note 11, at 2.3.

The stimulus necessary to provoke such a deeper concern for man's environment is often lethal. When air and water pollution was shown actually to kill people, there was action. Fortunately or unfortunately, a direct cause and effect relationship between excessive noise and death cannot yet be shown.¹³ However, the bell that is tolling is a loud one, and it is getting louder. If complete environmental deterioration is to be avoided, we must view the world, in Barbara Word's terminology, as a *spaceship Earth* which is capable of carrying only so much cargo and whose environmental level must be qualitatively maintained.¹⁴

Existing legal remedies have proved grossly inadequate to meet the expanding needs for effective noise control. Common law nuisance remedies and outdated municipal noise ordinances are not sufficient to protect individual rights and public health and safety from the damages caused by noise pollution. Even recent legislation, embodying modern scientific audiometric concepts, has had only limited success. Ultimately, the quieting process will not gain impetus until individual outlooks are changed. We must first realize that noise is not just an unpleasant annoyance, which must be endured as part of the price of progress. Once individuals realize that unwanted noise is a threat to health, not too dissimilar from air or water pollution, and that determined efforts are needed to keep it within reasonable bounds, then market pressures can be brought on manufacturers of noise-producing items and public pressure can become an effective catalyst for securing particularized legal regulation of specific noise-producing sources.

The purpose of this article is to provide an introduction to the practical problems surrounding noise as an environmental pollutant. The continuing deterioration of man's habitat demands a reevaluation of the present approaches to ecomanagement,¹⁵ and it is hoped that the discussion of the physiological, behavioral and psychological effects on the physical and mental well-being of our society and its members will emphasize the current need for legislative as well as judicial regulation. The article will also discuss the various sources of noise pollution and what can be done to ameliorate their disruptive influences. Finally, an outline for future legal research to meet the needs of

13. It is rumored, however, that the latest exotic weapon for military use in Vietnam is a siren capable of emitting 200 decibels—a sound intense enough to literally "boil" the inner ear. Dreher, *It's Getting Noisier*, THE NATION, Sept. 18, 1967, at 238-39.

14. In the last few decades, mankind has been overcome by the most fateful change in its entire history. Modern science and technology have created so close a network of communication, transport, economic interdependence—and potential nuclear destruction—that planet earth, on its journey through infinity, has acquired the intimacy, the fellowship, and the vulnerability of a spaceship. B. WARD, *SPACESHIP EARTH* vii (1966).

15. Ecology is the science of the relations between organisms and their environment. Ecomanagement can be defined as the public management of all natural resources, including space and air. See J. MATTA, *ENVIRONMENT AND RESOURCES: FROM CONSERVATION TO ECOMANAGEMENT* (1968).

planned and rational ecomanagement in the area of noise pollution will be suggested.

I. THE EFFECTS OF NOISE POLLUTION

As in other areas of environmental pollution, the adverse effects of noise pollution are multivariate and interrelated. While it can be shown empirically that exposure to excessive noise causes loss of hearing, it is more difficult to show the subjective effects of noise on individual and societal mental well-being. Man's ability to adapt to the deterioration of his environment further complicates attempts to measure the effects of noise pollution in any objective fashion. "It is possible to become 'acclimatized' to some noises, although only to the extent that one may become less aware of their subjective effects. However, the reverse may also occur and the noise become more noticeable."¹⁶ For simplification, this discussion will divide the effects of noise pollution on the human organism into physiological effects—including hearing loss, occupational deafness, and noise-induced diseases—and psychological and behavioral effects—including annoyance, speech interference, fatigue, psychosomatic disorders, tension-related diseases, sleep interference, and mental illness. The effects of infrasound and ultrasound and the effects of noise pollution on other animals and on our nation's wilderness areas will then be discussed.

A. Physiological Effects

The most severe and noticeable effect of exposure to excessive noise is loss or impairment of hearing. In the United States alone, 11 million adults and 3 million children suffer some form of hearing loss.¹⁷ Airborne sound is

16. A. BELL, *supra* note 4, at 33.

17. Brower, *Noise Pollution: A Growing Menace*, SATURDAY REVIEW, May 27, 1967, at 17. There are several types of deafness: (1) nerve deafness, sometimes called inner-ear, perceptive, or neurosensory deafness, in which noise is the usual cause; (2) conductive hearing loss, in which there is interference with the conduction of sound to the inner-ear; (3) additive or mixed hearing losses due to a combination of the above; and (4) functional deafness, which is due to psychological factors or to malingering. A. BELL, *supra* note 4, at 22. See generally J. BALLANTYNE, DEAFNESS (1960); H. DAVIS & S. SILVERMAN, HEARING AND DEAFNESS (1961). On the mechanism of hearing, see T. LITTEL, THE PHYSICS OF THE EAR (1965); I. WHITFIELD, THE AUDITORY PATHWAY (1967); A. GLORIE, NOISE AND YOUR EAR (1958).

Until recently it was generally thought to be a physiological effect of aging that the ability to hear high tones gradually diminishes starting at about age 32 for men and age 37 for women. However, it is now believed by some doctors, including Dr. Samuel Rosen, consulting ear surgeon and clinical professor of otology at New York's Mount Sinai Hospital, that this hearing change, called presbycusis, is not a natural hearing loss but rather is caused by the general noise level in our society. See Rosen, *Presbycusis Study of a Relatively Noise-free Population of the Sudan*, 71 ANNALS OF OTOLARYNGOLOGY & LARYNGOLOGY 727 (1962); Rosen, *Hearing Studies in Selected Urban-Rural Populations*, 29 TRANSACTIONS OF THE N.Y. ACADEMY OF SCIENCES 9 (1966). Of course, it is possible that factors other than noise cause a loss of hearing which correlates with age in Western society. Dr. Roy Sullivan has suggested that atherosclerosis and hypertension are two other possible factors, and he warns that Dr. Rosen's findings should be interpreted "with caution, in light of cultural, hereditary, diet and other environmental differences between the [Sudan and Western] societies." 113 Cong. Rec. H670 (daily ed. Jan. 26, 1967). See generally A. BELL, *supra* note 4, 41-43; W. BURNS, *supra* note 4, at 17-18.

a variation in normal atmospheric pressure,¹⁸ and the response of the ear is proportional to such pressure. There are numerous ways that noise can damage hearing. The most common effect of excessive noise on hearing is nerve deafness, which occurs when noises damage the hearing mechanism to a point where the sensory nerve function is depressed. In the process of hearing, sound waves are transmitted to the inner ear's cochlea, a shell-like chamber which is lined with hair-like sensors. Sounds are analyzed by the ear in this chamber. Prolonged exposure to excessive noise can cause marked changes in the cells of the hair-like sensors, causing a hearing loss which may be permanent.¹⁹ A more exceptional hearing damage, called acoustic trauma, or blast trauma, is caused when a sudden burst of noise, such as gunfire, ruptures the eardrum or disrupts the chain of small bones that transmit the sound within the ear to the auditory nerve. Explosive noise may also affect the inner ear, producing cochlear damage and permanent nerve deafness.²⁰

Not only the intensity of noise but such factors as duration of exposure, distance from the source, and frequency must be considered when assessing the probability of both correctable and irreparable hearing damage. Obviously, the longer the exposure the greater the damage. The intensity of sound diminishes over distance, with a progressively greater reduction as the frequency increases. Moreover, higher frequency sounds, such as that created by a turbo-prop airplane, are more disagreeable and dangerous than those of lower frequencies.²¹

18. A. PETERSON & E. GAOS, JR., *supra* note 4, at 3. Sound can be defined as a mechanical disturbance or an oscillation in pressure, stress, particle displacement, particle velocity, etc., propagated in an elastic medium, of such character as to be capable of exciting the sensation of hearing. By extension, the term sound is sometimes applied to any disturbance, irrespective of frequency, which may be propagated as a wave motion in an elastic medium. The medium in which the source exists is often indicated by an appropriate adjective, e.g., airborne, waterborne, structureborne. Sound can also be defined as the sensation of hearing excited by mechanical disturbance. Disturbances of frequency too high to be capable of exciting the sensation of hearing are described as ultrasonic. Hypersonic is the name given to ultrasonic disturbances in a medium, whose wavelength is comparable with the inter-molecular spacing. Disturbances of frequency too low to be capable of exciting the sensation of hearing are described as infrasonic. See *id.* at 213; BRITISH STANDARDS INSTITUTION, BS661, GLOSSARY OF ACOUSTICAL TERMS (1969). For a discussion of the physical properties of sound, see W. BURNS, *supra* note 4, at 10-51; W. HALL & O. MATTHEWS, SOUND (2d ed. 1965); L. KINSLER & A. FRY, FUNDAMENTALS OF ACOUSTICS (1962); R. STEPHENS & A. BATT, ACOUSTICS AND VIBRATIONAL PHYSICS (1966).

19. See W. BURNS, *supra* note 4, at 69; Brower, *supra* note 17, at 17; discussion in note 21 *infra*.

20. Lehmann, *Noises and Health*, UNESCO COURIER, July 1967, at 26.

21. *Id.*

Two physicians, Dr. John D. Dougherty of the Harvard School of Public Health and Dr. Oliver I. Welsh, chief of the Audiology Unit of the Veterans Administration Outpatient Clinic in Boston, made a study of loss of hearing in the high frequencies. Their report was published in the New England Journal of Medicine [Vol. 275, No. 14, Oct. 6, 1966, at 759]. In the process of hearing, they explained, sound waves are transmitted to the inner ear's cochlea, a shell-like chamber which is lined with hairlike sensors. High-frequency sounds are analyzed by the ear at the front of this chamber, while the low-frequency sounds are dealt with all along the path of the inner cochlea. Consequently, there is persistent wear in that one small area where the high-frequency sounds impinge; this area wears out first. The two physicians also noted marked tissue changes in the hair cells during noise exposure. According to Dr. Dougherty, "the hair

Loss or partial impairment of hearing is not the only physical damage that can be caused to the human organism by noise pollution. There is a growing concern that other serious physical difficulties may be caused or aggravated by the increasing noise in the urban environment.²² At a recent meeting of the American Association for the Advancement of Science, it was asserted by Dr. Lester W. Sontag that the human fetus may be damaged by noise pollution either directly by such violent noise as sonic booms, or indirectly by the mother's psycho-physiological reaction to excessive noise.²³ On the adult level, physicians have reported a causal relationship between exposure to excessive noise over a period of time and the incidence of heart disease and cardiovascular dysfunction,²⁴ migraine headaches, gastrointestinal disorders, and allergies, as well as endocrine and metabolic effects.²⁵ A recent report by the Federal Council for Science and Technology has stated that "[i]ncreasing numbers of competent investigators believe that [prolonged exposure to intense noise] may adversely affect other organic, sensory and physiologic functions of the human body."²⁶ Dr. Vern O. Knudsen, a physicist, a founder of the Acoustical Society of America, and former Chancellor of the University of California, did not overstate the problems when he said: "Noise is a slow agent of death."²⁷

B. Psychological and Behavioral Effects

Noise can be defined simply as one or a group of loud, harsh, nonharmonious sounds or vibrations that are unpleasant and irritating to the ear.²⁸

cells regenerate themselves after noise exposure; but after long-term exposure, it is entirely likely that they will wear out altogether."

Brower, *supra* note 17, at 17.

22. See, e.g., *Hearings on Noise: Its Effect on Man and Machine, Before the Special Investigating Subcomm. of the House Comm. on Science and Astronautics, 86th Cong., 2d Sess. (Aug. 23-25, 1960)* [hereinafter cited as *Hearings on Noise*]; AMERICAN ASS'N FOR THE ADVANCEMENT OF SCIENCE, *Symposium: Physiological Effects of Audible Sound*, Boston, Mass., Dec. 28-29, 1969 [hereinafter cited as AAAS Symposium], discussed in Welch, *Physiological Effects of Audible Sound*, 166 SCIENCE 533 (1969); N.Y. Times, Dec. 29, 1969, at 1, cols. 4-5. The papers presented at the AAAS Symposium are scheduled to be published later this year by the Plenum Press.

23. Sontag, *Effects of Noise During Pregnancy Upon Foetal and Subsequent Adult Behavior*, at AAAS Symposium, *supra* note 22, discussed in N.Y. Times, Dec. 29, 1969, at 1, cols. 4-5, and 25, col. 2.

24. Rosen, *Noise, Hearing and Cardiovascular Function*, at AAAS Symposium, *supra* note 22; Rosen, *Hearing Loss and Coronary Heart Disease*, 82 ARCHIVES OF OTOLARYNGOLOGY 236 (1965); Rosen, *Relation of Hearing Loss to Cardiovascular Disease*, TRANSACTIONS AM. ACAD. OPHTHALMOLOGY AND OTOLARYNGOLOGY 433 (1964). See also N.Y. Times, Mar. 19, 1967, § 1, at 42, col. 1 (report of Dr. Samuel Rosen at Conference on Noise Control, New York); Ragon, *Impact, WORLD HEALTH*, Feb.-Mar. 1966, at 26-28.

25. N.Y. Times, June 23, 1967, at 22, col. 2 (report of Professor Lee E. Farr to American Medical Ass'n Convention); Blum, *Noise: How Much Can We Take?*, McCALLS, Jan. 1967, at 113. See generally AAAS Symposium, *supra* note 24.

26. REPORT OF THE COMM. ON ENVIRONMENTAL QUALITY OF THE FEDERAL COUNCIL FOR SCIENCE AND TECHNOLOGY, *NOISE: SOUND WITHOUT VALUE 3* (1968) [hereinafter cited as *Noise: Sound Without Value*], discussed in N.Y. Times, Nov. 10, 1968 at 42, col. 1.

