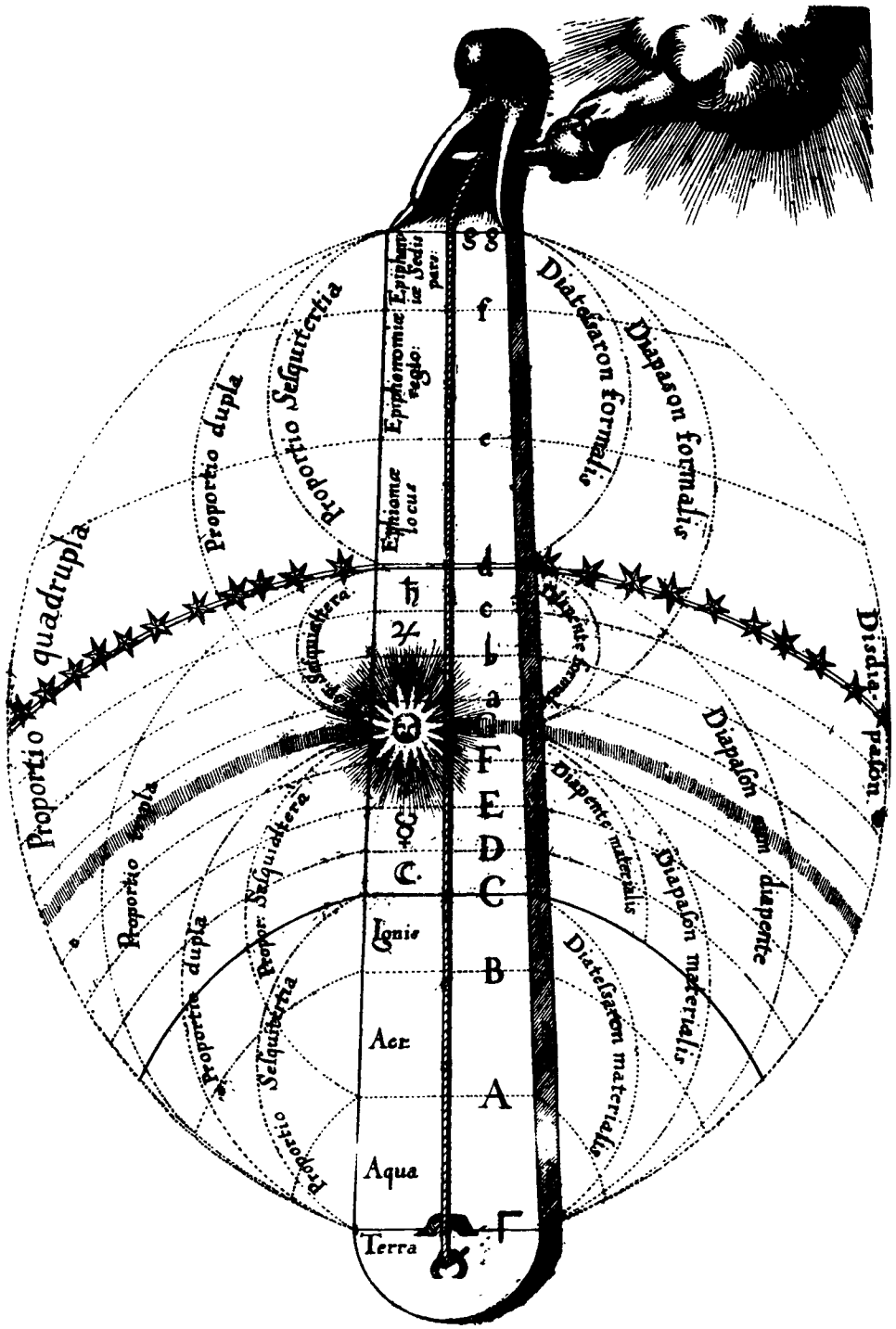

Our Sonic Environment and

THE SOUNDSCAPE

the Tuning of the World

R. MURRAY SCHAFER

- programmatic Statement -

cross-cultural + historical

aesthetic
legal
political

> who/what gets h

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Rochester, Vermont

Introduction

Now I will do nothing but listen . . .
I hear all sounds running together, combined,
fused or following,
Sounds of the city and sounds out of the city, sounds
of the day and night. . . .

WALT WHITMAN, *Song of Myself*

The soundscape of the world is changing. Modern man is beginning to inhabit a world with an acoustic environment radically different from any he has hitherto known. These new sounds, which differ in quality and intensity from those of the past, have alerted many researchers to the dangers of an indiscriminate and imperialistic spread of more and larger sounds into every corner of man's life. Noise pollution is now a world problem. It would seem that the world soundscape has reached an apex of vulgarity in our time, and many experts have predicted universal deafness as the ultimate consequence unless the problem can be brought quickly under control.

In various parts of the world important research is being undertaken in many independent areas of sonic studies: acoustics, psychoacoustics, otology, international noise abatement practices and procedures, communications and sound recording engineering (electroacoustics and electronic music), aural pattern perception and the structural analysis of language and music. These researches are related; each deals with aspects of the world soundscape. In one way or another researchers engaged on these various themes are asking the same question: what is the relationship between man and the sounds of his environment and what happens when

those sounds change? Soundscape studies attempt to unify these various researches.

Noise pollution results when man does not listen carefully. Noises are the sounds we have learned to ignore. Noise pollution today is being resisted by noise abatement. This is a negative approach. We must seek a way to make environmental acoustics a *positive* study program. Which sounds do we want to preserve, encourage, multiply? When we know this, the boring or destructive sounds will be conspicuous enough and we will know why we must eliminate them. Only a total appreciation of the acoustic environment can give us the resources for improving the orchestration of the world soundscape. For many years I have been fighting for ear cleaning in schools to eliminate audiometry in factories. Clairaudience not ear muffs. It is an idea over which I do not wish to exercise permanent ownership.*

The home territory of soundscape studies will be the middle ground between science, society and the arts. From acoustics and psychoacoustics we will learn about the physical properties of sound and the way sound is interpreted by the human brain. From society we will learn how man behaves with sounds and how sounds affect and change his behavior. From the arts, particularly music, we will learn how man creates ideal soundscapes for that other life, the life of the imagination and psychic reflection. From these studies we will begin to lay the foundations of a new interdiscipline—acoustic design.

From Industrial Design to Acoustic Design

The most important revolution is aesthetic education in the twentieth century was that accomplished by the Bauhaus, that celebrated German school of the twenties. Under the leadership of architect Walter Gropius, the Bauhaus collected some of the great painters and architects of the time (Klee, Kandinsky, Moholy-Nagy, Mies van der Rohe), together with craftsmen of distinction. At first it seemed disappointing that the graduates of this school did not rise to rival their mentors as artists. But the purpose of the school was different. From the interdisciplinary synergy of faculty skills a whole new study field was created, for the school invented the subject of industrial design. The Bauhaus brought aesthetics to machinery and mass production.

It devolves on us now to invent a subject which we might call acoustic design, an interdiscipline in which musicians, acousticians, psychologists, sociologists and others would study the world soundscape together in order to make intelligent recommendations for its improvement. This study would consist of documenting important features, of noting differences, parallels and trends, of collecting sounds threatened with extinction, of studying the effects of new sounds before they are indiscriminately

*For definitions of *ear cleaning, clairaudience* and other special terms, see the glossary.

released into the environment, of studying the rich symbolism sounds have for man and of studying human behavior patterns in different sonic environments in order to use these insights in planning future environments for man. Cross-cultural evidence from around the world must be carefully assembled and interpreted. New methods of educating the public to the importance of environmental sound must be devised. The final question will be: is the soundscape of the world an indeterminate composition over which we have no control, or are *we* its composers and performers, responsible for giving it form and beauty?

Orchestration Is a Musician's Business

Throughout this book I am going to treat the world as a macrocosmic musical composition. This is an unusual idea but I am going to nudge it forward relentlessly. The definition of music has undergone radical change in recent years. In one of the more contemporary definitions, John Cage has declared: "Music is sounds, sounds around us whether we're in or out of concert halls: cf. Thoreau." The reference is to Thoreau's *Walden,* where the author experiences in the sounds and sights of nature an inexhaustible entertainment.

To define music merely as *sounds* would have been unthinkable a few years ago, though today it is the more exclusive definitions that are proving unacceptable. Little by little throughout the twentieth century, all the conventional definitions of music have been exploded by the abundant activities of musicians themselves. First with the huge expansion of percussion instruments in our orchestras, many of which produce nonpitched and arhythmic sounds; then through the introduction of aleatoric procedures in which all attempts to organize the sounds of a composition rationally are surrendered to the "higher" laws of entropy; then through the opening-out of the time-and-space containers we call compositions and concert halls to allow the introduction of a whole new world of sounds outside them (in Cage's *4'33" Silence* we hear only the sounds external to the composition itself, which is merely one protracted caesura); then in the practices of *musique concrète,* which inserts any sound from the environment into a composition via tape; and finally in electronic music, which has revealed a whole gamut of new musical sounds, many of them related to industrial and electric technology in the world at large.