27. Quoted in Bailey, *supra* note 5, at 131.

28. Noise is any undesired sound. By extension, noise is any unwanted disturbance within a useful frequency band, such as undesired electric waves in any

"Whether a sound becomes noise—whether it is wanted or unwanted—whether it is injurious—in many instances is all in the point of view."²⁹ The degree of annoyance is not necessarily related to the intensity of the sound; it may often be influenced by subjective factors, such as familiarity and personal attitudes. Very loud music may still be considered beautiful by an appreciative listener,³⁰ whereas even minute scratching and extremely weak sounds can be a disturbing noise. Since annoyance is largely an individual response, and varies with persons and situations, it can be said that what makes a sound a noise is a matter of *psychology* rather than acoustics.

A sound which we associate with something pleasurable is far less likely to be considered as a noise than one with unwelcome connotations. We always tend to underrate the noise of our own car, for example, and the children next door always seem to make more noise than our own. So whether a sound is regarded as a noise and how noisy it is depends also on who causes the noise and his relationship with the person who hears it.³¹

In determining whether a sound is a noise, mental attitude and environment are of major importance,³² and it is interesting to note that groups of people with different backgrounds of work experience have differing annoyance thresholds.³³

As in other areas of psychological and behavioral reaction, there is no objective method of measuring annoyance as such. By asking a sufficient number of people about their reactions to noises, it is possible to obtain some

transmission channel or device Noise is an erratic, intermittent, or statistically random oscillation If ambiguity exists as to the nature of the noise, a phrase such as "acoustic noise" or "electric noise" should be used Since the above definitions are not mutually exclusive, it is usually necessary to depend upon context for the distinction.

A. PETERSON & E. GROSS, JR., *supra* note 4, at 210.

29. AMERICAN MEDICAL ASS'N, *Noise and Its Health Effects*, HUMAN DEVELOPMENTS IN ACTION, May-June 1967, at 23.

We shall apply the term noise to describe sounds which are unwanted and possibly also loud and objectionable. The criteria are thus subjective. The very nature of these definitions presupposes a very wide range of reactions by different people to the same sound, but if the sound is sufficiently loud or long-lasting, or both, or if it has some peculiarity in quality or time pattern, it will be found disagreeable by some people. By and large the louder the noise the greater the number of people who will find it objectionable; with certain noises, a larger proportion of those exposed will be likely to object strongly.

W. BURNS, *supra* note 4, at 7-8.

30. Even desired sound can be damaging, whether you call it noise or not:

In Melbourne, Australia, noise researcher R. F. Burton set out to discover why he was noticing "tender ear" in two or three percent of teen-agers. He went to a rock'n roll teenage dance and clocked 114 decibels of sound, a dangerously high level for the ear to tolerate. He came away predicting that many teen-agers who subject themselves to this wanted noise will lose their hearing earlier in life than usual, and many will be deaf at 40.

Conn, *supra* note 5, at 32. See also *Medicine, Going Deaf from Rock'n'Roll*, TIME, Aug. 9, 1968, at 47; *Not Exactly Music to Your Ears: High Sound Levels of Rock-and-Roll Music*, CONSUMER REPORT, July 1968, at 349; *Rock Physically Unsound*, SCIENCE DIGEST, June 1968, at 67.

31. Lehmann, *supra* note 20, at 26.

32. A. BELL, *supra* note 4, at 33.

33. See Kryten, *Noise Control Criteria For Buildings*, 3 NOISE CONTROL, Nov. 1957, at 14; Noise: SOUND WITHOUT VALUE, *supra* note 26, at 2.

indication of the general degree of annoyance or distress. On the statistical basis of replies to specific questions concerning annoyance caused by noise, "together with a knowledge of the relevant noise environment, some quantitative indication of the way in which noise interferes with people's lives can be obtained."³⁴ It can be generally said that the louder the noise and the higher the pitch of its components, the greater the annoyance is likely to be; other factors are the characteristics of the sound and the modulation of loudness and pitch.

Another behaviorally disruptive effect of noise is its interference with speech communication. This is probably the best understood of the non-auditory effects of noise. This aspect of noise pollution is important for industry where the ability to communicate by speech is vital, and its interference may cause inconvenience, disruption of work, inefficiency, and accidents. The consonants convey most of the information content of speech, and because they are articulated in higher frequencies and are weaker in intensity than the vowels, they are more readily drowned out by other noises.³⁵ The interference with speech communication caused by noise is basically a masking process.³⁶ Background noises increase an individual's threshold of hearing, and the extent to which the hearing threshold is increased is called the speech interference level and can be expressed in decibels. "Discontinuous or impulsive noises often produce less interference than expected because speech that is partly masked may be complemented by interpolation or gesture to make good the gaps in what is actually heard."³⁷ The necessity to talk loudly or the extra effort caused by misunderstandings due to speech interference may cause fatigue. However, because of differing individual reactions it is not easy to prove that employees become more tired working in noisy surroundings than in quiet ones.³⁸

34. W. BURNS, *supra* note 4, at 101.

35. See Grimm, *Perception of Segments of English-Spoken Consonant-Vowel Syllables*, 40 J. Acoust. Soc. AM. 1454 (1966); Fairbanks & Miron, *Effects of Vocal Effort Upon the Consonant-Vowel Ratio Within the Syllable*, 29 J. Acoust. Soc. AM. 621 (1957); Kryter, Williams & Green, *Auditory Acuity and the Perception of Speech*, 34 J. Acoust. Soc. AM. 1217 (1962).

36. See Webster, *Speech Communications as Limited by Ambient Noise*, 37 J. Acoust. Soc. AM. 692 (1965). For a discussion of masking, see note 52 *infra*.

37. A. BELL, *supra* note 4, at 31. For a discussion of non-verbal communication, see Rosenthal, *Unintended Communication of Interpersonal Expectations*, 10 AMERICAN BEHAVIORAL SCIENTIST 24 (Apr. 1967); *Communication: What's in a Glance?*, TIME, Oct. 17, 1969, at 74; N.Y. Times, Sept. 28, 1969, § 1, at 53, col. 1. See also Bacon, *The Man Who Reads Nature's Secret Signals*, NATIONAL WILDLIFE, Feb.-Mar. 1969, at 4.

38. A. BELL, *supra* note 4, at 35, citing Fugh, *Noise—Noxious or Nice*, 15 AM. INDUSTRY, HYG. ASS'N Q. 127 (1954). Similarly, the claim that noisy working environments cause a loss of employee morale is a matter difficult to assess objectively. "In general, morale is related more to the degree of ego involvement in one's work than to noise levels or other disturbing conditions." A. BELL, *supra* note 4, at 35, citing Felton & Spencer, *Morale of Workers Exposed to High Levels of Occupational Noise*, 22 AM. INDUSTRY, HYG. ASS'N Q. 136 (1961). Because of psychological considerations, often resulting from the participation of employees in noise-effect investigations, employee work performance may improve temporarily under simulated noisy conditions. See discussion and citations in A. BELL, *supra* note 4, at 34.

Psychiatrists and psychologists have recently noted the connection between excessive undesired noise and mental disorders. Drs. Rosen and Knudsen suggest that loss of hearing may in fact be the *least* serious impairment to the human organism caused by noise pollution. Both of these doctors point out that one no longer has to work in a boiler factory to suffer noise-induced psychological and physiological damage. Day and night most of us are exposed to a general racket. These noises are now being recognized as a major factor in the celebrated "tensions" of modern living; they contribute and aggravate all of the tension-related diseases—from stomach ulcers, neuroses, and mental illness to allergies and cardiovascular and circulatory diseases.³⁹

Dr. Knudsen calls the total effect of the background roar of modern life "*decibel fatigue*," and says that millions of Americans suffer from it. Dr. Rosen believes that medical science will one day recognize an entire "*noise syndrome*"—a family of symptoms related to unwanted or unexpected noises. He and others already cite dilation of the pupils, dry mucous membranes, skin paleness, intestinal spasms and glandular secretions as candidates for membership in the full "*noise syndrome*" when it is recognized.⁴⁰

Similarly, the late Dr. Fabian Rouke reported to the New York Committee for a Quiet City:

One of the insidious aspects of excessive noise is the fact that an individual may be unconsciously building up nervous tension due to noise exposures. This may cause a person thus exposed to noise suddenly to be catapulted into an act of violence, or mental collapse, by some seemingly minor sounds which drive him beyond the point of endurance. Many persons who are using tranquilizers may be treating the symptoms rather than the disease.⁴¹

Persons exposed to unwanted noise easily become irritable and unsociable: "Studies show that workers in noisy jobs tend to be more quarrelsome at work and away from it (at home, for example) than those doing equivalent jobs, but who are not subjected to similar noise stresses."⁴² There is evidence of increasing concern relating to the effect of noise on the efficiency, performance, and concentration of factory workers and office employees. It has been reported that astronauts subjected to a reproduction of the 145 decibel sound of a jet engine at full thrust experience difficulty in carrying out simple arithmetical operations, and tended to put down any answer in order to end the experiment.⁴³ "In many cases, [people working

39. See notes 22-36 and accompanying text *supra*. For additional citations, see A. BELL, *supra* note 4, at 34.

40. Conn, *supra* note 5, at 31-32 (emphasis added).

41. COMMITTEE FOR A QUIET CITY, INC., FINAL REPORT & RECOMMENDATIONS, July 7, 1960, at 24.

42. Lehmann, *supra* note 20, at 30-31.

43. A. BELL, *supra* note 4, at 34.

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in a noisy environment] make more mistakes and their thinking gets slow and fuzzy. Often they carry a burden of resentment and irritation, have more 'social conflicts' at home and on the job than workers in quieter surroundings."⁴⁴ Obviously, unwanted noise that is deleterious to an individual's well-being and that also decreases working efficiency will add significantly to the costs of production and industry. As noted above, these costs caused by lowered efficiency and increased errors have been estimated to result in an annual \$4 billion loss to American industry.⁴⁵

One of the most disruptive effects of noise pollution, both physically and mentally, is loss of sleep. Even when the sleeping area is quiet a person may be kept awake by a ringing sensation in the ears, called tinnitus, which may have been caused by exposure to excessive noise several hours earlier. Adequate sleep is a physiological necessity, and noises which prevent sleep can be said to be prejudicial to physical health.⁴⁶ Victims may also "develop psychotic symptoms because their dreams are interrupted."⁴⁷ Because of the individual and personal peculiarities in the reaction to noise with respect to interference with sleep, it is virtually impossible to lay down rules of a practicable nature for preventing such disturbance. Maximum permissible noise levels for sleeping accommodation can be suggested,⁴⁸ "but an additional factor is that of intermittent noise, such as that from passing road or air traffic, and attempts must be made to account for the consequent individual disturbances on the basis of their frequency of occurrence. This factor is of particular importance in the case of aircraft noise."⁴⁹

C. *Effects of Infrasound and Ultrasound*

"Sound" may damage body and mind even though it cannot be heard. Studies have only recently been started by the French National Centre for Scientific Research in Marseilles concerning infrasound, which has a pitch or frequency of below 30 cycles per second and is thus inaudible to the human

44. Manchester, *Rising Time of Noise*, 53 NAT'L CIVIC REV. 418, 419 (1964). See also Broadbent, *Effects of Noise on Behavior*, in HANDBOOK ON NOISE CONTROL, *supra* note 6, at 10-10.

45. See Mecklin, *supra* note 9 at 133. For a discussion of one company's early attempts at combating industrial noise, see Scholtz, *supra* note 9.

46. See W. BURNS, *supra* note 4, at 100; Thiessen, *Psychological Effects of Noise During Sleep*, at AAAS Symposium, *supra* note 22; Lukas & Kryter, *Awakening Effects of Simulated Sonic Boom and Subsonic Jet Noise*, at AAAS symposium, *supra* note 22. See also Atherly, Hempstock & Noble, *Study of Tinnitus Induced Temporarily by Noise*, 44 J. ACOUST. SOC. AM. 1503 (1968).

47. TRIAL, Aug.-Sept., 1966, at 6 (summarizing testimony of Dr. Julius Buchwald, psychiatrist, New York State Medical Center, before the Mental Hygiene Commission of the New York State Assembly. See Mendels, *Sleep and Depression*, at AAAS Symposium, *supra* note 22.

48. It has been suggested that 35 decibels is the threshold for optimum sleeping conditions. See Bragdon, *Noise—A Syndrome of Modern Society*, 10 SCIENTIST & CITIZEN 29, 33 (1968).

49. W. BURNS, *supra* note 4, at 101.

ear, but which is still capable of harming the human organism. "Industrial cities abound in infrasound, generated by many kinds of machines and motors that turn at a slow rate. Even infrasound of weak intensity can penetrate houses and become the unsuspected cause of such ills as dizziness and fatigue."⁵⁰ Infrasound is blamed for feelings of malaise and discomfort sometimes experienced by airplane passengers,⁵¹ and for this reason most airlines cancel out or "mask" such infrasound with music while the engines are idling.⁵² Persons affected by infrasound experience physiological effects similar to those caused by low-frequency mechanical vibration. Vertigo and nausea are attributed to the excitation of the semi-circular canals, and infrasound may also cause resonances of internal organs producing intense irritation, visual disturbances, and interference with intellectual activity.⁵³

At the other end of the frequency scale are the ultrasounds which are also inaudible to the human ear but which may have other serious effects on the human organism. In an extensive survey of the auditory and subjective effects of industrial ultrasonic sources made in 1967, it was found that unpleasant subjective effects, including headache, nausea, tinnitus, and fatigue, were experienced by some persons and that temporary threshold shift occurred.⁵⁴ However, the conclusion of this report suggested that the effects were probably due to noise in the high but audible frequency range which also occurred in the industrial machine noise, and was not necessarily due to the ultrasonic components as such.

50. *The Danger of Sounds We Cannot Hear*, UNESCO COURSE, July 1967, at 28. See also discussion in note 18 *supra*.

51. *Id.*

52. It is common experience to have one sound completely drowned out when another, louder noise occurs. For example, during the early evening when a fluorescent light is on, the ballast noise may not be heard, because of the usual background noise level in the evening. But late at night when there is much less activity and correspondingly less noise, the ballast noise may become relatively very loud and annoying. Actually, the noise level produced by the ballast may be the same in the two instances. But psychologically the noise is louder at night because there is less of the masking noise that reduces its apparent loudness.