Today all sounds belong to a continuous field of possibilities lying *within the comprehensive dominion of music.* Behold the new orchestra: the sonic universe!

And the musicians: anyone and anything that sounds!

Dionysian Versus Apollonian Concepts of Music

It is easier to see the responsibilities of the acoustical engineer or the audiologist toward the world soundscape than to understand the precise manner

in which the contemporary musician is supposed to attach himself to this vast theme, so I am going to grind my axe on this point for a moment longer.

There are two basic ideas of what music is or ought to be. They may be seen most clearly in two Greek myths dealing with the origin of music. Pindar's twelfth Pythian Ode tells how the art of aulos playing was invented by Athena when, after the beheading of Medusa, she was touched by the heart-rending cries of Medusa's sisters and created a special *nomos* in their honor. In a Homeric hymn to Hermes an alternative origin is mentioned. The lyre is said to have been invented by Hermes when he surmised that the shell of the turtle, if used as a body of resonance, could produce sound.

In the first of these myths music arises as subjective emotion; in the second it arises with the discovery of sonic properties in the materials of the universe. These are the cornerstones on which all subsequent theories of music are founded. Characteristically the lyre is the instrument of Homer, of the epos, of serene contemplation of the universe; while the aulos (the reed oboe) is the instrument of exaltation and tragedy, the instrument of the dithyramb and of drama. The lyre is the instrument of Apollo, the aulos that of the Dionysian festivals. In the Dionysian myth, music is conceived as internal sound breaking forth from the human breast; in the Apollonian it is external sound, God-sent to remind us of the harmony of the universe. In the Apollonian view music is exact, serene, mathematical, associated with transcendental visions of Utopia and the Harmony of the Spheres. It is also the *anāhata* of Indian theorists. It is the basis of Pythagoras's speculations and those of the medieval theoreticians (where music was taught as a subject of the quadrivium, along with arithmetic, geometry and astronomy), as well as of Schoenberg's twelve-note method of composition. Its methods of exposition are number theories. It seeks to harmonize the world through acoustic design. In the Dionysian view music is irrational and subjective. It employs expressive devices: tempo fluctuations, dynamic shadings, tonal colorings. It is the music of the operatic stage, of *bel canto,* and its reedy voice can also be heard in Bach's Passions. Above all, it is the musical expression of the romantic artist, prevailing throughout the nineteenth century and on into the expressionism of the twentieth century. It also directs the training of the musician today.

Because the production of sounds is so much a subjective matter with modern man, the contemporary soundscape is notable for its dynamic hedonism. The research I am about to describe represents a reaffirmation of music as a search for the harmonizing influence of sounds in the world about us. In Robert Fludd's *Utruisque Cosmi Historia* there is an illustration entitled "The Tuning of the World" in which the earth forms the body of an instrument across which strings are stretched and are tuned by a divine hand. We must try once again to find the secret of that tuning.

Music, the Soundscape and Social Welfare

In Hermann Hesse's *The Glass Bead Game* there is an arresting idea. Hesse claims to be repeating a theory of the relationship between music and the state from an ancient Chinese source: "Therefore the music of a well-ordered age is calm and cheerful, and so is its government. The music of a restive age is excited and fierce, and its government is perverted. The music of a decaying state is sentimental and sad, and its government is imperiled."

Such a theory would suggest that the egalitarian and enlightened reign of Maria Theresa (for instance, as expressed in her unified criminal code of 1768) and the grace and balance of Mozart's music are not accidental. Or that the sentimental vagaries of Richard Strauss are perfectly consistent with the waning of the same Austro-Hungarian Empire. In Gustav Mahler we find, etched in an acid Jewish hand, marches and German dances of such sarcasm as to give us a presentiment of the political *dance macabre* soon to follow.

The thesis is also borne out well in tribal societies where, under the strict control of the flourishing community, music is tightly structured, while in detribalized areas the individual sings appallingly sentimental songs. Any ethnomusicologist will confirm this. There can be little doubt then that music is an indicator of the age, revealing, for those who know how to read its symptomatic messages, a means of fixing social and even political events.

For some time I have also believed that the general acoustic environment of a society can be read as an indicator of social conditions which produce it and may tell us much about the trending and evolution of that society. Throughout this book I will suggest many such relationships, and though it is probably in my nature to do this emphatically, I hope the reader may continue to regard the method as valid even if some of the equations seem disagreeable. They are all open to further testing.

The Notation of Soundscapes (Sonography)

The soundscape is any acoustic field of study. We may speak of a musical composition as a soundscape, or a radio program as a soundscape or an acoustic environment as a soundscape. We can isolate an acoustic environment as a field of study just as we can study the characteristics of a given landscape. However, it is less easy to formulate an exact impression of a soundscape than of a landscape. There is nothing in sonography corresponding to the instantaneous impression which photography can create. With a camera it is possible to catch the salient features of a visual panorama to create an impression that is immediately evident. The microphone does not operate this way. It samples details. It gives the close-up but nothing corresponding to aerial photography.

Similarly, while everyone has had some experience reading maps, and many can draw at least significant information from other schematics of the visual landscape, such as architects' drawings or geographers' contour maps, few can read the sophisticated charts used by phoneticians, acousticians or musicians. To give a totally convincing image of a soundscape would involve extraordinary skill and patience: thousands of recordings would have to be made; tens of thousands of measurements would have to be taken; and a new means of description would have to be devised.

A soundscape consists of events *heard* not objects *seen*. Beyond aural perception is the notation and photography of sound, which, being silent, presents certain problems that will be discussed in a special chapter in the Analysis section of the book. Through the misfortune of having to present data on silent pages, we will be forced to use some types of visual projection as well as musical notation, in advance of this discussion, and these will only be useful if they assist in opening ears and stimulating clairaudience.

We are also disadvantaged in the pursuit of a historical perspective. While we may have numerous photographs taken at different times, and before them drawings and maps to show us how a scene changed over the ages, we must make inferences as to the changes of the soundscape. We may know exactly how many new buildings went up in a given area in a decade or how the population has risen, but we do not know by how many decibels the ambient noise level may have risen for a comparable period of time. More than this, sounds may alter or disappear with scarcely a comment even from the most sensitive of historians. Thus, while we may utilize the techniques of modern recording and analysis to study contemporary soundscapes, for the foundation of historical perspectives, we will have to turn to earwitness accounts from literature and mythology, as well as to anthropological and historical records.

Earwitness The first part of the book will be particularly indebted to such accounts. I have always attempted to go directly to sources. Thus, a writer is trustworthy only when writing about sounds directly experienced and intimately known. Writing about other places and times usually results in counterfeit descriptions. To take an obvious instance, when Jonathan Swift describes Niagara Falls as making "a terrible squash" we know he never visited the place; but when Chateaubriand tells us that in 1791 he heard the roar of Niagara eight to ten miles away, he provides us with useful information about the ambient sound level, against which that of today could be measured. When a writer writes uncounterfeitingly about directly apprehended experiences, the ears may sometimes play tricks on the brain, as Erich Maria Remarque discovered in the trenches during the First World War when he heard shells exploding about him followed by the rumble of the distant guns that fired them. This aural illusion is perfectly accountable, for as the shells were traveling at supersonic speeds they arrived in advance of the sounds of their original detonations; but only someone trained in acoustics could have predicted this. *All Quiet on the Western Front* is convincing because the author was there. And we trust him when he describes other unusual sound events—for instance, the sounds made by dead bodies. "The days are hot and the dead lie unburied. We cannot fetch them all in, if we did we should not know what to do with them. The shells will bury them. Many have their bellies swollen up like balloons. They hiss, belch, and make movements. The gases in them make noises." William Faulkner also knew the noise of corpses, which he described as "little trickling bursts of secret and murmurous bubbling."

In such ways is the authenticity of the earwitness established. It is a special talent of novelists like Tolstoy, Thomas Hardy and Thomas Mann to have captured the soundscapes of their own places and times, and such descriptions constitute the best guide available in the reconstruction of soundscapes past.

Features of the Soundscape What the soundscape analyst must do first is to discover the significant features of the soundscape, those sounds which are important either because of their individuality, their numerousness or their domination. Ultimately some system or systems of generic classification will have to be devised, and this will be a subject for the third part of the book. For the first two parts it will be enough to categorize the main themes of a soundscape by distinguishing between what we call *keynote sounds, signals* and *soundmarks.* To these we might add *archetypal* sounds, those mysterious ancient sounds, often possessing felicitous symbolism, which we have inherited from remote antiquity or prehistory.