Experimenters have found that the masking effect of a sound is greatest upon those sounds close to it in frequency. At low levels the masking effect covers a relatively narrow region of frequencies. At higher levels, above 60 [decibels], say, the masking effect spreads out to cover a wide range, mainly for frequencies above the frequencies of the dominating components. In other words, the masking effect is asymmetrical with respect to frequency. Noises that include a wide range of frequencies will correspondingly be effective in masking over a wide-frequency range.

A. PRYMONTE & E. GODES, *supra* note 4, at 20-21.

53. W. BURNS, *supra* note 4, at 249, citing Gaveau, Condat & Saul, *Intra-sons: Généralités, Distorsions, Propriétés Physiques, Effets Biologiques*, 17 *ACUSTICA* 1 (1966). Another very important study in this area is Mohr, Cole, Guild & von Gierke, *Effects of Low Frequency and Infrasonic Noise on Man*, 36 *AEROSPACE MEDICINE*, No. 9, at 817 (1965).

54. Acton & Carson, *Auditory and Subjective Effects of Airborne Noise from Industrial Ultrasonic Sources*, 24 *Env. J. INDUSTR. MED.* 297 (1967). See also Parrack, *Effect of Airborne Ultrasound on Humans*, 3 *INTERNATIONAL AUDIOLOGY* 294 (1966). For a discussion of temporary and permanent threshold shift, see note 82 *infra*.

D. *Effects of Noise Pollution on Other Animals and on Wilderness Areas*

Man is not the only animal affected by noise pollution. Mink farmers can lose a majority of their animals in the killing frenzy the female minks undergo after being startled by a sonic boom.⁵⁵ "The laboratory exposure of animals to short loud sounds can cause diverse effects, such as a temporary rise in breathing and heart rates, a rise of blood pressure, or a lessened flow of gastric juice; but these responses quickly subside when the noise ceases."⁵⁶ Laboratory experiments have also demonstrated that sound with an intensity of 150 to 160 decibels is fatal to certain animals. The animals suffered from burns, spasms, and paralysis before dying.⁵⁷ Sport fish are believed to be hypersensitive to sound,⁵⁸ and research is also being undertaken to determine the effects of noise on commercial oyster beds.⁵⁹ Guinea pigs exposed to short periods of above-normal but supposedly tolerable noise have developed swollen inside-the-ear membranes, and vital auditory ear hair cells have been destroyed. Prolonged exposure to excessive noise has made rats lose their fertility, turn homosexual, and eat their young. If loud enough (150 decibels) the noise eventually kills them through heart failure.⁶⁰

America's wilderness areas and national parks, which to date have remained out of hearing range of urban and industrial noise, will soon be subjected to a new menace—sonic booms from supersonic transport (SST) planes flying overhead.⁶¹ Serious damage connected with sonic booms has been observed and reported in the Canyon de Chelly National Monument in Arizona, Bryce Canyon in Utah, Mesa Verde National Park in Colorado, and elsewhere.

At the Canyon de Chelly an ancient Indian dwelling was demolished when a large portion of an overhanging cliff fell following a sonic

55. *The Minneapolis Tribune* reports that Zack Taylor, a mink farmer at Frazee, Minnesota, was recently awarded \$37,490 in damages resulting from an Air Force sonic boom in 1965. The farmer said his minks "exploded" simultaneously from their nest boxes and crashed against the ends of their cages with all four feet, then became quiet. Later, he found dead kittens in the boxes and cages, some partially devoured, and concluded that the frenzied mothers had eaten many of their young. In 1966 his herd produced less than half the expected number of kittens.

NATIONAL PARKS, Aug. 1968, at 21. See Bond, *Effects of Noise on the Physiology and Behavior of Farm Animals and Farm-raised Mink*, in AAAS Symposium, *Supra* note 22. See also Heinemann, *Effects of Sonic Booms on the Hatchability of Chicken Eggs*, at AAAS Symposium, *supra* note 22.

56. A. BELL, *supra* note 4, at 35. See N.Y. Times, Feb. 8, 1970, § 1, at 83, col. 5 (report on experiments by Dr. Joseph Buckley, chairman and associate dean of pharmacology, University of Pittsburgh).

57. *Echoes from Our Noisy World*, UNESCO COURIER, July 1967, at 22, 23.

58. See N.Y. Times, Oct. 27, 1968, § 5, at 28, col. 2.

59. See Cleveland Plain Dealer, Mar. 16, 1968, at 10, col. 1. See also A. PETERSON & E. GROSS, JR., *supra* note 4, at 21.

60. Bailey, *supra* note 5, at 131. See also *Rocket Blasts and Guinea Pigs*, SCIENCE DIGEST, Oct. 1968, at 63. Ecological studies have shown that rats exposed to excessively loud noise exhibit a marked decline in the pregnancy rate. *Echoes from Our Noisy World*, *supra* note 57, at 23.

61. See generally text accompanying notes 126-132 *infra*.

boom. Rare sandstone formations in Bryce Canyon have been severely damaged. A rockfall of 66,000 tons occurred recently in Mesa Verde after the passage of two jet planes traveling at supersonic speeds. A rock slide from a canyon wall of the Navajo National Monument in Arizona has just been reported. In the Death Valley National Monument (California and Nevada), 323 sonic booms were counted in a six-month period ending in February 1968, with 68 of these considered to be serious enough to cause weakening and demolition of geologic features.⁶²

The future does not appear promising. "In a hearing before a congressional committee on May 22, 1967, Secretary of Transportation Alan S. Boyd said that it was probable that certain routes over thinly populated areas could be worked out in order to avoid booming the cities."⁶³ This means, of course, that special efforts will be made to find routes over our nation's wilderness and national park areas for the supersonic jets. If such efforts are successful, the tranquility and solitude of these sanctuaries will be destroyed by the persistent cannonade of sonic booms.⁶⁴

Increasing the threat to our parks and wilderness areas is the opinion of some government officials that these areas provide the only "feasible and prudent alternative" for locating the new SST jetports. The first of such airports was scheduled to be built, and construction was begun in the Everglades National Park in Florida. Six months after the project had begun, and after \$13 million had been spent on the construction of a landing strip for training flights, the international jetport was banned by a joint federal and state agreement.⁶⁵ When finished, the jetport would have covered 39 square miles in the middle of the Great Cypress Swamp, which supplies 38 percent of the water flowing into the park. Conservationists contended that the interruption of this flow would have upset, if not totally destroyed, the ecological balance in what has been regarded as the last refuge of solitude along the Eastern Seaboard. The construction of the flight training landing strip has already endangered the fragile and unique ecology of the park.⁶⁶

62. Editorial Comment to Graves, *Sonic Booms and Wilderness*, *THE LIVING WILDERNESS*, Winter 1967-68, at 17, 18. See also *N.Y. Times*, Dec. 1, 1968, § 1 at 73, col. 4 (discussion of sonic boom damage to Mesa Verde National Park, Colorado); 113 Cong. Rec. H352 (daily ed. Jan. 18, 1967).

63. Graves, *supra* note 62, at 19.

64. The magnitude and range of the noise created by the new SST's are, to say the least, awesome. On its maiden flight, the Anglo-French Concorde was heard 20 miles away. Boeing's SST will generate noise above the threshold of pain. Soucie, *The Everglades Jetport—One Hell of an Uproar*, 34 *SIERRA CLUB BULLETIN*, July 1969, at 4, 7. See also SST: *Noise Reduction Sideline Noise Viewed as Major Problem by Boeing 21 AEROSPACE TECHNOLOGY*, May 20, 1968, at 53.

65. *N.Y. Times*, Jan. 16, 1970, at 1, cols. 6-7; *N.Y. Times*, Feb. 1, 1970, § 10, at 1, cols. 1-4.

66. See Soucie, *supra* note 64, at 7. See also Editorial, *A Jetless Everglades*, *N.Y. Times*, Sept. 7, 1969, § 4, at 14, col. 1; Pennekamp, *Disaster in Everglades National Park*, 30 *SIERRA CLUB BULLETIN*, Oct. 1965, at 4.

Another aspect of our ecological crisis is that pollution problems are not only multivariate but they are also interrelated—where there is big-league noise pollution, there invariably will be air and water pollution. The construction and expansion of our nation's

II. SOURCES OF NOISE POLLUTION—AND WHAT WE CAN DO ABOUT THEM

The sources of noise pollution are infinite in number and diversity. If the average person were to stop for ten minutes and attempt to identify all the unwanted sounds he hears, he would find it impossible to even list them in that amount of time. We have already defined noise as any unwanted or disruptive sound. Noise control can be defined as the technology of achieving an acceptable noise environment consistent with economic and operational considerations.⁶⁷ There are three approaches to the problem: One solution is to reduce the noise level at its source; the second solution is to dampen or insulate the places where we live and work; the third alternative is to "mask" unwanted noises with other more pleasing sounds.⁶⁸ For purposes of this discussion the sources of noise pollution will be divided into four general categories: (1) household appliances; (2) industry and construction; (3) traffic; and (4) aircraft noise and the sonic boom.

A. Household Appliances

The kitchen is the noise center of the modern home. An electric blender can produce 98 decibels, as compared with 95 by a subway and 107 by a loud power motor.⁶⁹ When the exhaust fan, the dishwasher, and the garbage disposal operate simultaneously, as much as 100 decibels may result. The situation has reached such proportions that Dr. John D. Dougherty of the Harvard School of Public Health has cited the kitchen as a major contributor to the increasing deafness of the general population.⁷⁰

The household roar, indoor and out, is multiplied not only by increasing the number of appliances but also by increasing the size of their power sources. Fifteen years ago, the typical, self-propelled power mowers had one horsepower engines, while today the "economy" models are equipped with engines three times that size; riding mowers and home tractors may have as much as twelve horsepower.⁷¹ Vacuum cleaners often will have more than two horsepower motors, and it is exceptional to find one with less than one horsepower.⁷² Music reproduction has undergone a similar, and perhaps unreason-

airports not only means an increase in pollution from jet sound, but also pollution from jet contrails and from the attendant on-ground sewage and industrial waste. It was estimated that the proposed Everglades jetport would have added 9,000 to 72,800 tons of carbon monoxide, 4,150 to 6,000 tons of nitrogen oxides, 13,000 to 40,250 tons of hydrocarbons, 1,000 tons of aldehydes and 1,260 to 3,250 tons of particulates to the surrounding atmosphere when it reached the projected operational level of 900,000 flights a year. Soucie, *supra* note 64, at 7.

67. Harris, *Noise, ENVIRONMENTAL SCIENCE & TECHNOLOGY*, April 1967, at 292.

68. See note 52 *supra*.

69. *That Noise You Hear May be Pollution*, *BUSINESS WEEK*, Apr. 22, 1967, at 42, 43.

70. See Brower, *supra* note 17, at 17; see note 21 *supra*.

71. Dreher, *supra* note 13, at 239.

72. Of course, another problem is changing personal attitudes—millions of dollars have

able, increase in power size. A stereo amplifier for home use will commonly produce 120 watts, or 60 watts of audio power per channel. The advantage is supposed to be that momentary peaks will be accommodated without distortion. The acoustic output of a 100-man symphony orchestra, however, seldom rises above 10 watts.⁷³

One approach to the problem of household appliance noise is to require manufacturers to rate their products on a numerical decibel scale so that consumers can compare relative noise levels of the products before they buy. Similarly, houses and apartments could be rated by city inspectors for noise so that prospective buyers and tenants will have some concept of how noisy the physical location actually is. Many noise levels encountered in community areas now exceed the safety standards found in industry.

"Sound absorbing materials, drapes, curtains and carpets which deaden noise, quieter air-conditioners, ventilators and other household appliances, and sound-insulated ceilings, walls, doors and windows all help to make the home a quieter and more restful place."⁷⁴ Acoustical research at the Owens-Corning Fiberglas Corporation has brought forth several simple ways that household noise can be reduced.⁷⁵ Since uninsulated walls are useless in stopping airborne noise (voices, street sounds, appliances), it is recommended that the house or apartment be built with a double-wall system in which there is no direct path for the transmission of undesired sound. Wall studs should be staggered so that the same stud does not touch the inner surface of both walls. "Blankets" of heavy insulation can then be hung between the walls. Impact noise (slamming doors, footsteps, mechanical equipment) can be reduced by cushioning. Carpets and sound-absorbing ceilings and walls can also greatly reduce impact sounds. Plumbing noise, which is a major headache for homeowners, can be reduced by "wrapping" the pipes so that they do not touch any part of the building structure, and holes where pipes pass through walls can be stuffed with resilient materials. One relatively easy way to control noise from motorized home appliances is to place them on sound-absorbing materials, and, if possible, within sound-insulated rooms.

been spent on advertising so that housewives will prefer "powerful" sounding household appliances. While it is technically feasible to build a vacuum cleaner that is nearly silent, it may not sell very well because today's housewife has been conditioned to the sound of power. See N.Y. Times, Apr. 30, 1969, at 31, cols. 4-8.

73. Dreher, *supra* note 13, at 239.

74. Schenker-Sprüngli, *Down With Decibels!*, UNESCO COURIER, July 1967, at 4, 7.

75. *Solutions to Noise Control Problems in the Construction of Houses, Apartments, Motels and Hotels*, Owens-Corning Fiberglass Corp. (undated); discussed in *Noise: Sound Without Value*, *supra* note 26, at 23, 26-28. For a comprehensive 420 page report which analyzes the basic causes of noise problems in buildings and recommends corrective measures for their alleviation, see U.S. DEPT. HOUSING & URBAN DEVELOPMENT, REPORT NO. ST/TS-24, GUIDE TO AIRBORNE, IMPACT AND STRUCTURE-BORNE NOISE CONTROL IN MULTIFAMILY DWELLINGS (Jan. 1968). See also *Noise Control in Architecture: More Engineering than Art*, ARCHITECTURE RECORD, Oct. 1967, at 193; *Some Particular Problems of Noise Control*, ARCHITECTURE RECORD, Sept. 1968, at 185.