Keynote is a musical term; it is the note that identifies the key or tonality of a particular composition. It is the anchor or fundamental tone and although the material may modulate around it, often obscuring its importance, it is in reference to this point that everything else takes on its special meaning. Keynote sounds do not have to be listened to consciously; they are overheard but cannot be overlooked, for keynote sounds become listening habits in spite of themselves.

The psychologist of visual perception speaks of "figure" and "ground," the figure being that which is looked at while the ground exists only to give the figure its outline and mass. But the figure cannot exist without its ground; subtract it and the figure becomes shapeless, nonexistent. Even though keynote sounds may not always be heard consciously, the fact that they are ubiquitously there suggests the possibility of a deep and pervasive influence on our behavior and moods. The keynote sounds of a given place are important because they help to outline the character of men living among them.

The keynote sounds of a landscape are those created by its geography

and climate: water, wind, forests, plains, birds, insects and animals. Many of these sounds may possess archetypal significance; that is, they may have imprinted themselves so deeply on the people hearing them that life without them would be sensed as a distinct impoverishment. They may even affect the behavior or life style of a society, though for a discussion of this we will wait until the reader is more acquainted with the matter.

Signals are foreground sounds and they are listened to consciously. In terms of the psychologist, they are figure rather than ground. Any sound can be listened to consciously, and so any sound can become a figure or signal, but for the purposes of our community-oriented study we will confine ourselves to mentioning some of those signals which *must* be listened to because they constitute acoustic warning devices: bells, whistles, horns and sirens. Sound signals may often be organized into quite elaborate codes permitting messages of considerable complexity to be transmitted to those who can interpret them. Such, for instance, is the case with the *cor de chasse,* or train and ship whistles, as we shall discover.

The term *soundmark* is derived from landmark and refers to a community sound which is unique or possesses qualities which make it specially regarded or noticed by the people in that community. Once a soundmark has been identified, it deserves to be protected, for soundmarks make the acoustic life of the community unique. This is a subject to be taken up in Part Four of the book, where the principles of acoustic design will be discussed.

I will try to explain all other soundscape terminology as it is introduced. At the end of the book there is a short glossary of terms which are either neologistic or have been used idiosyncratically, in case doubt exists at any point in the text. I have tried not to use too many complex acoustical terms, though a knowledge of the fundamentals of acoustics and a familiarity with both musical theory and history is presupposed.

Ears and Clairaudience

We will not argue for the priority of the ear. In the West the ear gave way to the eye as the most important gatherer of information about the time of the Renaissance, with the development of the printing press and perspective painting. One of the most evident testaments of this change is the way in which we have come to imagine God. It was not until the Renaissance that God became portraiture. Previously he had been conceived as sound or vibration. In the Zoroastrian religion, the priest Srosh (representing the genius of hearing) stands between man and the pantheon of the gods, listening for the divine messages, which he transmits to humanity. *Samā* is the Sufi word for audition or listening. The followers of Jalal-ud-din Rumi worked themselves into a mystical trance by chanting and whirling in slow gyrations. Their dance is thought by some scholars to have represented the solar system, recalling also the deep-rooted mystical belief in an extraterrestrial music, a Music of the Spheres, which the attuned soul may at times hear. But these

exceptional powers of hearing, what I have called clairaudience, were not attained effortlessly. The poet Saadi says in one of his lyric poems:

> I will not say, my brothers, what *samā* is
> Before I know who the listener is.

Before the days of writing, in the days of prophets and epics, the sense of hearing was more vital than the sense of sight. The word of God, the history of the tribe and all other important information was heard, not seen. In parts of the world, the aural sense still tends to predominate.

> . . . rural Africans live largely in a world of sound—a world loaded with direct personal significance for the hearer—whereas the western European lives much more in a visual world which is on the whole indifferent to him. . . . Sounds lose much of this significance in western Europe, where man often develops, and must develop, a remarkable ability to disregard them. Whereas for Europeans, in general, "seeing is believing," for rural Africans reality seems to reside far more in what is heard and what is said. . . . Indeed, one is constrained to believe that the eye is regarded by many Africans less as a receiving organ than as an instrument of the will, the ear being the main receiving organ.

Marshall McLuhan has suggested that since the advent of electric culture we may be moving back to such a state again, and I think he is right. The very emergence of noise pollution as a topic of public concern testifies to the fact that modern man is at last becoming concerned to clean the sludge out of his ears and regain the talent for clairaudience—clean hearing.

A Special Sense

Touch is the most personal of the senses. Hearing and touch meet where the lower frequencies of audible sound pass over to tactile vibrations (at about 20 hertz). Hearing is a way of touching at a distance and the intimacy of the first sense is fused with sociability whenever people gather together to hear something special. Reading that sentence an ethnomusicologist noted: "All the ethnic groups I know well have in common their physical closeness and an incredible sense of rhythm. These two features seem to co-exist."

The sense of hearing cannot be closed off at will. There are no earlids. When we go to sleep, our perception of sound is the last door to close and it is also the first to open when we awaken. These facts have prompted McLuhan to write: "Terror is the normal state of any oral society for in it everything affects everything all the time."

The ear's only protection is an elaborate psychological mechanism for filtering out undesirable sound in order to concentrate on what is desirable. The eye points outward; the ear draws inward. It soaks up information. Wagner said: "To the eye appeals the outer man, the inner to the ear." The

ear is also an erotic orifice. Listening to beautiful sounds, for instance the sounds of music, is like the tongue of a lover in your ear. Of its own nature then, the ear demands that insouciant and distracting sounds would be stopped in order that it may concentrate on those which truly matter.

Ultimately, this book is about sounds that matter. In order to reveal them it may be necessary to rage against those which don't. In Parts One and Two I will take the reader on a long excursion of soundscapes through history, with a heavy concentration on those of the Western world, though I will try to incorporate material from other parts of the world whenever it has been obtainable. In Part Three the soundscape will be subjected to critical analysis in preparation for Part Four, where the principles of acoustic design will be outlined—at least as far as they can be determined at the moment.

All research into sound must conclude with silence—a thought which must await its development in the final chapters. But the reader will clearly sense that this idea also links the first part of the book to the last, thus uniting an undertaking that is above all lyrical in character.

One final warning. Although I will at times be treating aural perception and acoustics as if they were abstractable disciplines, I do not wish to forget that the ear is but one sense receptor among many. The time has come to move out of the laboratory into the field of the living environment. Soundscape studies do this. But even they must be integrated into that wider study of the total environment in this not yet best of all possible worlds.

PART ONE

First Soundscapes

In those days men's ears heard sounds
whose angelic purity cannot be conjured
up again by any amount of science or magic.

HERMAN HESSE, *The Glass Bead Game*

parts of a city) and the more persistent or characteristic sounds would be conspicuously revealed. Material for the events map would have to be limited to a specific period of time and would be gathered by walking over or around the selected location. (In the case of a city block this might be a single excursion around the block.)

Another example of aerial sonography, which brings value judgment into play, is that used by Michael Southworth in his article "The Sonic Environment of Cities." Here, after walking about the given territory freely, numerous observers were asked to comment on the sounds they heard, and the results of their observations were gathered together for display. The resulting map for a section of the downtown area of Boston shows where the acoustic designer could profitably begin his work.

Such diagrams are hints only, but perhaps this is all one should expect of sound visualization—a few hints which the ear can then follow up in its own way. It is easier for the inexperienced to absorb the salient information from them than from other types of graphic presentation, and that is to their advantage. The temptation of bad habits is no doubt still implicit in them, and it is for this reason that I conclude this chapter with a warning that no silent projection of a soundscape can ever be adequate. The first rule must always be: if you can't hear it, be suspicious.

NINE

Classification

Why classify? We classify information to discover similarities, contrasts and patterns. Like all techniques of analysis, this can only be justified if it leads to the improvement of perception, judgment and invention.

Consider the dictionary—words slashed from their contexts and arbitrarily arranged according to their attack sounds. Yet, when used properly, the dictionary can contribute to the improvement of the language and can even provide us with inchoate thoughts and aesthetic moments.

Any classification system or taxonomy is surrealistic; for surrealistic art also depends on bringing together incongruous or anachronistic facts, which nevertheless somehow snap together to illuminate new relationships. The first such artists were the encyclopedists, who brought together strange groups of animals, vegetables and ideas for surrealistic family portraits.

Sounds may be classified in several ways: according to their physical characteristics (acoustics) or the way in which they are perceived (psychoacoustics); according to their function and meaning (semiotics and semantics); or according to their emotional or affective qualities (aesthetics). While it has been customary to treat these classifications separately, there are obvious limitations to isolated studies. My colleague Barry Truax puts the problem this way:

> Disintegrating a total sound impression into its component parameters appears to be a skill that must be learned; and while it is probably one that is necessary for acoustic design, a soundscape cannot be understood merely by a catalogue of such parameters, even if that were possible, but only through the representations formed mentally that function as a basis for memory, comparison, grouping, variation and intelligibility.

In this chapter I introduce some cataloguing systems for sounds—those systems which seem to be useful for dealing with various aspects of the soundscape—and the chapter will end with a discussion of the chief problems remaining to be solved. These have principally to do with the integration of classification systems. If soundscape study is to develop as an interdiscipline, it will have to discover the missing interfaces and unite hitherto isolated studies in a bold new synergy. This task will not be accomplished by any one individual or group. It will only be accomplished by a new generation of artist-scientists trained in acoustic ecology and acoustic design.

Classification According to Physical Characteristics

Let us consider first a physical classification for sound objects. Pierre Schaeffer has spent much effort in devising such a system. Schaeffer's concern is not really with acoustics but rather with psychoacoustics. He has tried to work out a paradigm by which it would be possible to classify all musical sound objects for the purpose of helping students to perceive their significant features clearly. He calls this a "solfège des objets musicaux." In his book he presents the paradigm in a table covering four pages. There are nearly eighty blocks in the table and many are further subdivided in a dazzling performance of French complexity. It would be useless to reproduce this table without Schaeffer's several-hundred-page explanation and rationale. The paradigm, it should be stressed, only deals with single musical sound objects. To cope with compound or more extended sound sequences, either the chart would have to be extended or the sounds would have to be broken up.

The system may be useful for the detailed analysis of isolated sound objects, but I would like to suggest a modification of it which might help to render it more immediately useful for soundscape field work. The idea would be to have a card on which the salient information of a sound heard could be quickly notated to be compared with other sounds. In line with our desire to comprehend sounds as events as well as objects (p. 131), it would be useful first to give some general information on setting: the distance of the sound from the observer, its strength, whether it rises clearly out of the ambiance or is barely perceptible, whether the sound under consideration is semantically isolable or is part of a larger context or message, whether the general texture of the ambiance is similar or dissimilar, and whether environmental conditions produce reverberation, echo or other effects such as drift or displacement.*

A chart could then be produced consisting of the answers to these questions plus a general physical description of the sound itself. For this purpose we might use a two-dimensional approach. On the horizontal

*Drift (fading) or displacement (ambiguous point of origin) often result from atmospheric disturbances such as wind or rain.

plane we will preserve the three components of the sound object discussed in the last chapter: *attack, body* and *decay.* On the vertical plane we will determine the relative *duration, frequency* and *dynamics* of the sound, to which we will add observations on any momentary *internal fluctuations* (technically called transients) and two new features, derived from Pierre Schaeffer: *mass* and *grain.*

These last two need an explanation. Mass is related to frequency. While some sounds consist of clearly defined frequencies or pitches, others consist of inextricably entangled frequency clusters. Such may be the case with the broad-band noise of traffic, a flock of birds or the pounding of surf. Sometimes the sound will occupy a fairly narrow frequency band, sometimes it will be broad-band. The frequency spectrum of white noise will extend across the entire audio range (20 to 20,000 hertz), though it may also be filtered down to occupy a quite narrow range, at which point it may even appear "tuned," so that it could almost be hummed or whistled. The mass of a sound is where its bulk seems to lie. It is regarded as the predominant bandwidth of the sound. Indeed both mass and frequency are often present in environmental sounds and they may sometimes occupy quite independent positions in the spectrum, as would be the case with a sound consisting of a low throb and a high warble. As mass is composed of frequency clusters it can be indicated in the frequency block on our chart by drawing in its approximate shape.

Similarly, grain is a special type of internal fluctuation, one with a regular modulatory effect. It is accordingly contrasted with transients, which are isolated or irregular fluctuations. Grain gives texture; it roughens up the surface of the sound and its effects consist of tremolo (amplitude modulation) or vibrato (frequency modulation). The tempo of these modulations may vary from slow pulsing effects to rapid warbles of 16 to 20 impulses per second, at which time their grainy effect will be lost. Thus in grain, a tactile word, we again meet the convergence of the senses of touch and audition as individual impulses pass from their flicker state to smooth contours of pitched sound.

I have devised my own signs to indicate these various effects, as shown on the following chart.

SETTING

1. Estimated distance from observer:_____meters.
2. Estimated intensity of original sound:_____decibels.
3. Heard distinctly ( ), moderately distinctly ( ), or indistinctly ( ) over general ambiance.
4. Texture of ambiance: hi-fi ( ), lo-fi ( ), natural ( ), human ( ), technological ( ).
5. Isolated occurrence ( ), repeated ( ), or part of larger context or message ( ).
6. Environmental factors: no reverb. ( ), short reverb. ( ), long reverb. ( ), echo ( ), drift ( ), displacement ( ).

Physical Description	Attack	Body	Decay
Duration	*sudden* *moderate* *slow* *multiple*	*non-existent* *brief* *moderate* *long* *continuous*	*rapid* *moderate* *slow* *multiple*
Frequency/ Mass	*very high* *high* *midrange* *low* *very low*	→	→
Fluctuations/ Grain	*steady-state* *transient* *multiple transients* *rapid warble* *medium pulsation* *slow throb*	→	→
Dynamics	*ff very loud* *f loud* *mf moderately loud* *mp moderately soft* *p soft* *pp very soft* *f>p loud to soft* *p<f soft to loud*	→	→
	← Total Estimated Duration of Event →		

Description of a sound event.

The symbols employed in the chart are not intended as exact graphic analogues, but rather as a handy index of devices for students to use in notating the significant physical features of sounds quickly during ear training exercises. Comparison of the chief characteristics of different sounds might also reveal useful distinctive features for the study of sound symbolism. The chart is, of course, useful only for isolated sound events, but despite its limitations it will serve to throw many of the most conspicuous features of isolated sounds into relief, as we can show in some simple classifications.

BARK OF A DOG
1 20 meters
2 85 dB
3 Heard distinctly
4 Hi-fi, human
5 Repeated, irregular
6 Short reverb.

FOG HORN
1 1,000 meters
2 130 dB
3 Heard distinctly
4 Hi-fi, natural
5 Periodic repetition
6 Long reverb., displacement

TELEPHONE
1 3 meters
2 75 dB
3 Heard distinctly
4 Hi-fi, human
5 Repeated
6 No reverb.

SONG OF A BIRD
1 10 meters
2 60 dB
3 Heard distinctly
4 Hi-fi, natural
5 Part of extended song
6 No reverb.

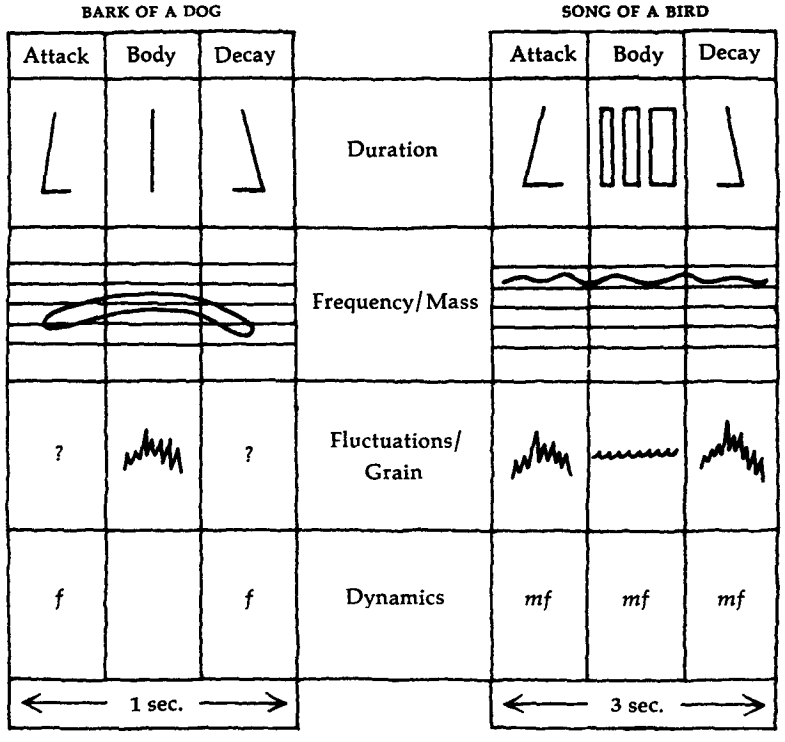
CHURCH BELL
1 500 meters
2 95 dB
3 Moderately distinctly
4 Lo-fi, technological
5 Periodic repetition
6 Med. reverb., drift