There is some indication that "sound conditioned" houses sell more rapidly than those in which noise-absorbers have not been installed. At a meeting of the National Association of Home Builders, in Washington, D.C., Charles McMahon, a spokesman for the association, reported that in a housing development in Birmingham, Alabama, 11 sound conditioned houses were built. These houses sold more quickly than similar homes in which the anti-noise features were not installed, despite the fact that the sound conditioned homes cost from \$600 to \$800 more. The homes included such special equipment as "a 'super-quiet toilet,' sound-proofed air-conditioning and heating units, sound-absorbing tiling and staggered stud construction in the walls."⁷⁶ In an attempt to develop low-cost methods and materials to reduce noise transmission between housing units and the intrusion of noise from outside sources, the United States Department of Housing and Urban Development has entered into a \$160,000 contract with Wyle Laboratories of Segundo, California, for an 18-month study. The findings of this study will be published as a guide to architects and builders.⁷⁷

Great Britain, Germany, Sweden, the Netherlands, and the Soviet Union have all developed strong building codes containing comprehensive noise-control provisions.⁷⁸ In the United States, building codes are being used to regulate noise in new apartment and office buildings. The New York City Council has drawn up a code calling for the reduction "of airborne noises traveling from one apartment to another through wall partitions or floors or coming from a public hallway; for the quieting of machinery such as central air conditioning; and for limitations on noises transmitted through ventilators, shafts, ducts, and outlets, as well as noises emanating from a neighboring building."⁷⁹ The New York City Board of Estimate recently withheld approval of Tracey Towers apartments in the Bronx until the builder agreed to include certain noise abating structures.⁸⁰ It is encouraging to note that the Federal Housing Administration has set impact-noise ratings in its minimum property standards.⁸¹ While such codes have inherent limitations, it can be hoped that they will have some effect in reducing the amount of acoustical garbage seeping from one apartment to another.

76. N.Y. Times, June 23, 1967, at 22, col. 2.

77. Cleveland Plain Dealer, July 13, 1969, ¶ E, at 23, col. 7.

78. Editorial, *City of Noise*, N.Y. Times, Nov. 26, 1967, § 4, at 12, col. 2.

79. Brower, *supra* note 17, at 19. See also Note, *Urban Noise Control*, 4 COLUM. J.L. & SOC. PROB. 105, 108-14 (1968); Waterhouse, *Noise Control Requirements in Building Codes*, HANDBOOK ON NOISE CONTROL, *supra* note 6, at 40-1.

80. N.Y. Times, Nov. 22, 1968, at 45, col. 1 (city ed.).

81. U.S. DEP'T HOUSING & URBAN DEVELOPMENT AND FEDERAL HOUSING ADMIN., REPORT NO. 2600, MINIMUM PROPERTY STANDARDS FOR MULTIFAMILY HOUSING, (Nov. 1963); discussed in NOISE: SOUND WITHOUT VALUE, *supra* note 26, at 25. See also FEDERAL HOUSING ADMIN. REPORT NO. 760, IMPACT NOISE CONTROL IN MULTIFAMILY DWELLINGS (1963).

B. Industry and Construction

Since the 19th century it has been recognized that workers in noisy surroundings suffered hearing loss earlier in life than other people. Today, hearing loss resulting from excessive noise is recognized in most countries as an occupational disease with financial compensation based on the extent of loss of hearing.⁸² The scope of such occupational deafness has reached impressive proportions. "Claims for compensation for hearing loss on the job now run at about \$2 million a year, while it has been estimated that 4 1/2 million American workers who don't file claims might win them if they would."⁸³ The Federal Council for Science and Technology, in a report issued in September 1968, estimated that the number of United States workers experiencing noise conditions unsafe for hearing to be in excess of 6 million and perhaps as high as 16 million.⁸⁴

A leading acoustical engineer, Dr. Leo L. Beranek,⁸⁵ has observed that men of 30 who have been exposed to a work environment with an average noise level of 90 decibels for periods as short as 10 years probably can hear no better than men in their 60's and 70's who have worked in a quiet environment.⁸⁶ The danger limit for most individuals is somewhere between 80 and

82. See Lehmann, *supra* note 20, at 26, 30. The most common result of excessive exposure to noise is a temporary shift in an individual's threshold of hearing, in other words, for the affected individual to hear clearly sounds must now be louder. By definition temporary threshold shift refers to any loss of hearing from which the ear recovers, however long this takes. If no recovery occurs, then there is said to have been a permanent threshold shift—an important factor in determining a workman's compensation. See Nelson, *Legal Liability For Loss of Hearing*, HANDBOOK OF NOISE CONTROL, *supra* note 6, at 38-1.

83. Conn, *supra* note 5, at 32. See also Brower, *supra* note 17, at 17.

84. NOISE: SOUND WITHOUT VALUE, *supra* note 26, at 32. See N.Y. Times, Nov. 10, 1968, at 42, col. 1; A. GLORIA, *supra* note 17, at 133.

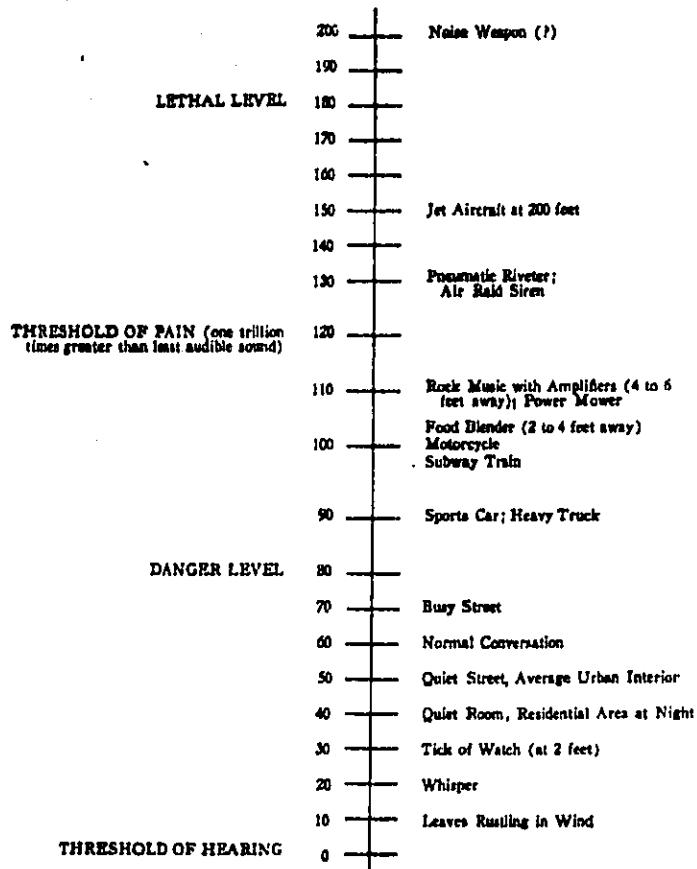
See generally SURCOMM. ON NOISE OF THE COMM. ON CONSERVATION OF HEARING AND RESEARCH CENTER, GUIDE FOR CONSERVATION OF HEARING IN NOISE (1964); cf. Address by William H. Stewart, Surgeon General, Public Health Service, U.S. Dep't of Health, Educ. & Welfare, Health and the Urban Environment, Medical Symposium on Biological Effects of Air Pollution, Oct. 28, 1966 (Public Health Service Reprint). Much of this research has been financed by affected industries. See Blum, *Noise: How Much More Can We Take?*, McCALLS, Jan. 1967, at 113. Industry has traditionally looked on the problem from a defensive position. Not only is industry the defendant in claims for occupational hearing loss, it is often the object of attack by irate citizens claiming that a factory or industrial plant is a public noise nuisance. A "classic" in this area is the article by William H. Lloyd, *Noise as a Nuisance*, 82 UNIV. PA. L. REV. 567 (1934). See also Note, *Nuisance and Legislative Authorization*, 52 COLUM. L. REV. 781 (1952); Note, *Nuisance—As a "Taking" of Property*, 17 U. MIAMI L. REV. 537 (1963); Prosser, *Private Action for Public Nuisance*, 52 VA. L. REV. 997 (1966).

85. Dr. Leo L. Beranek is a leading American specialist on problems of acoustics. He is a lecturer at the Massachusetts Institute of Technology, Cambridge, Massachusetts, where he was formerly associate professor of communications engineering, and is president of an American noise research and consulting firm. See L. BERANEK, *ACOUSTICS* (1954); L. BERANEK, *NOISE REDUCTION* (1960).

86. Dreher, *supra* note 13, at 239.

85 decibels.⁸⁷ The United States Air Force, the largest single employer with an inescapably noisy environment for most of its personnel, has settled on 85 decibels as the level where ear protection is mandatory.⁸⁸ Long-term exposure to noise with a decibel rating of over 80 is a generally accepted cause of hearing loss, and investigations have shown that some degree of hearing loss

87. RELATIVE NOISE LEVELS IN DECIBELS:



Compiled from the following sources: Schenker-Sprungli, *supra* note 74, at 6; Dreher, *supra* note 13, at 241; *Medicine, Going Deaf from Rock'n Roll*, TIME, Aug. 9, 1968, at 47; Brower, *supra* note 17, at 17-18.

88. U.S. AIR FORCE REGULATION 160-3:5, *Hazardous Noise Exposure* (1956).

may occur at levels which are well below those commonly encountered under all sorts of contemporary conditions. Temporary deafness can be caused by short exposure to levels between 100 and 125 decibels. Listening becomes painful in the range of 125 and 140 decibels, and at 150 decibels the ear can be permanently damaged even with only short exposures.

Industrial noise is also a source of irritation for the general community. Mayor John Lindsay of New York City has been quoted as saying:

This city has an obligation to protect its citizens against all forms of violence, including assault by decibels . . . In a modern industrial civilization, I suppose we have to be prepared to tolerate some increase in the sound level, but I see no reason why this city or its people should have to put up with battering, shattering noises.⁸⁹

This statement holds true for every other American city as well as for our nation as a whole.

With liability on their minds, it is not surprising that industries are searching for quieting processes. A relatively quiet pile-driver and air compressor are already on the market,⁹⁰ and it would take little research to develop similar less noisy industrial and construction equipment. The silenced machines are usually enclosed in a solid plastic housing lined with sound-deadening material. Furthermore, some noise reducing progress could be made if silencers and adequate mufflers were attached to present equipment, or if this equipment were properly isolated, screened, or enclosed. Techniques are being developed to permit economical and effective noise reduction where it was once considered too difficult or too expensive. Industries should be encouraged to seek suitable noise control measures, "and where large numbers of persons are exposed to a severe noise hazard, governments should encourage research and provide, directly or indirectly, the necessary financial assistance."⁹¹ Since noise control measures which are economically impossible today may become feasible or mandatory tomorrow, the problems must be kept under constant review.

Laws which allow unlimited construction noises between 7 a.m. and 6 p.m. in New York City and elsewhere should be re-evaluated. There is little reason why millions of people should be awakened by drills and jackhammers at 7 a.m. if these tools can be effectively quieted. Even the noisy garbage collectors celebrated by Carl Sandburg can be made more quiet by the use of rubber or plastic containers or by placing rubber bumper-rings around the garbage cans.

To a great extent the problem of controlling needless construction noise

89. Quoted in Brower, *supra* note 17, at 19.

90. *Id.*, at 19; *Muffling the Clamor of Urban Construction*, BUSINESS WEEK, Dec. 14, 1968, at 168. For a discussion of European efforts to abate construction noises, see Schenker-Sprüngh, *supra* note 74, at 7.

91. A. BELL, *supra* note 3, at 62.

is a legal one. The typical municipal zoning ordinance or anti-noise regulation is more or less capable of regulating the neighborhood nuisance potential of fixed industrial installations, but there is virtually no legal restriction on how much noise temporary or transient construction companies can make in any neighborhood they invade. "If complaining citizens attack them as public nuisances, courts will generally rule that if even the noisiest construction project serves a social purpose, it isn't a public nuisance—and of course construction serves a social purpose."⁹² The logical result of the absence of legal control is that existing methods of abating construction noise are not applied. Air compressors and jack hammers, riveters, paving breakers, cement mixers, auxiliary engines, and pumps are all used amidst stores, homes, and office buildings with little or no muffling. Sometimes, the engines are surrounded with metal sheets that only act as sounding boards. In their vicinity conversation and rational thought are impossible. The answers to these problems must be in the form of new laws and law enforcement to reduce the volume of construction and demolition noise as much as possible. Noise control is expensive, and it is as unreasonable as it is naive to ask sympathetic construction firms and industries to invest in noise control measures voluntarily, only to let the unsympathetic companies underbid them on jobs by avoiding noise control costs.⁹³

C. Traffic Noises

Traffic noise is one of the major irritants contributing to our environmental noise pollution. Inter-city expressways, which extend for hundreds and thousands of miles, are bringing the din of the city to the country. Passenger car traffic, however, need not necessarily be irritating; many new car models are being equipped with better exhaust silencers and specially designed quiet tire treads. Furthermore, city and highway planners have it in their power to choose (and the public can demand) quieter road surfaces.⁹⁴

The more blatant violators of our relative urban peace and quiet are

92. Conn. *supra* note 5, at 33-34.

93. On May 16, 1969 the United States Department of Labor, under Secretary George P. Shultz, took an unprecedented step forward in the battle for noise control by promulgating new standards for industrial noise. These standards, known as the Walsh-Healy Health and Safety Regulations, 34 Fed. Reg. 7948 (1969), became effective on May 20, 1969 and apply to all industrial firms which have federal contracts of \$10,000 or more during the course of one year. These new regulations establish a maximum allowable level of 90 decibels measured on the A scale for a continuous eight hour per day exposure; as the permissible noise level exposures increase in decibels, the duration per day and per number of exposure hours decreases. The new regulations will benefit some 27 million workers in about 70,000 plants. However, the \$10,000 minimum, and the fact that the standards apply only to government contractors means that millions of other workers will not be covered by these safety regulations. Furthermore, the regulations establish a maximum noise level of 90 decibels which is 5 to 10 decibels higher than most experts regard as safe.