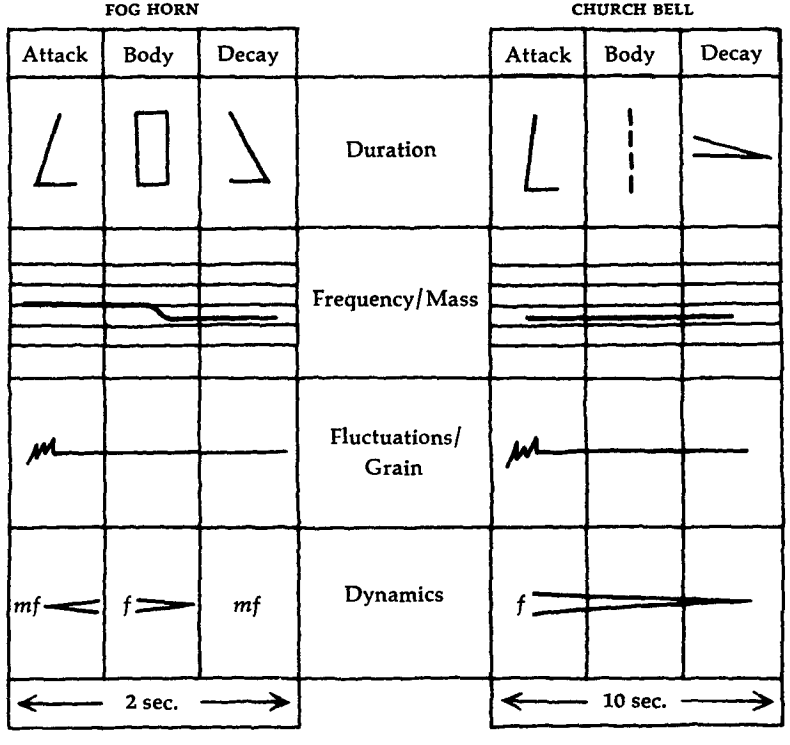
MOTORCYCLE
(passing on highway)
1 100 meters-pass-100 meters
2 90 dB
3 Indistinctly-distinctly-indistinctly
4 Lo-fi, technological
5 Isolated
6 No reverb.

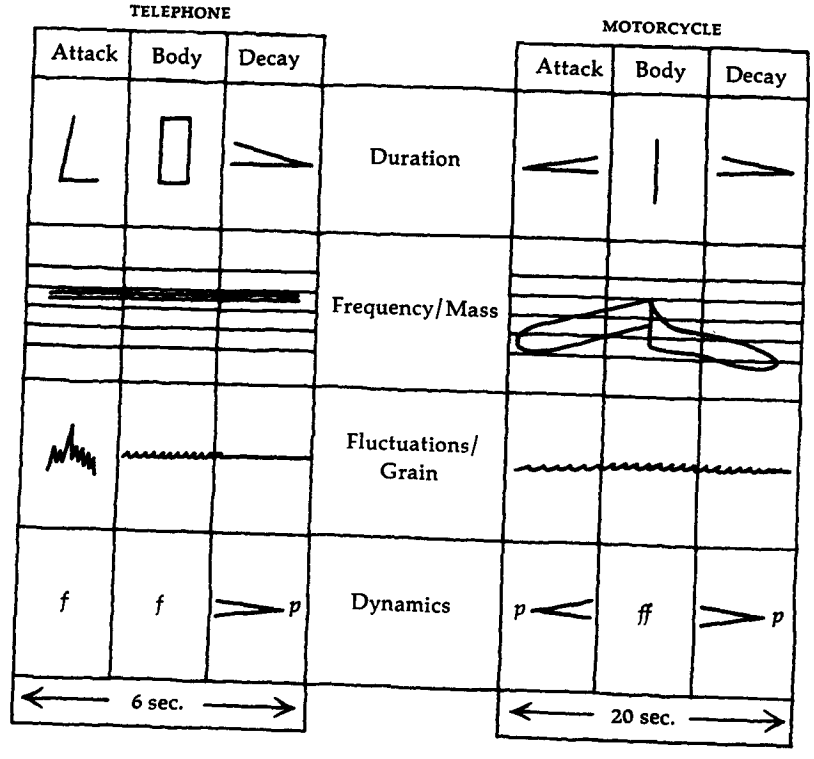
Classification According to Referential Aspects

We have next to consider a framework which will allow us to study the functions and meanings of sounds. Most sounds of the environment are produced by known objects and one of the most useful ways of cataloguing them is according to their referential aspects. But the system used to organize such a vast number of designations will be arbitrary, for no sound has objective meaning, and the observer will have specific cultural attitudes toward the subject. Even a library cataloguing system is stylized and reflects the interests and reading habits of librarians and library users. The only framework inclusive enough to embrace all man's undertakings with equal objectivity is the garbage dump.

The framework I present here is that which we have been using for one of the sub-projects of the World Soundscape Project, an extended card catalogue of descriptions of sound from literary, anthropological and historical documents. The only way we have of gathering information about the soundscapes of the past is through earwitness accounts by those who were there. From the first part of the book, the reader will know that I derived a great deal of information from this catalogue, which now numbers several thousand cards. The catalogue headings are arbitrary and have been built up empirically, but they do at least accommodate all descriptions we have encountered to date.







I. Natural Sounds

A. SOUNDS OF CREATION

B. SOUNDS OF APOCALYPSE

C. SOUNDS OF WATER
1. Oceans, Seas and Lakes
2. Rivers and Brooks
3. Rain
4. Ice and Snow
5. Steam
6. Fountains. Etc.

D. SOUNDS OF AIR
1. Wind
2. Storms and Hurricanes
3. Breezes
4. Thunder and Lightning. Etc.

E. SOUNDS OF EARTH
1. Earthquakes

2. Landslides and Avalanches
3. Mines
4. Caves and Tunnels
5. Rocks and Stones
6. Other Subterranean Vibrations
7. Trees
8. Other Vegetation

F. SOUNDS OF FIRE
1. Large Conflagrations
2. Volcanoes
3. Hearth and Camp Fires
4. Matches and Lighters
5. Candles
6. Gas Lamps
7. Oil Lamps
8. Torches
9. Festival or Ritual Fires

G. SOUNDS OF BIRDS
1. Sparrow
2. Pigeon
3. Killdeer
4. Hen
5. Owl
6. Lark. Etc.

H. SOUNDS OF ANIMALS
1. Horses
2. Cattle
3. Sheep
4. Dogs
5. Cats
6. Wolves
7. Gophers. Etc.

I. SOUNDS OF INSECTS
1. Flies
2. Mosquitoes
3. Bees
4. Crickets
5. Cicadas. Etc.

J. SOUNDS OF FISH AND SEA CREATURES
1. Whales
2. Porpoises
3. Turtles. Etc.

K. SOUNDS OF SEASONS
1. Spring

2. Summer
3. Fall
4. Winter

II. Human Sounds

A. SOUNDS OF THE VOICE
1. Speaking
2. Calling
3. Whispering
4. Crying
5. Screaming
6. Singing
7. Humming
8. Laughing
9. Coughing
10. Grunting
11. Groaning. Etc.

B. SOUNDS OF THE BODY
1. Heartbeat
2. Breathing
3. Footsteps
4. Hands (Clapping, Scratching, etc.)
5. Eating
6. Drinking
7. Evacuating
8. Lovemaking
9. Nervous System
10. Dream Sounds. Etc.

C. SOUNDS OF CLOTHING
1. Clothing
2. Pipe
3. Jewelry. Etc.

III. Sounds and Society

A. GENERAL DESCRIPTIONS OF RURAL SOUNDSCAPES
1. Britain and Europe
2. North America
3. Latin and South America
4. Middle East
5. Africa
6. Central Asia
7. Far East

B. TOWN SOUNDSCAPES
1. Britain and Europe. Etc.

C. CITY SOUNDSCAPES
1. Britain and Europe. Etc.

D. MARITIME SOUNDSCAPES
1. Ships
2. Boats
3. Ports
4. Shoreline. Etc.

E. DOMESTIC SOUNDSCAPES
1. Kitchen
2. Living Room and Hearth
3. Dining Room
4. Bedroom
5. Toilets
6. Doors
7. Windows and Shutters. Etc.

F. SOUNDS OF TRADES, PROFESSIONS AND LIVELIHOODS
1. Blacksmith
2. Miller
3. Carpenter
4. Tinsmith. Etc.

G. SOUNDS OF FACTORIES AND OFFICES
1. Shipyard
2. Sawmill
3. Bank
4. Newspaper

H. SOUNDS OF ENTERTAINMENTS
1. Sports Events
2. Radio and Television
3. Theater
4. Opera. Etc.

I. MUSIC
1. Musical Instruments
2. Street Music
3. House Music
4. Bands and Orchestras. Etc.

J. CEREMONIES AND FESTIVALS
1. Music
2. Fireworks
3. Parades. Etc.

K. PARKS AND GARDENS
1. Fountains
2. Concerts
3. Birds. Etc.

L. RELIGIOUS FESTIVALS
1. Ancient Greek
2. Byzantine
3. Roman Catholic
4. Tibetan. Etc.

IV. Mechanical Sounds

A. MACHINES (GENERAL DESCRIPTIONS)

B. INDUSTRIAL AND FACTORY EQUIPMENT (GENERAL DESCRIPTIONS)

C. TRANSPORTATION MACHINES (GENERAL DESCRIPTIONS)

D. WARFARE MACHINES (GENERAL DESCRIPTIONS)

E. TRAINS AND TROLLEYS
1. Steam Locomotives
2. Electric Locomotives
3. Diesel Locomotives
4. Shunting and Yard Sounds
5. Coach Sounds
6. Street Cars. Etc.

F. INTERNAL COMBUSTION ENGINES
1. Automobiles
2. Trucks
3. Motorcycles. Etc.

G. AIRCRAFT
1. Propeller Aircraft
2. Helicopters
3. Jets
4. Rockets. Etc.

H. CONSTRUCTION AND DEMOLITION EQUIPMENT
1. Compressors
2. Jackhammers
3. Drills
4. Bulldozers
5. Pile Drivers. Etc.

I. MECHANICAL TOOLS
1. Saws
2. Planes
3. Sanders. Etc.

J. VENTILATORS AND AIR-CONDITIONERS

K. INSTRUMENTS OF WAR AND DESTRUCTION

L. FARM MACHINERY
1. Threshing Machines
2. Binders

3. Tractors
4. Combines. Etc.

V. QUIET AND SILENCE

VI. SOUNDS AS INDICATORS

A. BELLS AND GONGS
1. Church
2. Clock
3. Animal. Etc.

B. HORNS AND WHISTLES
1. Traffic
2. Boats
3. Trains
4. Factory. Etc.

C. SOUNDS OF TIME
1. Clocks
2. Watches
3. Curfew
4. Watchmen. Etc.

D. TELEPHONES

E. (OTHER) WARNING SYSTEMS

F. (OTHER) SIGNALS OF PLEASURE

G. INDICATORS OF FUTURE OCCURRENCES

Other categories in this system include Mythological Sounds, the Sounds of Utopias and the Psychogenic Sounds of Dreams and Hallucinations. We also have categories for the last sounds heard before sleep, the first sounds heard on waking and acoustic experiences that connect with the other senses (synaesthesia). The final section of the catalogue indicates whether the reporter showed a particular attitude to the sound(s) described. Was it considered as a signal, as noise, as painful, pleasurable, etc.?

As sounds may function in a variety of contexts, all descriptive cards, indexed in this system, are cross-referenced generously. Thus any given sound may appear in several places, allowing us the opportunity to regard it from several angles or to compare it with others of a similar set.

Playing with this index is a splendid listening exercise. Let me pull out a few cards dealing with the sounds of footsteps and you will hear what I mean. I have already mentioned how the felt boots of *Doctor Zhivago*'s Russian winter seemed to "screech angrily" in the snow. Compare this with

- "the slap, slap of Gran's carpet slippers" (Emily Carr)
- "the clattering of the clogs" in Coketown (Dickens)
- "the loose tripping" feet of the Moroccans (Hans Ganz)

- "the violent clatter of . . . hobnailed wooden-soled shoes on the school flagstones" of a French provincial town (Alain-Fournier)
- "the flat, soft steps of the barefooted" (W. O. Mitchell)
- "the impish echoes of . . . footsteps" in the cloisters and quadrangles of Oxford (Thomas Hardy)
- or the way "the floor timbers boomed" under the strong rough feet of Beowulf.

By noting the date and place heard for every sound in the index, it is possible to measure historical changes in the world soundscape as well as social reactions to them. Then we can learn, for instance, that Virgil, Cicero and Lucretius did not like the sound of the saw, which was relatively new in their time (*c.* 70 B.C.), but that no one complained of factory noise until a hundred years after the outbreak of the Industrial Revolution (Dickens, Zola).

We can also note interesting proportional changes, for instance, between the number of descriptions of natural as against technological sounds. I am limiting the following observations to a period for which we have several hundred card samples. (It will be a long time before the index can be built up to a point where it may serve as a reliable indicator for all times and places.) Let us compare the nineteenth and twentieth centuries in Europe and America. We note that of all sound quotes from nineteeth-century Britain, 48 percent referred to natural sounds, while during the twentieth century, mentions of natural sounds had dropped to 28 percent. Among European authors the same decline is observed over the two centuries: 43 percent has dropped to 20 percent. Interestingly enough, this decline is not observed in North America (and our sample is very large here so that there can be little doubt about it); just over 50 percent of all quotes for both centuries refer to natural sounds. One might assume that North Americans are still closer to the natural environment, or at least have easier access to it than Europeans, for whom it definitely appears to be disappearing.

But the matter is not so simple. Our index does not show any corresponding increase in the perception of technological sounds throughout the same two centuries except for the period of the First World War, where the number increases sharply and then falls again. (The Second World War did not have a similar effect.) In fact, while the number of perceptions of technological sounds remains at the same level in Europe and Britain (about 35 percent of all observations), in America it actually declines!

But we also notice a decline in the number of times quiet and silence are evoked in literary descriptions. Of all descriptions in our file for the decades 1810–30, 19 percent mention quiet or silence; by 1870–90 mentions had dropped to 14 percent, and by 1940–60 to 9 percent. Thus it would appear that while writers are not consciously perceptive of the accumulation of technological sounds, at an unconscious level they are noticing the disappearance of quiet and silence. All this is perfectly consis-

tent with the keynote character of technological noise as I have been describing it.

In going through the cards, I am struck by the negative way in which silence is described by modern writers. There are few felicitous descriptions. Here are some of the modifiers employed by the most recent generation of writers: solemn, oppressive, deathlike, numb, weird, awful, gloomy, brooding, eternal, painful, lonely, heavy, despairing, stark, suspenseful, aching, alarming. The silence evoked by these words is rarely positive. It is not the silence of contentment or fulfillment. It is not the silence toward which this book is modulating.

Classification According to Aesthetic Qualities Sorting sounds according to their aesthetic qualities is probably the hardest of all types of classification. Sounds affect individuals differently and a single sound will often stimulate such a wide assortment of reactions that the researcher can easily become confused or dispirited. As a result, study of this problem has been thought too subjective to yield meaningful results. Out in the real world, however, aesthetic decisions of great importance for the changing soundscape are constantly being made, often arbitrarily. The Moozak industry does not hesitate to make decisions about what kinds of music the public is most likely to tolerate, nor did the aviation industry consult the public before it entered on the development of the supersonic-boom-producing aircraft. Acoustic engineers have also succeeded in introducing increasing amounts of white noise into modern buildings and have invoked aesthetics in the process, by referring to the results as "acoustic perfume."*

When such stupid decisions are being made almost daily, can the systematic study of soundscape aesthetics continue to be ignored? If the soundscape researcher is to assist in developing improved acoustic environments for the future, some kinds of tests will have to be developed for the measurement of aesthetic reactions to sounds. At first they should be kept as simple as possible.

Reduced to its simplest form, aesthetics is concerned with the contrast between the beautiful and the ugly, so a good place to begin might be by simply asking people to list their most favorite and least favorite sounds. It would be good to know which sounds were especially pleasing or displeasing to people of different cultures; for such catalogues, which might be called sound romances and sound phobias, would not only be of inestimable value in a consideration of sound symbolism, but could obviously give valuable directives for future soundscape design. Read in conjunction with noise abatement legislation, sound phobias would also give a good impression of whether a given by-law fairly reflected contemporary public opinion concerning undesirable sounds.

*Acoustical engineering firms have also already taken over our term *soundscape* and speak of "soundscaping an office" to refer to the same white-noise mesmerism.

One of the sub-projects of the World Soundscape Project has been to offer such a test in as many different countries as possible. We have tried to run the test in two parts. First, the subjects, who were mostly high school or university students, were simply asked to list the five sounds they liked best and the five they disliked most. Next we had them take a short soundwalk around their environment, and when they returned they were asked to repeat the assignment with specific reference to the sounds they had heard during the walk. I wish we had space to print the complete results to some of the tests, for they make a fascinating exercise in imagination and perception. Reducing them to the extent necessary for inclusion here can only be excused on the grounds that the general patterns produced support the hypothesis that different cultural groups have varying attitudes to environmental sounds.*

A few general observations are in order. First, climate and geography obviously influence likes and dislikes to some considerable extent. We note, for instance, that while in countries which touch the sea, ocean waves are well liked, in an inland country like Switzerland, the sounds of brooks and waterfalls are a much greater favorite. Where tropical storms may blow in suddenly from the sea, strong winds are disliked (New Zealand, Jamaica). It is also clear that reactions to nature are affected by the degree of proximity to the elements. As people move away from open-air living into city environments, their attitudes toward natural sounds become benign. Compare Canada, New Zealand and Jamaica. In the two former countries, the sounds of animals were scarcely ever found to be displeasing. But every one of the Jamaicans interviewed disliked one or more animals or birds—particularly at night. Hooting owls, croaking frogs, toads and lizards were mentioned frequently. Barking dogs and grunting pigs were also strong dislikes. The animal sound most universally liked was the purring of a cat.