94. See, Beranek, *Street and Air Traffic Noise—And What We Can Do About It*, UNESCO COURSES, July 1967, at 12, 14. A brief biography of Dr. Beranek appears in note 85 *supra*.

trucks, buses, motorcycles, sports cars, and passenger cars with loud or faulty mufflers. In general, the average truck at 60 miles per hour is about twice as noisy as a steady stream of automobile traffic. Truck noise is also more irritating because it is sporadic. Sports cars, motorcycles, and buses create similar disruptions. The obvious remedy for this aspect of the noise pollution problem is to require adequate shielding and noise-insulation on all engine compartments and exhaust systems. It is encouraging to note that the new air pollution control mufflers are quieter than the regular exhaust mufflers. The organized parts of the trucking industry, such as the large fleet owners, have openly recognized their fast-growing contribution to national noise pollution. Generally, these large trucking concerns have encouraged reasonable laws and fair enforcement; they want truck noise control to be more legal than voluntary so that the "gypsies" will have to conform to the same noise standards as the fleets.

Traffic noise may be abated through technology in a number of ways. One solution is to place major thoroughfares in "ditches"—that is, building the roads in troughs which are 15 to 20 feet below the normal land surface. This approach is especially needed where the high-speed roads are extended into the heart of major cities. Some futuristic architects have predicted the use of covered tunnels for all city vehicular traffic.⁹⁵ Even lining streets and highways with trees, shrubs, fences, earth banks, and so forth, helps to insulate and to protect the surrounding area from the noise.

Ultimately, or from the long-term viewpoint, it can be hoped that other forms of propulsion may alleviate or at least alter the noise created by road vehicles. One such development is the Wankel engine which, while still an internal combustion engine, employs a rotor in a casing rather than the more common piston in a cylinder.⁹⁶ A gas-turbine powered bus is being currently tested in New York City, but General Motors has indicated that a production model of the bus would not be available for another two years.⁹⁷ The gas-turbine vehicle engines have been praised for their low noise levels—"the engine gives off a subdued canine whine, instead of the familiar feline purr that turns into a roar when the diesel engine accelerates."⁹⁸ Since gas-turbine produce a different type of noise, albeit quieter, than that of piston engines, road engineers and vehicle designers are likely to continue to face noise problems in the future. The most attractive possibility for the reduction of noise is some form of electric engine. A dual-mode transit system has been devised by Dwight M. Baumann, a professor at the Massachusetts Institute of Tech-

95. See Sullivan; N.Y. Times, Dec. 31, 1967, § 4, at 7, cols. 1-7. See also text accompanying notes 165-66 *infra*.

96. W. BURNS, *supra* note 4, at 133. The only commercially available passenger vehicle with a Wankel engine is the German NSU Moter's "Ro-80." See Chinitz, *Rotary Engines*, SCIENTIFIC AMERICAN, Feb. 1969, at 90.

97. N.Y. Times, Dec. 20, 1969, at 61, cols. 1-5.

98. *Id.* at col. 1.

nology, which uses special buses and cars, equipped with both internal combustion engines and electric motors. The conventional engines would be used on city streets and highways. "On specially built transit corridors, however, they would be operated by electric motors and be guided by a retractable side arm that would swing out and touch an electric rail along the transit way. The rail would provide the power and guidance and control speeds."⁹⁹

Still a third solution would be to encourage a shift from individual automobile transportation to mass transportation. Indeed, there is some indication that Americans may be reaching the end of their long romance with the automobile.¹⁰⁰ In many cities the planner's dream has become the commuter's nightmare. In New York, for example, it is virtually impossible to cross Manhattan in the rush hour, either with a car or without one. The suffocation and immobilization of the cities by the automobile has been encouraged greatly by the federal government since the Eisenhower Administration. At that time, the powerful lobbying interests of the oil and automobile industries persuaded Congress to set up a huge self-perpetuating highway trust fund which is financed from a tax imposed on all sales of gasoline. The money can only be used for building new interstate highways. In a futile effort to abate city congestion, large multi-story car parks have been built in the midst of the metropolitan areas—and the effect of their presence has been to encourage more motorists to drive into town.

The public has finally begun to react against this lunacy. The city authorities in San Francisco, for example, flatly refused to cooperate with the state and federal governments in permitting a huge new highway, which would have destroyed one of that city's loveliest parks. Other cities, including Cleveland, New Orleans, and Memphis, are now putting up similar fights.

In addition, the new National Environment Policy Act of 1969¹⁰¹ may have a revolutionary effect on projects affecting the environment, including highway construction. This landmark legislation attempts to establish a national environmental policy and an independent body of environmental advisors within the executive office of the President. Besides the important declaration of a national policy for a better environment, the Act requires agencies of the federal government to consider environmental impact in deciding on project development, and gives the Council of Environmental Advisors surveillance over proposals. Oscar S. Gray, acting director of the Department of Transportation's Office of Environmental and Urban Systems

99. N.Y. Times, Nov. 26, 1969, at 90 cols. 1-3.

100. See Boyd, *The Transportation Dilemma*, 54 VA. L. REV. 428 (1968); J. MEYER, J. KAIN & M. WOHL, *THE URBAN TRANSPORTATION PROBLEM* (1966); C. PELL, *MEGALOPOLIS UNBOUND: THE SUPER-CITY AND THE TRANSPORTATION PROBLEM* (1966).

101. Pub. L. No. 91-190, 83 Stat. 852 (1970). See Sive, *Some Thoughts of an Environmental Lawyer in the Wilderness of Administrative Law*, 70 COLUM. L. REV. 612 (1970).

Research, has stated recently that among the factors to be evaluated in the early stages of highway planning will be such environmental concerns as recreation, parks, aesthetics, neighborhood character, erosion, wildlife, noise, and air and water pollution.¹⁰² It remains to be seen, however, if these federal guidelines will be followed on the state level.

Yet if transportation by automobile is to be discouraged, one must substitute a viable alternative in the form of fast, efficient, and quiet mass transportation. The rapid public transit systems have been sadly neglected. New York's subway system, which was designed at the beginning of the century, has had no new lines added to it for 40 years, despite a tremendous population increase in the areas it serves. The railroads, which used to be the major carriers of freight and passengers, have suffered and many have died. There are at least two states today (Maine and Vermont) where all passenger trains have stopped running, making the residents almost entirely dependent upon automobiles. Moreover, city subways and rail lines are presently one of the most important sources of urban noise pollution. "The San Francisco Bay Area Rapid Transit District, the Montreal subway and a few other urban-suburban railroads have taken pains to reduce noise, but most of the major systems, like that of New York City, seem to be operated on the basis that noise is unimportant."¹⁰³ It would seem that the well-known and perfectly feasible engineering measures for abating rail noise are "a refinement to which the users of public transportation are not entitled."¹⁰⁴

There is some indication that a new generation of mass transportation trains, capable of operating at speeds up to 250 miles an hour, may help to entice travelers and commuters off the busy highways. "Two developments have made such trains possible; the air cushion that replaces wheels and virtually eliminates friction, and the linear electric motor that pulls the train in almost complete silence."¹⁰⁵ Low noise levels are unquestionably a great advantage of such municipal transit vehicles; other high speed trains, propelled by jet or propeller engines, would be too noisy for use in urban and residential areas.

The conversion to swift, silent, and exhaust-free mass transport systems will not be easy. Not only will it require a tremendous capital investment in new equipment, but it will also mean the sacrifice of already-existing invest-

102. Boston Globe, Jan. 22, 1970, at 4, cols. 3-4.

103. Dreher, *supra* note 13, at 239.

104. *Id.* at 240. It is encouraging to note that: "The Washington [D.C.] area's planned \$2.5 billion transit system will boast . . . quiet-gentle track curves to avoid screech, continuous welded rails, sound-absorbing carpet between tracks, rubberized insulation of vehicle components, acoustical treatment of stations." *The Boom Nobody Wants*, NATION'S BUSINESS, Sept. 1968, at 76, 78.

105. N.Y. Times, Dec. 14, 1969, § E, at 14, cols. 1-3. The United States has recently let a \$3 million contract with Gruman Aerospace Corporation for the designing of a similar transit vehicle. N.Y. Times, Mar. 18, 1970, at 73, cols. 1-4.

level. A reading of more than 85 decibels is considered excessive in Connecticut,¹¹² and in a six-month study, which recorded the noise levels of 2,900 vehicles on the Connecticut Turnpike, 11 percent of the vehicles had decibel levels of 94 or higher from 25 feet away.

A British regulation requires that all passenger cars and trucks constructed after April 1, 1970 shall not produce more than 85 decibels; motorcycles and other mechanically propelled two-wheeled vehicles are limited to noise levels below 90 decibels.¹¹³ Maximum permissible noise levels in France, determined under the British testing procedure,¹¹⁴ are 83 decibels for passenger cars and small trucks, 86 decibels for motorcycles, and a maximum 90 decibels for large trucks and buses. In Switzerland the maximum permissible noise levels, measured laterally in an open field at a distance of seven meters with full engine power, are 80 decibels for passenger cars, 85 decibels for two-stroke motorcycles, large trucks, and buses.¹¹⁵ The "maximum noise level" scales established by the Swiss Anti-Noise Commission,¹¹⁶ have been of great value in providing points of departure for the anti-noise legislation of other countries.¹¹⁷

State decibel laws are a delayed step in the right direction for abating noise pollution from surface traffic. Perhaps truck noise and commercial vehicle noise should be federally regulated because of the heavy interstate

112. Connecticut's Motor Vehicles Law states in part: "(c) Each motor vehicle . . . shall be provided with a muffler or mufflers designed to prevent excessive, unusual or unnecessary exhaust noise, which muffler shall be maintained by the owner in good working order and in constant operation." CONN. GEN. STATS. ANN. § 14-80 (Supp. 1969).

113. *The Motor Vehicles (Construction and Use) Regulations 1969*, reprinted in THE BRITISH NOISE ABATEMENT SOCIETY, *THE LAW ON NOISE* 53-64 (1969).

114. The acoustical test for British automobiles requires measurement of the noise at a point 25 ft. from the centerline of the lane in which the vehicle travels for three different operating conditions: [1] constant speed of 30 mph in top gear; [2] starting from a steady speed of 30 mph and (beginning 32 ft. before passing the test microphone) accelerating as rapidly as possible over a distance of 65 ft.; and [3] maintaining a constant speed of 30 mph at full throttle with brakes applied. The highest noise level obtained under these three conditions of test is used to rate the vehicle.

Beranek, *supra* note 94, at 15.

115. Beranek, *supra* note 94, at 15.

116.

MAXIMUM NOISE LEVELS (in decibels)

Established by the Swiss Anti-Noise Commission

Areas	Basic sound		Frequent peaks		Infrequent peaks	
	night	day	night	day	night	day
Recreational	35	45	45	50	55	55
Residential	45	55	55	65	65	70
Mixed	45	60	55	70	65	75
Commercial	50	60	60	70	65	75
Industrial	55	65	60	75	70	80
Main Traffic Arteries	60	70	70	80	80	90

Source: Schenker-Sprüngli, *supra* note 74, at 7.

117. *Id.*

traffic involved. Due to the increased costs of providing and maintaining adequate mufflers and engine covers, decibel laws may be ultimately effective only if they are national in scope and apply uniformly to all vehicles.¹¹⁸

D. Aircraft Noise and the Sonic Boom

In no other area of noise control are conflicting values more clearly seen than in the controversy over jet noise and the location and extension of airports.¹¹⁹ William F. McKee, Federal Aviation Administrator, has indicated that irritated citizens, protesting over aircraft noise, are the main obstacle to airport expansion.¹²⁰ The creation of any new airport or the enlargement of an existing one brings immediate protest from whole communities and chains of communities. Airlines and airports alter flight patterns and runways, while manufacturers attempt to minimize the noise problem on the ground by drastically altering airplane design. Recognizing the problem, federal agencies as well as private organizations are searching for means to control such noise.

Although quieter jet aircraft engines have been developed, the airline companies have been slow to change engines in mid-stream. Because of the increased costs of the new quieter jets,¹²¹ the public must exert economic and political pressure on the aircraft industry and the government. Many citizens are now demanding that their legislatures pass laws requiring all aircraft to

118. Beranek, *supra* note 94, at 15.

119. The first comprehensive report on the growing aircraft noise problem was the Doolittle Report in 1952. *THE AIRPORT AND ITS NEIGHBORS, REPORT OF THE PRESIDENT'S AIRPORT COMMISSION* (1952). Since then numerous other reports have been made. See, e.g., *Noise: Sound Without Value*, *supra* note 26, at 8-16; White House Press Secretary, *Aircraft Noise and Compatible Land Use in the Vicinity of Airports*, Memorandum for Heads of Departments and Agencies (Mar. 22, 1967); Office of Science and Technology, *Alleviation of Jet Aircraft Noise Near Airports*, Report of the Jet Aircraft Noise Panel (1966); *Investigation and Study of Aircraft Noise Problems*, H.R. Rep. No. 36, 88th Cong., 1st Sess. (1963).

For a discussion of the legal aspects of aircraft noise, including noise litigation, claims, and theories of recovery, see Hill, *Liability for Aircraft Noise: The Aftermath of Casady and Griggs*, 19 U. MIAMI L. REV. 1 (1964); Munro, *Aircraft Noise as a Taking of Property*, 13 N.Y.L. FORUM 476 (1967); Spater, *Noise and the Law*, 63 MICH. L. REV. 1373 (1965); Tenzer, *Jet Aircraft Noise: Problems and Their Solutions*, 13 N.Y.L. FORUM 465 (1967); Tondel, *Noise Litigation at Public Airports*, 32 J. AIR L. & COMMERCE 387 (1966); Note, *Jet Noise in Airport Areas: A National Solution Required*, 51 MINN. L. REV. 1087 (1967). See also Nat'l Aircraft Noise Abatement Council *Aircraft Noise Litigation and Claim Survey* (June 1965); 115 Cong. Rec. E9031 (daily ed. Oct. 29, 1969) (remarks by Senator Hatfield).

120. N.Y. Times, Oct. 5, 1967, at 79, col. 1. See generally Tenzer, *supra* note 119; Note, *supra* note 119.

121. "Prior to the introduction of jet-powered commercial aircraft, an estimated \$50 million was spent on research and development by the industry to perfect in-flight sound suppressors for jet powerplants. By 1965, the industry had invested an estimated \$150 million in installation of in-flight suppressors." *Noise: Sound Without Value*, *supra* note 26, at 10, citing Report of Proceedings, NAT'L AIRCRAFT NOISE SYMPOSIUM, Jamaica, New York, at 11-1 (1965).

On the federal level, Representative John W. Wydler introduced a bill during the second session of the 89th Congress which sought to amend the National Aeronautical and Space Administration (NASA) appropriations to include \$20 million for noise reduction research. Although this bill was defeated, NASA has since instituted research on jet noise reduction, with a budget of \$1.5 million. See Bragdon, *supra* note 48, at 31.

For a discussion of jet engine noise and its reduction, see W. Burns, *supra* note 4, at 209-14.

produce lower noise levels in residential areas. Such laws have little immediate effect, however, because most of today's jet aircraft cannot meet a substantially lower noise requirement. The proper approach to abating commercial aircraft noise is to impose noise limitations on all new aircraft entering the airlines' inventories. Then the process of quieting existing aircraft can begin. Federal requirements establishing acceptable noise levels before certification of new aircraft are the existing legal means available to accomplish this result. "Without such regulation, competitive pressures in both the manufacturing and operating industries will maintain the same lack of concern about noise as that which now exists from trucks."¹²² Municipal ordinances which attempt to ban excessive jet noise and sonic booms caused by airplanes flying over their territory may be invalidated, as was the case in *American Airlines, Inc. v. Town of Hempstead*,¹²³ on grounds of federal preemption.¹²⁴ But while local anti-noise ordinances may be ineffective, they at least give clear warning to the federal government and to the airplane industry that the public is very much disturbed by the problem and demands a solution.¹²⁵

The public has also made clear its impatience with the problem of sonic booms—"the loudest, most startling and most damaging noise yet made by any ordinary thing for routine peaceful human use"¹²⁶—which will be a part of the next generation of jet aircraft.¹²⁷ Any airplane flying faster than the speed of sound produces pressure or shock waves around the nose and around protruding parts of the plane, much like the waves created by a rapidly moving ship. These shock waves form a cone which encircles and follows the aircraft and intersects with the earth. "As the line of intersection with the earth advances with the movement of the airplane, people living within the width of the

122. Beranek, *supra* note 94, at 20.

123. 272 F. Supp. 226 (E.D.N.Y. 1966). Private action may be brought on theories of "taking of property" or public nuisance even though it is no longer a trespass to fly through the airspace over private property. See generally Spater, *supra* note 119; Munro, *supra* note 119; Hill, *supra* note 119; Tondel, *supra* note 119. See also Note, *Nuisance and Legislative Authorization*, 52 COLUM. L. REV. 781 (1952); Note, *Nuisance—As a "Taking" of Property*, 17 U. MIAMI L. REV. 537 (1963); Lloyd, *Noise As Nuisance*, 82 U. PA. L. REV. 567 (1934); Prosser *Private Action for Public Nuisance*, 52 VA. L. REV. 997 (1966).

124. See discussion in Note, *supra* note 79, at 117-18 & n.95; Spater, *supra* note 119, at 1381-96. Compare *Griggs v. County of Allegheny*, 369 U.S. 84 (1962), discussed in Hill, *supra* note 119.

125. See *TIME*, Oct. 6, 1967, at 67.

126. Conn, *supra* note 5, at 35. Concerning the damaging effects of the sonic boom on the human organism, see Nixon, *Human Response to the Sonic Boom*, at AAAS Symposium, *supra* note 22; Sontag, *Effects of Noise During Pregnancy Upon Fetal and Subsequent Adult Behavior*, at AAAS Symposium, *supra* note 22; see also N.Y. *Times*, Aug. 3, 1967, at 43, col. 2.

127. See U.S. DEP'T OF TRANSPORTATION, SUMMARY OF SONIC BOOM CLAIMS PRESENTED IN THE UNITED STATES TO THE AIR FORCE, FISCAL YEARS 1956-1967 (1967); Baxter, *The SST: From Walls to Harlem in Two Hours*, 21 STAN. L. REV. 1 (1968); Ormer, *Sonic Boom: Containment or Confrontation*, 34 J. AIR L. & COMMERCE 208 (1968); Note, *Sonic Booms—Ground Damage—Theories of Recovery*, 32 J. AIR L. & COMMERCE 596 (1966); Note, *Torts—Liability—Sonic Boom*, 36 J. AIR L. & COMMERCE 117 (1970); Katz, *The Function of Tort Liability in Technological Assessment*, 38 U. CONN. L. REV. 587, 655-61 (1969).

intersecting path usually hear two closely-spaced explosive sounds, known as the 'sonic boom,'¹²⁸ an explosive phenomena of the air caused by shock waves generated at supersonic flight speeds.¹²⁹ It is estimated that a single supersonic transport (SST) while flying across the nation will create a 50 to 80 mile wide noise carpet, or "bang zone," behind it that could startle as many as 20 million persons.¹³⁰ Furthermore, a fleet of 150 SST's in operation could cause an estimated \$1 million in damage every day to windows, plaster and other building materials.¹³¹ Unrestrained, the SST could change noise pollution from a local phenomenon to one of national and international proportions.¹³²

In an attempt to "afford present and future relief and protection to the public from unnecessary aircraft noise and sonic boom" the federal government passed the aircraft noise abatement law on July 21, 1968.¹³³ While this law will not solve all the problems involved in aircraft noise abatement, it can be an essential instrument in finding solutions and coordinating remedial research.¹³⁴

128. Beranek, *supra* note 94, at 20.

Measured outdoors, a typical sonic boom from a high-flying aircraft is a pressure wave that suddenly increases above normal atmospheric pressure by 0.5 to 2 pounds per square foot, then decreases somewhat more slowly to below normal atmospheric pressure by about the same amount, and finally jumps back to atmospheric pressure. The result is an N-shaped pressure wave less than half a second long. The lateral spread of the boom becomes greater as the altitude of the airplane increases, although the intensity of the boom decreases.

Id.

129. Roth, *Sonic Boom: A Definition and Some Legal Implications*, 25 J. AIR L. & COMMERCE 68 (1958).

130. N.Y. Times, June 18, 1967, § 1, at 60, col. 3 (statement by Harvard University physicist Dr. William Shurcliff, Director of the Citizen's League Against the Sonic Boom); Brower, *supra* note 17, at 19. See generally W. SHURCLIFF, *SST AND SONIC BOOM HANDBOOK* 50-56 (1970).

If the boom turns out to be seriously disturbing, by the time the prototype is built public resentment will collide head-on with the project. Some experts believe that by modifying the shape of the aircraft to reduce drag and hence the force of the boom, it can be kept within tolerable limits. If they prove wrong, there is little doubt that the SST will be barred from overland use. The economic consequences would be serious, but the public relations problem would be even worse. Either the technical problem will be solved, or the SST will be the first major casualty of the antinnoise movement.

Dreher, *supra* note 13, at 242. See also N.Y. Times, Sept. 28, 1969, § 4, at 8, cols. 7-8.

131. N.Y. Times, June 18, 1967, § 1, at 60, col. 3; see also Note, *supra* note 79, at 105. See *United States v. Gravelle*, 407 F.2d 964 (10th Cir. 1969), discussed in Note, *Torts—Liability—Sonic Boom*, *supra* note 125. Compare *Brown v. United States*, 230 F. Supp. 774 (D. Mass. 1964).

132. The application of international law to the SST is a serious question. Under existing treaties, overflights may be restricted or prohibited for reasons of public safety. See Huard, *The Roar, the Whine, the Boom and the Law: Some Legal Concerns About the SST*, 9 SANTA CLARA L. REV. 189 (1969); Hill, *supra* note 119, at 9-13; W. SHURCLIFF, *supra* note 130, at 108-10. There is also a wide variety of foreign laws that might be applicable, including doctrines of strict liability. See Mankiewicz, *Airport Noise—Compensation of Adjoining Landowners under French Law: A Report on a Case and Some Further Considerations*, 35 J. AIR L. & COMMERCE 238 (1969); Mankiewicz, *Some Aspects of Civil Law Regarding Nuisance and Damage Caused by Aircraft*, 28 J. AIR L. & COMMERCE 44 (1958). Clearly, some new international convention regarding the SST will be necessary.

133. 82 Stat. 395 (1968); discussed in S. REP. NO. 1353, 1968 U.S. CONG. & ADMIN. NEWS 2688-98.

134. Statement of the Sec'y of Transportation, Alan S. Boyd, on Noise Abatement,

In amending Title VI of the Federal Aviation Act of 1958,¹³⁵ the law gives the Administrator of the Federal Aviation Administration, after consultation with the Secretary of Transportation, the power to fix standards for the measurement of aircraft noise and regulations for noise control and abatement.¹³⁶ This law forms a part of an overall noise control program encompassing eight basic areas: aircraft noise research, aircraft operations, sonic boom research, airport and land use, natural environment, legal, structures, and human response.¹³⁷ At the time of enactment it was intended that all federal efforts in these areas would be coordinated through an Inter-Agency Aircraft Noise Abatement Program to be established by the Department of Transportation.¹³⁸

Before the Transportation & Aeronautics Subcomm. of the House Interstate & Foreign Commerce Comm., Wednesday, Nov. 15, 1967 (U.S. Dep't of Transportation Reprint), at 6, discussed in *N.Y. Times*, Nov. 11, 1967, at 1, col. 7.

135. 49 U.S.C. §§ 1421-30 (1964).

136. Public Law 90-411, 82 Stat. 395 (1968) reads as follows:

Sec. 611. (a) In order to afford present and future relief and protection to the public from unnecessary aircraft noise and sonic boom, the Administrator of the Federal Aviation Administration, after consultation with the Secretary of Transportation, shall prescribe and amend standards for the measurement of aircraft noise and sonic boom and shall prescribe and amend such rules and regulations as he may find necessary to provide for the control and abatement of aircraft noise and sonic boom, including the application of such standards, rules, and regulations in the issuance, amendment, modification, suspension, or revocation of any certificate authorized by this title.

(b) In prescribing and amending standards, rules, and regulations under this section, the Administrator shall—

(1) consider relevant available data relating to aircraft noise and sonic boom, including the results of research, development, testing, and evaluation activities conducted pursuant to this Act and the Department of Transportation Act;

(2) consult with such Federal, State, and interstate agencies as he deems appropriate;

(3) consider whether any proposed standard, rule, or regulation is consistent with the highest degree of safety in air commerce or air transportation in the public interest;

(4) consider whether any proposed standard, rule, or regulation is economically reasonable, technologically practicable, and appropriate for the particular type of aircraft, aircraft engine, appliance, or certificate to which it will apply; and

(5) consider the extent to which such standard, rule, or regulation will contribute to carrying out the purposes of this section.

(c) In any action to amend, modify, suspend, or revoke a certificate in which violation of aircraft noise or sonic boom standards, rules, or regulations is at issue, the certificate holder shall have the same notice and appeal rights as are contained in section 609, and in any appeal to the National Transportation Safety Board, the Board may amend, modify, or reverse the order of the Administrator if it finds that control or abatement of aircraft noise or sonic boom and the public interest do not require the affirmation of such order, or that such order is not consistent with safety in air commerce or air transportation.

In November 1969, the Federal Aviation Administration issued a regulation intended to reduce by half the amount of noise produced by jet aircraft landings and take-offs. "The new rule, which sets maximum noise levels, will at first apply only to the big new jets scheduled to appear at airports within the next year. But it is expected that similar regulations will be ordered for current jet planes." Bailey, *supra* note 5, at 132. For a discussion of a similar British attempt to reduce jet aircraft noise, see W. BURNS, *supra* note 4, at 214-41.

137. Statement of the Sec'y of Transportation, *supra* note 134, at 4.

138. *Id.*

III. AN OUTLINE FOR FUTURE RESEARCH

The purpose of this article has been to provide an introduction to the practical problems and damaging effects of noise as an environmental pollutant. The solutions to these problems will only be found with the backing of informed public opinion and proper laws and regulations. As in other areas of environmental control, law-making and enforcement is a vital factor in any anti-noise campaign. The following outline for future research is an attempt to point out various areas where information, research, and understanding are needed. This outline does not pretend to be definitive in scope; rather its purpose is to indicate the inadequacies of existing legal remedies, to suggest some possible legislative solutions concerning noise pollution, and to emphasize the polycentricity of our ecological crisis.

A. Existing Legal Remedies

The legal responses to noise pollution, as to any problem, may be characterized as private or public remedies. Broadly stated, private remedies consist of individual law suits; public remedies consist of regulatory and remedial legislation. While these categories are obviously not mutually exclusive—a law suit brought under a public nuisance statute is both a public and private remedy—they do provide a convenient framework in which to analyze the adequacy of existing legal remedies and to suggest needed research.