While the Jamaicans had no attitude concerning machine sounds, these were strongly disliked in Canada, Switzerland and New Zealand. Jamaicans also approved of aircraft while the other nationalities did not. For all nations except Jamaica traffic noise was especially objectionable. There can be little doubt about this. From the present as well as similar tests we have run with smaller groups of other nationalities, it appears clear that technological sounds are strongly disliked in technologically advanced countries, while they may indeed be liked in parts of the world where they are more novel. I stress this finding because in attempts to confront the contemporary noise pollution problem I have frequently heard politicians and other opponents argue that we represent a minority, citing the case of the mechanic who enjoys a good motor or the pilot who enjoys listening to aircraft. But there can be no doubt that such attitudes form a small minority, at least among young people.

Among other striking cultural differences is the intense fondness of the Swiss for bells, while in other countries they are scarcely mentioned.

*See Appendix II for International Sound Preference Survey.

On the phobia side, the dentist's drill elicits some mention in all countries except Jamaica (where it is less familar?). But the sound of fingernails or chalk on slate is mentioned as a sound phobia in all countries, a matter to which we will return presently.

This test needs to be followed by others, more detailed. We need to find out with greater precision how and why different groups of people react differently to sounds. To what extent are the differences cultural? To what extent individual? To what extent are sounds perceived at all? The field is open for some intelligent testing on an international scale.

Sound Contexts Throughout this chapter sound has been considered in separate compartments. Acoustics and psychoacoustics have been dissociated from semantics and aesthetics. It is traditional to divide the study of sound in this way. The physicist and engineer study acoustics; the psychologist and physiologist study psychoacoustics; the linguist and communications specialist study semantics, while to the poet and composer is left the domain of aesthetics.

ACOUSTICS	PSYCHOACOUSTICS	SEMANTICS	AESTHETICS
What sounds are	How they are perceived	What they mean	If they appeal
Physicist Engineer	Physiologist Psychologist	Linguist Communicator	Poet Composer

But this will not do. Too many misunderstandings and distortions lie along the edges separating these compartments. Interfaces are missing. Let us follow through a few specimen sounds to understand the nature of the problem. Consider first the sample pair of sounds in the following table.

SAMPLE SOUND	ACOUSTICS	PSYCHOACOUSTICS	SEMANTICS	AESTHETICS
Alarm bell	Sharp attack; steady-state with rapid amplitude modulation; narrow band noise on center frequency of 6,000 hertz; 85 decibels	Sudden arousal; continuous warble; high pitch; loud; decreasing interest; subject to auditory fatigue; sensitive pitch area	Alarm signal	Frightening, unpleasant, ugly
Flute music	Interrupted modulations of shifting frequency; near pure	Active patterned sound of shifting pitch;	Sonata by J. S. Bach; inducement to sit down and listen	Musical, pleasant, beautiful

SAMPLE SOUND	ACOUSTICS	PSYCHOACOUSTICS	SEMANTICS	AESTHETICS
Flute music (*continued*)	tones with some presence of even harmonics; varying between 500 and 2,000 hertz; 60 decibels	melodic contour; pure tones; highish register; moderately loud		

There are apparently no problems here. The two sounds are physically quite different and they accordingly have different meanings and draw forth different aesthetic responses. But even here the context can produce divergent effects. Thus, without altering the physical parameters of the sound, the meaning of the alarm bell could change if, for instance, it was only being tested. Knowing this, the listener would not be impelled to drop everything and run. Or, without changing the physical character of Bach's flute sonata, the aesthetic effect could be quite different if the listener did not like the flute or did not care for the music of J. S. Bach.

When we get discrepancies such as these, our reliance on automatic across-the-board equations falters, and we become aware of the fallacy that a given sound will invariably produce a given effect. Let us consider some more discrepancies. Two sounds may be identical but have different meanings and aesthetic effects:

SAMPLE SOUND	ACOUSTICS	SEMANTICS	AESTHETICS
Car horn	Steady-state, reiterative; predominant frequency of 512 hertz; 90 decibels	Get out of my way!	Annoying, unpleasant
		I've just been married!	Festive, exciting

Or two sounds with quite different physical characteristics may have the same meaning and aesthetic effect:

SAMPLE SOUND	ACOUSTICS	SEMANTICS	AESTHETICS
I say, "Pierre, how are you?"	My crimpled baritone	Pierre is called.	Friendship
Margaret says, "Bonjour, Pierre."	Margaret's glorious contralto	Pierre is called.	Friendship

But supposing we are ringing up the Prime Minister of Canada, whose name is also Pierre. Margaret is his wife. I am not. Everything else remains the same, but the aesthetic effect is different:

SAMPLE SOUND	ACOUSTICS	SEMANTICS	AESTHETICS
Ditto	Ditto	Ditto	Annoyance
Ditto	Ditto	Ditto	Pleasure

Now consider the following pair of sounds:

SAMPLE SOUND	ACOUSTICS	PSYCHOACOUSTICS	SEMANTICS	AESTHETICS
Kettle boiling	Colored noise; narrow band (8,000+ hertz) steady-state; 60 decibels	High-pitched hissing sound	Tea is on.	Pleasing
Snake hissing	Colored noise; narrow band (7,500+ hertz); steady-state (occasionally intermittent); 55 decibels	High-pitched hissing sound	Snake preparing to attack	Frightening

Here two sounds with similar, but not identical, physical characteristics appear to be identical in perception, but nevertheless cause no confusion in meaning and accordingly have different aesthetic effects. Their contexts keep them clear. But when they are removed from their contexts in tape recordings, they may quickly lose their identities. Nor is the ear acute enough to be able to distinguish whatever differences may exist in their physical structure. Then the kettle may become the snake or either may become a green log on a fire.

It has always surprised me how even quite a common sound can be completely mistaken by listeners, dramatically affecting their attitudes toward it. For instance an electric coffee grinder was described as "hideous," "frightening," "menacing" by a group after listening to it on tape, though as soon as it was identified their attitudes immediately mollified.

There is one celebrated sound which seems to epitomize the interface dilemma which I have been describing: the sound of chalk or fingernails on slate. We have shown that it is an international sound phobia. Yet physical analysis fails to reveal why it should send cold shivers up the spine. It is not extraordinarily high or loud. It is not accompanied by any hurtful action. It does not even designate anything in particular. No single discipline then is capable of accounting for its remarkable effect. When sound enigmas like this are explained—and not until then—we will know that the missing interfaces are at last falling into place.

TEN

Perception

It is not surprising, noting the visual bias of modern Western culture, that the psychology of aural perception has been comparatively neglected. Much of the work done has been concerned with binaural hearing and sound localization—which also has largely to do with space. Quite a lot of work has been done on masking (covering one sound by another) and some has been done on auditory fatigue (the effect of prolonged exposure to the same sound); but taken as a whole such researches leave us a long way from our goal, which would be *to determine in what significant ways individuals and societies of various historical eras listen differently.*

Thus it is inconceivable that a music or soundscape historian should get quite the same thrill out of the preparatory work the laboratories have provided as that which has stimulated art historians such as Rudolph Arnheim and E. H. Gombrich, whose work owes such a heavy debt to research in the psychology of visual perception. In the work of men like these it has begun to be possible to comprehend the history of vision, at least in the Western world. The soundscape historian can only speculate tentatively on the nature and causes of perceptual changes in listening habits and hope that psychologist friends may respond to the need for more experimental study.

Figure and Ground

It is indeed possible that some terms employed in visual perception may have equivalents in aural perception. At least they are probably worth careful examination. For instance, a phenomenon like irradiation—by which a brightly illuminated area seems to spread—does seem to have an analogy in that a loud sound will appear to

FOURTEEN

Listening

Acoustic Ecology and Acoustic Design The most important revolution in aesthetic education in the twentieth century was that accomplished by the Bauhaus. Many famous painters taught at the Bauhaus, but the students did not become famous painters, for the purpose of the school was different. By bringing together the fine arts and the industrial crafts, the Bauhaus *invented* the whole new subject of industrial design.

An equivalent revolution is now called for among the various fields of sonic studies. This revolution will consist of a unification of those disciplines concerned with the science of sound and those concerned with the art of sound. The result will be the development of the interdisciplines acoustic ecology and acoustic design.

Ecology is the study of the relationship between living organisms and their environment. Acoustic ecology is therefore the study of sounds in relationship to life and society. This cannot be accomplished by remaining in the laboratory. It can only be accomplished by considering on location the effects of the acoustic environment on the creatures living in it. The whole of this book up to the present chapter has had acoustic ecology as its theme, for it is the basic study which must precede acoustic design.