1. *Private Remedies.* Private law suits are usually based on public nuisance statutes, or on the common law of nuisance, or on the constitutional theory of the "taking" of property.¹³⁹ Generally, these solutions, based as they are on economic and political theories developed during a period less technological and less complex than today, have proved inadequate to solve the problems posed by present-day noise pollution. Public nuisance statutes were not written with unwanted noise in mind.¹⁴⁰ Moreover, other legal and social problems limit the usefulness of the common law nuisance suit. In an urban environment, the most offensive noise is often the conglomeration of sounds caused by an almost infinite number of unidentifiable sources. The burden of showing causation, combined with the important requirement that the nuisance impair the enjoyment of the plaintiff's own property, can prove an insurmountable barrier to recovery.¹⁴¹ Finally, the constitutional theory of "taking"

139. See generally citations in note 123 *supra*. See also Note, *The Cost-Internationalisation Case for Class Actions*, 21 *STAN. L. REV.* 383 (1969); cf. Juergensmeyer, *Control of Air Pollution Through the Assertion of Private Rights*, 1967 *Duke L.J.* 1126.

140. Of course, this defect is easily remedied by amendment. In the area of air pollution, the State Senate of Massachusetts is currently considering legislation which would allow private citizens to bring suit against anyone polluting the environment within that state. (Mass. Senate No. 907). The bill would allow judgments requiring that the pollution be stopped unless the costs of such action would threaten the existence of the polluting concern. See *N.Y. Times*, Feb. 4, 1970, at 19, col. 4.

141. Note, *supra* note 79, at 108.

of property requires governmental activity and does not reach the primary cause of noise pollution, that is private industry.

Certainly the damaging effects of noise as an environmental pollutant is a harm for which there should be an appropriate legal remedy. The physical damage to nerve receptors caused by excessive noise is not unlike that caused by a series of physical blows, and it may not be unreasonable to characterize excessive and deliberate public noise as a form of battery.¹⁴² Perhaps our developing law of the right of privacy, or, more appropriately, the right to sanity, should also encompass infringement by excessive noise.¹⁴³ These and other theories deserve exploration in the light of developing sociological and psychological studies of the effects of unwanted noise.¹⁴⁴

2. *Public Remedies.* While legislative solutions to noise pollution can be as broad and as varied as man's creativity, the response to date has fallen considerably short of that limit. Such laws as the federal aircraft noise abatement law¹⁴⁵ and the various schemes of limiting decibel levels have already

142. See generally citations in note 127 *supra*.

143. Under British common law, freedom from noise is considered essential to the full private enjoyment of a dwelling house. Noise alone may constitute a nuisance. *Crump v. Lambert*, L.R. 3 Eq. 409 (1867); *R. v. Smith*, 93 Eng. Rep. 795 (K.B. 1726). There are eight general principles relating to the common law of noise nuisance which have been established in the Chancery Division of the High Court, the Court of Appeal, and the House of Lords. These principles are: (1) *There must be material interference with property or personal comfort.* *Walter v. Selfe*, 64 Eng. Rep. 849 (Ch. 1851); *Betta v. Penge* U.D.C., [1942] 2 K.B. 154 (1942); *Rushmer v. Polsue & Alfieri Ltd.*, [1906] 1 Ch. 234 (1906). (2) *It is no defense for the defendant to show that he has taken all reasonable steps and care to prevent noise.* *Polsue & Alfieri Ltd. v. Rushmer*, [1907] A.C. 121, 122 (1907) (opinion of Lord Loreburn); *Halsey v. Esso Petroleum Co., Ltd.*, [1961] 1 W.L.R. 683 (Q.B. 1961). (3) *The noise need not be injurious to health.* *Vanderpant v. Mayfair Hotel Co.*, [1930] 1 Ch. 138 (1929); *Hampstead & Suburban Properties Ltd. v. Diomedous*, [1969] 1 Ch. 248 (1968). (4) *Temporary or transient noise will not generally be accepted as a nuisance.* *Andrae v. Selfridge & Co.*, [1938] Ch. 1 (1937); *Loeman v. Montagu*, E.R. 1677 (K.B. 1936). (5) *The courts do not seek to apply a fixed standard of comfort.* *Rushmer v. Polsue & Alfieri Ltd.*, [1906] 1 Ch. 234 (1906); *Colla v. Home & Colonial Stores Ltd.*, [1904] A.C. 179 (1904); *Halsey v. Esso Petroleum Co.*, [1961] 1 W.L.R. 683 (Q.B. 1961); *Sedleigh-Denfield v. O'Callaghan*, [1940] A.C. 880 (1940). (6) *It is no defense to show that the plaintiff came to the nuisance.* *Bliss v. Hall*, 132 Eng. Rep. 758 (C.P. 1838); *Sturges v. Bridgman*, 11 Ch. D. 852 (C.A. 1879). (7) *The courts will not interfere with building operations conducted in a reasonable manner.* *De Keyser's Royal Hotel Ltd. v. Spicer Bros. Ltd. & Minter*, 30 T.L.R. 257 (Ch. 1914) (dictum); *Andrae v. Selfridge & Co.*, [1938] Ch. 1 (1937); *Barrette v. Franki Compressed Pile Co.*, 2 D.L.R. 665 (1954). (8) *Malice may be a significant factor.* *Christie v. Davey*, [1893] 1 Ch. 316 (1892); *Hollywood Silver Fox Farm Ltd. v. Emmett*, [1936] 2 K.B.D. 468 (1936). For a discussion of these and other cases, see *THE LAW ON NOISE*, *supra* note 113, at 13-19; *Spater*, *supra* note 119, at 1396-97.

144. As of yet, the possibility that light may be an environmental pollutant has been largely ignored. The increasing ocular barrage of neon signs and flashing lights, however, may soon become of greater concern. There is some indication that excessive light, like excessive noise, may produce physical and psychological damage to the human organism. See, e.g., Gregory, *Visual Illusions*, *SCIENTIFIC AMERICAN*, Nov. 1968, at 66; Thomas, *Movements of the Eye*, *SCIENTIFIC AMERICAN*, Aug. 1968, at 88. Assuming that light can be an environmental pollutant, then the plethora of legal problems being raised concerning noise pollution will also arise concerning unwanted and obtrusive light, and there is little hope that nuisance laws, our "taking" of property laws, or our right of privacy laws will provide adequate remedies. The suggestions in text, therefore, apply also to the probable future problem of light pollution.

145. See notes 133-38 and accompanying text *supra*.

been mentioned.¹⁴⁶ Other, as yet untried, possibilities suggest themselves. While it would be difficult to tax noise polluters directly,¹⁴⁷ tax incentives on the state and federal level could be employed to encourage noise abatement programs. A corporation might be given the option to treat expenditures for noise pollution abatement as a business expense in order to receive an immediate tax write-off without having to depreciate such expenditures over several years.¹⁴⁸ Federal or state governments could also make low-interest loans to companies unable to secure funds from traditional sources. Such loans might be limited to companies presently in existence and presently causing noise pollution without the means of abating it.

The reason for the failure of legislatures to grapple fully with the very real problems of environmental pollution generally and noise pollution specifically is probably the lack of understanding of both the problem and its possible solutions. There remains much to be done in the area of comprehensive anti-noise regulation on city, state, and federal levels. Studies in comparative law might attempt to evaluate various legislative solutions to noise control. Moreover, legislators and legal counsel for legislative bodies must be familiar with the scientific intricacies of noise pollution as well as the legal intricacies of anti-noise legislation.

B. *The Possibilities for International Action*

As business and transportation integrate on an international level, noise pollution, as with air and water pollution, becomes a problem of international control. It is obvious that international treaties and conventions are needed to resolve international environmental conflicts. There is growing concern over our global environment which transcends purely national interests, and it is foreseeable that in the near future a body of transnational environmental law will be developed.

1. *Education and Communication.* On the international level, the educational approaches to our environmental problems can assume various forms. They include international conferences and symposia, demonstrations, and scholarships. Because of its polycentric effects, a comprehensive educational program on noise must include architects, engineers, factory inspectors, health organization representatives, industrialists, insurance executives, lawyers, medical doctors, machine designers and manufacturers, politicians, and trade-union officials. Help from the World Health Organization and the Inter-

146. See notes 106-17 and accompanying text *supra*. See also discussion of the new Walsh-Healy anti-noise regulations in note 93 *supra*.

147. However, in the area of traffic noise one effective abatement solution would be for local governments to limit the use of private motor vehicles by means of increased taxation on private vehicle ownership or by means of "city entrance" tolls for all private vehicles. The revenue obtained by taxing motorists who insist on driving and parking in congested, noise and air polluted inner-city areas could be used to improve and subsidize quieter public transportation.

148. See Int. Rev. Cons. of 1954 §§ 162, 167.

national Labor Organization should also be solicited. The aim of a comprehensive educational program should be to establish a body of experts in each country with a thorough knowledge of the subject, capable of stimulating the development of, and perhaps even directing, noise abatement activities.¹⁴⁹

Several international meetings devoted to noise have been held, but none of these have been planned specifically for public health and labor officials or for lawyers and legislators. Forums must be established where various national approaches to environmental problems can be compared. And the structure of model national and international noise control legislation is a matter of prime importance.

Among the legislative considerations are a general survey of the problem, including methods, instrumentation and standards; the definition of harmful noise levels by intensity, frequency and duration of exposure; specification of the persons, places and circumstances where the law applies; details of enforcement agencies and penalties for infringements; the principles and practice of engineering noise control; standards and methods for medical examination and action to be taken when noise-induced hearing loss is found; the qualifications of medical and engineering control staffs; and the types of ear-protector, with indications for their use.¹⁵⁰

2. *International Cooperation.* "Although increasing attention is being paid in many countries to health problems arising from noise, in only a few has there been any systematic attempt to assess the extent of the problem on a national scale."¹⁵¹ To date, no survey of noise pollution has been made on an international scale. However, there are indications of increased international cooperation in the area of environmental control. Plans are being drafted by a "task force" of specialists at the National Academy of Sciences for a global warning network on environmental changes which threaten life forms.¹⁵² The

149. A. BELL, *supra* note 4, at 111.

150. A. BELL, *supra* note 4, at 112. There is also a need for a wider and freer interchange of knowledge and increased communication between nations concerning our global environmental problems.

Apart from certain publications and periodicals of various organizations and societies, the International Occupational Safety and Health Information Centre of the ILO [International Labor Organization] has made a praiseworthy attempt to break down this isolation, but it has to cover a very wide field. A detailed up-to-date bibliography, including recommendations, standards and codes, would be most useful. . . . Since the volume of published material on acoustics is prodigious and spans many disciplines, there is considerable need for some international correlation and for the dissemination of sufficiently detailed abstracts on every aspect of the subject.

Id.

151. *Id.* at 113.

152. N.Y. Times, Feb. 12, 1970, at 1, cols. 6-7. See Kennan, *To Prevent a World Wasteland: A Proposal*, 48 FOREIGN AFFAIRS 401 (1970); N.Y. Times, Mar. 20, 1970, at 12, cols. 1-3 (city ed.).

The United States itself has taken a major step toward recognizing the desirability of encouraging international cooperation in preservation of world environment. Title I, section 102(E) of the National Environmental Policy Act of 1969 states:

The Congress authorizes and directs that, to the fullest extent possible: (1) the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act, and (2)

General Assembly of the United Nations has begun plans for an international conference in 1972 to explore the possibilities of cooperation to "eliminate the impairment of human environment" and to organize a worldwide defense against pollution.¹⁵³ In a similar attempt, the 22-nation Organization for Economic Cooperation and Development (OECD) has recently announced its intention to establish international tolerance limits for environmental pollutants.¹⁵⁴ Countries who exceed the limits would pay indemnities. Members of OECD include the United States, Canada, Japan, and 19 Western European countries. But the organization operates by voluntary compliance, and since there is no way of enforcing action on the independent governments, it cannot be assumed that all the members will adhere to the standards of environmental control.

C. Suggested Remedial Approaches

1. *Population Control.* Our exponential population explosion is the underlying cause for all our natural resources problems; there are simply too many people fighting over a limited supply of renewable and non-renewable resources.¹⁵⁵ The population problem is by no means limited to the "have-not" and underdeveloped nations. In November of 1967 the population of the United States was 200 million, by November 1969 it had exceeded 203 million and the average annual population growth rate was 1.3 percent (compared with 2.1 percent growth rate of underdeveloped nations and a world average population-growth rate of 1.8 percent).¹⁵⁶ Present projections put the United

all agencies of the Federal Government shall . . . (E) recognize the worldwide and long-range character of environmental problems and, where consistent with the foreign policy of the United States, lend appropriate support to initiatives, resolutions, and programs designed to maximize international cooperation in anticipating and preventing a decline in the quality of mankind's world environment.

Pub. L. No. 91-190, 83 Stat. 853 (1970). See also Sive, *supra* note 101.

153. This conference will be the First International Conference on the Human Environment. See N.Y. Times, Mar. 30, 1970, at 34, cols. 2-6; *id.*, Dec. 4, 1968, at 18, col. 1. An eight-day symposium on international environmental problems, sponsored by the Standing Committee on Environmental Disruption of the International Social Science Council (a United Nations auxiliary body), was held in Tokyo, Japan, on March 9-16, 1970. Forty-five delegates, including social scientists from 13 industrial countries, exchanged views on environmental pollution at this meeting. See N.Y. Times, Mar. 3, 1970, at 18, col. 5 (city ed.).

154. N.Y. Times, Feb. 19, 1970, at 11, col. 1.

155. Exponentially viewed, it will not be long before the earth's surface is packed solid with humans, the whole mass standing in individual refrigerated capsules on a thick layer of immovable automobiles. Babies will issue from this mass in a constant stream to stand on the shoulders of their parents. Suddenly, atomic fusion is achieved by the central computer which runs this horror and the mass dissolves into a small exploding universe of positive and negative electrons, neutrinos and antineutrinos, baryons and leptons, all moving apart at relativistic speeds. Before this, of course, we shall have all killed one another off by the exponential rise in the crime rate, by radiation diseases, and, lacking all exercise, by dying shortly after birth from the ultimate pollution, namely, the inability to move away from our own excrement.

Cowan, *Law and Technology: Uneasy Leaders of Modern Life*, 19 CASE W. RES. L. REV. 120, 122 (1967).

156. See TRICK, Nov. 24, 1967, at 70; N.Y. Times, Jan. 11, 1970, § 12, at 16, cols. 2-8;

States population at 308 million by the year 2000, and 374 million by the year 2015. The world population, which now stands at 3.5 billion, will be increased by at least another 3 billion in the next 30 years; and by 2050 the world population will exceed 15 billion unless extreme measures are taken.

One effective way of abating noise is to limit the number of noise-producers, beginning with the biggest noise-makers—the people themselves. Generally speaking, there are two approaches to controlling the population: first, by limiting the number of births, and second, by increasing the number of deaths through a comprehensive program of applied eugenics.¹⁵⁷ For moral and philosophical reasons, applied eugenics is not a viable solution; birth control is the only alternative.

The United States is becoming aware, as a nation, that a voluntary birth control program, as enunciated by President Nixon in July 1969, is an unrealistic and futile approach to the problem.¹⁵⁸ Direct controls, such as compulsory sterilization or abortion, would be too offensive. However, indirect economic incentives should be used to encourage the postponement of marriage and the limitation of births within marriage. The federal government should stop taxing single persons more heavily than married ones, eliminate tax exemptions for children, legalize abortions and sterilization, and levy a "child tax" on parents having more than one or two children. These suggestions are extreme, and yet the choice today is not between the ideal and the undesirable, but rather between the undesirable and the disastrous. If nothing is done, in 10 or 20 years, 50 to 100 million people may starve yearly.¹⁵⁹ Add to this the de-civilizing aspects of unwanted noise and the fact that the noise problem is becoming more acute with urbanization, and the undesirable aspects of the optimal alternatives become minimal.

2. *Expanding the "Decibel Limit" Concept.* As noted earlier, laws are being enacted on state and federal levels to define prohibited noise in terms of decibels, a measure of the intensity of sound.¹⁶⁰ Inherent in any anti-noise legislation based on the objective "decibel limit" concept are problems regarding standard-setting, enforcement, and constitutionality.

id., Nov. 24, 1968, § 4, at 5 (full-page ad sponsored by the Campaign to Check the Population Explosion).

157. See Golding, *Ethical Issues in Biological Engineering*, 15 U.C.L.A.L. Rev. 443 (1968); Grad, *Legislative Responses to the New Biology: Limits and Possibilities*, 15 U.C.L.A. L. Rev. 480 (1968); Wald, *The Evolution of Life and the Law*, 19 Case W. Res. L. Rev. 17 (1967); Hardin, *The Tragedy of the Commons: The Population Problem has no Technical Solution, It Requires a Fundamental Extension in Morality*, 162 SCIENCE 1243 (1968).

158. See, e.g., N.Y. Times, Oct. 5, 1969, at 51, col. 1; *id.*, Sept. 22, 1969, at 31, cols. 3-7.

159. N.Y. Times, Sept. 22, 1969, at 35, col. 4. See Wall Street J., Dec. 3, 1968, at 20, col. 4; N.Y. Times, Dec. 15, 1968, at 55, col. 1; Cleveland Plain Dealer, Sept. 4, 1968, at 20, cols. 1-2 (Report of the 19th Annual Meeting, American Institute of Biological Sciences, at Ohio State Univ., Sept. 4, 1968); Cleveland Plain Dealer, May 23, 1968, at 53, cols. 1-8. See generally P. EHRLICH, *THE POPULATION BOMB* (1968); P. EHRLICH & A. EHRLICH, *POPULATION, RESOURCES AND ENVIRONMENT: ISSUES IN HUMAN ECOLOGY* (1970).

160. See text accompanying notes 107-117 *supra*.

In measuring [noise], three characteristics of sound are significant. First, sound cannot be separated from its environment. Therefore, when a noise-meter measurement is made, the one sound being measured cannot be isolated, and the reading is affected by all the sounds in the area. A meter reading is also affected by the physical nature of the surroundings and by atmospheric conditions. Second, since sound intensity is a function of distance, a decibel reading is meaningful only when the distance from the noise source to the microphone is reported. Third, the decibel is a limited standard of measurement; i.e., it only registers the intensity of, or pressure created by, sound waves. Yet the offensiveness of noise varies with the frequency as well as with the intensity of sound. Thus, two noises which register the same number of decibels on a meter can sound louder or softer to the hearer, depending on pitch.¹⁶¹

The traditional type of anti-noise ordinance, which merely limits noise that is "excessive or unusual," may be attacked as unconstitutional on grounds of arbitrariness and vagueness. The new "decibel limit" laws, while establishing an objective standard and thus avoiding the vagueness problem, may provide additional problems of enforcement. It is almost impossible to conduct measurement tests on crowded highways because of noises from other vehicles and outside sources. More research is needed to determine the maximum noise levels for our modern urban environment, and the multitude of legal problems, outlined earlier, must be attacked before the decibel-limiting laws can become a truly viable solution.

3. *The Quieting Process.* In the area of noise pollution man has two alternatives: he can attempt to abate the unwanted and disruptive noise which pervades his habitat, or he can attempt to adjust and adapt to ever-increasing levels of noise. People become accustomed to a steady noise level or familiar sounds and tend to adjust themselves and their lives to these otherwise unwanted noises. Where convenient, chemical pollution—of the air, water, and food—noise pollution, and light pollution will be sufficiently controlled to prevent the kind of damaging effects that are immediately disabling and otherwise obvious. "Human beings will then tolerate without complaints concentrations of environmental pollutants (whatever their nature and origin) that they do not regard as a serious nuisance and that do not interrupt social and economic life."¹⁶²

However, man's ability to adapt to the "quality" deterioration of his environment has ominous implications. It is probable that continued exposure to even low levels of toxic agents and pervasive noise will eventually result in a great variety of delayed or latent pathological manifestations, creating physiological and psychological misery.¹⁶³ Behaviorally, a similar slow mental

161. Note, *supra* note 79, at 111-12 (footnotes omitted).

162. Dubos, *Adapting to Pollution*, 10 *SCIENTIST & CITIZEN* 1, 3, Jan.-Feb. 1968.

163. [T]he worst pathological effects of environmental pollutants will not be detected at the time of exposure; indeed they may not become evident until several decades later. In other words, society will become adjusted to levels of pollution sufficiently low not to have an immediate nuisance value,

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disintegration may result from noise-induced cognitive dissonance, thus giving impetus to what has been characterized as the mass societal neuroses. Insanity and irrationality scales are based on *current* relative deviations from what is considered "normal" behavior. The frightening aspect of slow societal trends towards what at an earlier time would have been considered irrational is that typically neurotic behavior of an earlier time may slowly become the normal and therefore acceptable level of behavior of a current or future stage of civilization or de-civilization. What is *degeneratus* at Time One may be accepted as *sapiens* at Time Two.

One way for our society to maintain its relative long-term sanity is to shift to a completely controlled environment. The elephants at Windsor Park Zoo in London have been fitted and are wearing noise-mufflers on their ears.¹⁶⁴ Soon those members of our society that can afford them will be wearing "space-helmets" which can filter out toxic impurities in the air and control the amount of noise that enters the wearer's head. Automobiles in the United States are already being fitted with air purification systems and are so constructed as to minimize the intrusion of outside traffic noises. "The ultimate long-term objective in environmental control should be to manage society in such a manner that these products of its activities can be recycled so as to become useful again, instead of being wasted and thereby added to environmental pollution."¹⁶⁵ Such futuristic city planners as Dr. Athelstan Spilhaus have already designed smokeless, noiseless, and trafficless cities with completely controlled environments and recycling systems.¹⁶⁶

CONCLUSION

It is obvious that laws and their just application could provide an effective coercive force for noise pollution abatement. Zoning is an important part of urban environmental planning, and it is applicable to noise pollution as well as such other environmental noxae as air and water pollution.¹⁶⁷ Legal compensation for hearing loss, mental disturbances, and invasion of one's right of quiet can also stimulate change in the noise level of our urban and industrial environments. Moreover, our civilization has the technology and resources to abate disturbances from unwanted noise. The ineffectiveness of present solutions to the quality deterioration of our habitat nevertheless indicates the need for re-evaluating both the methods used and the goals desired in environmental law.

but this apparent adaptation will eventually cause much pathological damage in the adult population and create large medical and social burdens.

Id.

164. N.Y. Times, Oct. 17, 1969, at 45, col. 8; *id.*, Sept. 28, 1969, at 80, cols. 4-7. 165. Dubos, *supra* note 162, at 6, citing Spilhaus, *The Experimental City, DAEDALUS*, Fall 1967, at 1129.

166. *See, e.g.*, N.Y. Times, Dec. 31, 1967, § 4, at 7, cols. 1-7; Spilhaus, *supra* note 165.

167. *See A. BELL, supra* note 4, at 103-105; C. W. Kosten, *Establishment of Zones and the Right For Quiet*, in *PROCEEDINGS OF THE SECOND INTERNATIONAL CONGRESS FOR NOISE ABATEMENT*, Salzburg, 1962.

Future environmental programs must be synoptic in their approach; no small facet of our complex cultural and technological system can be overlooked without incurring the hazards of latent dysfunctionality, the long-term disruptive and unwanted consequences of policies which attempt to solve polycentric problems and which otherwise, at least in the short-term, appear functionally viable solutions to immediate socio-economic problems.¹⁶⁸ Today many of the central ecological issues are essentially "legal" in nature, but the success of any legal policy for environmental control must ultimately be evaluated in terms of its long-term effects. To help make this evaluation, lawmakers must turn to the science of human ecology. Human ecology is still a young science where advances must "depend in part on mutual understanding and cooperation among social and natural scientists and humanists, and in part on the development of new methods for studying interacting processes in complex systems."¹⁶⁹ Lawyers and legal scholars can and must participate in this cooperation and development if legal solutions are to be successful.

The types of solutions necessary to avoid the impending environmental crisis will obviously place great strains upon basic political and economic axioms. Such concepts as zero population growth¹⁷⁰ and no "no-growth economy"¹⁷¹ require a shift in values away from quantitative and toward qualitative criteria. The most fundamental questions concerning our environmental crisis, therefore, are ethical ones: Will a national policy of negative population

168. "A problem is 'polycentric' when it involves a complex of decisions judgment upon each of which depends upon the judgment to be made upon each of the others." H. HART & A. SACKS, *THE LEGAL PROCESS: BASIC PROBLEMS IN THE MAKING AND APPLICATION OF LAW* 669 (tent. ed. 1958). For a legal example of latent dysfunctionality because of only unidimensional success in socially engineering a change in female mobilization in Central Asia, see Massell, *Law as an Instrument of Revolutionary Change in a Traditional Milieu: the Case of Soviet Central Asia*, 2 *LAW & SOC'Y REV.* 179, 221 (1968). See generally Alston, *Social Problems and Sociological Theory*, in *CONTEMPORARY SOCIAL PROBLEMS* 627 (R. Merion & R. Nisbet eds. 1961); FUNCTIONALISM IN THE SOCIAL SCIENCES, *THE STRENGTH AND LIMITS OF FUNCTIONALISM IN ANTHROPOLOGY, ECONOMICS, POLITICAL SCIENCE, AND SOCIOLOGY* (D. Martindale ed. 1965).

169. *N.Y. Times*, Jan. 12, 1970, at 75, cols. 3-6. See also Hardin, *supra* note 157.

170. A population rate growth of zero occurs when the number of births equals the number of deaths. Obviously, any program to reach this end, would clash with the "right to propagate." Compare *Skinner v. Oklahoma*, 316 U.S. 535 (1942), with *Buck v. Bell*, 274 U.S. 200 (1926). Professor Kingsley Davis, director of international population and urban research at the University of California and an advocate of the zero population growth concept, has stated that such a drastic reduction in births would necessarily require not only a change in existing laws but also absolute government regulation of the size of families—a concept that most nations have found impossible to accept. "In a more Orwellian guise," writes Davis, "such control might include pressure through limits on availability of housing, manipulation of inflation to force mothers to work, increased city congestion by the deliberate neglect of transit systems, and increased personal insecurity through rigged unemployment." *TIME*, Nov. 24, 1967, at 70. See Davis, *Population Policy: Will Current Programs Succeed?*, 158 *SCIENCE* 730 (1967).

171. The concept of a "no-growth economy" was discussed extensively at a recent meeting of the United States Commission for UNESCO held in San Francisco, Calif., on November 24-28, 1969. Basically, the concept means of repudiation of the tenet of bigness and perpetual economic expansion for the more optimal and qualitative concern for the ultimate consumer and the environment in general. See *N.Y. Times*, Nov. 28, 1969, at 26, cols. 2-5; *id.*, Jan. 11, 1970, ¶ 12, at 22, col. 1; *id.*, April 12, 1970, ¶ 1, at 40, cols. 3-4.

growth or of negative economic growth enhance the freedom of human beings as individuals, and will it enhance justice for all human beings as members of society? "These two ethical ideals of individual freedom and distributive justice often are, or seem to be, more or less incompatible. The task of law-givers throughout history, however, has been to strike a workable balance between them."¹⁷² So it must be as we prepare to meet our environmental crisis.

Environmental destruction has always been an aesthetic problem, but today it also involves the survival of mankind as a species. In the area of noise pollution, we are not dealing only with the maintenance of our own sanity, but also with the mental well-being of our children and our society as a free and rational civilization. To paraphrase Arthur Schopenhauer,¹⁷³ the amount of noise which any civilization can bear undisturbed stands in inverse proportion to its mental capacity, and may therefore be regarded as a pretty fair measure of it. Our ability to meet our environmental crisis may be a test of our intelligence and ultimately a test of the survival of our species.

172. N.Y. Times, Jan. 12, 1970, at 75, col. 6. (Article by Dr. Roger Revelle, Richard Saltonstall Professor of Population Policy and director of the Center for Population Studies at Harvard University).

173. A. SCHOPENHAUER, *On Noise*, in 2 THE WORLD AS WILL AND IDEA 199 (H. Haldane & J. Kemp trans. 1844).