The best way to comprehend what I mean by acoustic design is to regard the soundscape of the world as a huge musical composition, unfolding around us ceaselessly. We are simultaneously its audience, its performers and its composers. Which sounds do we want to preserve, encourage, multiply? When we know this, the boring or destructive sounds will become conspicuous enough and we will know why we must eliminate them. Only a total appreciation of the acoustic environment can give us

the resources for improving the orchestration of the soundscape. Acoustic design is not merely a matter for acoustic engineers. It is a task requiring the energies of many people: professionals, amateurs, young people—anyone with good ears; for the universal concert is always in progress, and seats in the auditorium are free.

Acoustic design should never become design control from above. It is rather a matter of the retrieval of a *significant aural culture,* and that is a task for everyone. Nevertheless, in provoking this design concern, certain figures have important roles to play. In particular, composers, who have too long remained aloof from society, must now return to give assistance to human navigation. Composers are architects of sounds. They have had the most experience devising effects to bring about specific listener responses, and the best of them are masters at modulating the flow of these effects to provide complex and variable experiences which some philosophers have described as a metaphor for the life-experience itself.

But composers are not yet ready to assume the leadership role in reorchestrating the world environment. Some are still devoting themselves with waspish bitterness to a Parnassus of two or three. Others, sensing the importance of the larger theme of environmental reconstruction, are fumbling ineptly with it, betrayed by inexperience or hedonism. I recall meeting a young Australian composer who told me he had given up writing music after becoming infatuated with the beauties of cricket song. But when asked how, when and why crickets sang, he couldn't say; he just liked taping them and playing them back to large audiences. I told him: a composer owes it to the cricket to know such things. Craftsmanship is knowing all about the material one works with. Here is where the composer becomes biologist, physiologist—himself cricket.

The true acoustic designer must thoroughly understand the environment he is tackling; he must have training in acoustics, psychology, sociology, music, and a great deal more besides, as the occasion demands. There are no schools where such training is possible, but their creation cannot long be delayed, for as the soundscape slumps into a lo-fi state, the wired background music promoters are already commandeering acoustic design as a *bellezza* business.

The Modules for Acoustic Design

A module is a basic unit to be used as a guide for measuring. In the human environment it is the human being who forms the basic module. When architects organize spaces for human habitation, they use the human anatomy as their guide. The doorframe accommodates the human frame, the stair the human foot, the ceiling the human stretch. To demonstrate the binding relationship between architectural space and the human beings for whom it is created, Le Corbusier made a man with an upstretched arm his modular symbol and imprinted it on all his buildings.

The basic modules for measuring the acoustic environment are the human ear and the human voice. Throughout this book I have been thumping the theory that the only way we can comprehend extrahuman sounds is in relationship to sensing and producing sounds of our own. To know the world by experience is the first desideratum. Beyond that lie the wonderful exercises of the imagination—the music of the stones, the music of the dead, the Music of the Spheres—but they are only comprehensible by comparison with what we can hear or echo back ourselves.

We know a good deal about the behavior and tolerances of the ear and the voice. When, as today, environmental sound reaches such proportions that human vocal sounds are masked or overwhelmed, we have produced an inhuman environment. When sounds are forced on the ear which may endanger it physically or debilitate it psychologically, we have produced an inhuman environment.

There are few sounds in nature that interfere with our ability to communicate vocally and almost none that in any way pose a threat to the hearing apparatus. It is interesting to consider, for instance, that while the naked voice can be raised to quite a loud level (say about 80 decibels at a distance of a few feet), it cannot be raised in normal human intercourse to a point where it might endanger the ear (over 90 decibels).* In discriminating against low-frequency sounds, the human ear conveniently filters out deep body sounds such as brainwaves and the movement of blood in our veins. Also, the human hearing threshold has been set conveniently just beyond a level which would introduce a continuous recital of air molecules crashing together. The quiet efficiency of all body movements is another stroke of genius. And has anyone speculated on how inconvenient it would be if the ears, instead of being placed on the side of the head, had been placed next to the mouth, where they would have been subjected to close-quarter vocal garrulity and soup-slurping?

God was a first-rate acoustical engineer. We have been more inept in the design of our machines. For noise represents escaped energy. The perfect machine would be a silent machine: all energy used efficiently. The human anatomy, therefore, is the best machine we know and it ought to be our model in terms of engineering perfection.

Contrary to these simple lessons in acoustic ecology, we live in a time when human sound is often suppressed while mechanical jabberware is encouraged. While some of our students were measuring the noise of a downtown construction site in Vancouver, they were entertained by some members of the Hare Krishna sect, an Eastern movement dedicated to the worship of God with song in the streets. In 1971 this group was arrested under the noise abatement by-law, was convicted, appealed the conviction and lost the appeal. This by-law expressly excludes all noise made by construction and demolition equipment—though the students discovered

*From Scarborough, England, comes the news that a British fisherman won what was billed as the World Shouting Competition by raising his voice to 3 decibels at a distance of three meters.

that such noise often ran as high as 90 decibels at precisely the point where the Hare Krishna singers were arrested. True, singing or hawking in the streets is frequently annoying; but when it disappears, so does humanism.

Ear Cleaning The first task of the acoustic designer is to learn how to listen. *Ear cleaning* is the expression we use here. Many exercises can be devised to help cleanse the ears, but the most important at first are those which teach the listener to respect silence. This is especially important in a busy, nervous society. An exercise we often give our students is to declare a moratorium on speech for a full day. Stop making sounds for a while and eavesdrop on those made by others. It is a challenging and even frightening exercise and not everyone can accomplish it, but those who do speak of it afterward as a special event in their lives.

On other occasions we prepare for listening experiences with elaborate relaxation or concentration exercises. It may take an hour of preparation in order to be able to listen clairaudiently to the next.

Sometimes it is useful to seek out one sound with particular characteristics. For instance, try to find a sound with a rising starting pitch, or one that consists of a series of short nonperiodic bursts; try to find one that makes a dull thud followed by a high twitter; or one that combines a buzz and a squeak. Such sounds will not be found in every environment, of course, but the listener will be forced to inspect every sound carefully in the search. There are numerous other exercises like this in my music education booklets.*

Sometimes it is useful to document only single sounds in the soundscape in order to get a better impression of their frequency and patterns of occurrence. Car horns, motorcycles, airplanes can be counted by anyone with ears, and it is surprising how discriminating one becomes when isolating one sound from many. Social surveys can also be conducted simultaneously in which citizens are asked to estimate the number of such sounds they imagine occur over a given time period. In repeated exercises of this sort, we have discovered that the imagined traffic is much below the actual volume—often as much as 90 percent. For instance, when we asked West Vancouverites to estimate the number of seaplane flights over their homes in 1969, the average estimate was 8 per day compared with an actual count of 65. In 1973 the same experiment was repeated in the same area. This time the average estimate had risen to 16, but the actual count had also risen to 106. Exercises like this extend ear cleaning to a wider public. To be reminded of a sound is to think about it; to miss it is to listen for it next time.

The tape recorder can be a useful adjunct to the ear. Trying to isolate a sound for high-fidelity recording always reminds the ear of details in the

* *The Composer in the Classroom, Ear Cleaning, The New Soundscape, When Words Sing,* Toronto, 1965, etc.

soundscape that have previously gone unnoticed. Sound events and soundscapes can be recorded for later analysis and if merited can be permanently stored for the future. It goes without saying that only the best tape recorders should be used for this purpose. When we record sounds we provide them with cards giving the following information:

No._____ Title:_____

Date recorded:_____ Name of recordist:_____

Equipment used:_____ 7½ i.p.s. mono_____

_____ 15 i.p.s. stereo_____

_____ other quadraphonic_____

Place recorded:_____ Distance from source:_____

Atmospheric conditions:_____ Intensity:____ dBA

____ dBB

____ dBC

Historical observations:_____

Sociological observations:_____

Additional observations:_____

Names, ages, occupations and addresses of local people interviewed:

_____

Sounds threatened with extinction should be noted in particular and should be recorded before they disappear. The vanishing sound object should be treated as an important historical artifact, for a carefully recorded archive of disappearing sounds could one day be of great value. We are currently building such an archive. Our list is very extensive, but a few examples will suffice for illustration.

The ringing of old cash registers.
Clothes being washed on a washboard.
Butter being churned.
Razors being stropped.
Kerosene lamps.
The squeak of leather saddlebags.
Hand coffee grinders.
Rattling milk cans on horse-drawn vehicles.
Heavy doors being clanked shut and bolted.
School hand bells.
Wooden rocking chairs on wooden floors.
The quiet explosion of old cameras.
Hand-operated water pumps.

We train students in soundscape recording by giving them specific sounds to record: a factory whistle, a town clock, a frog, a swallow. It is not easy if the result is to be "clean," without distracting interferences. How often has the novice recordist, sent out to record a "complete" passage of an aircraft, switched off the machine before the sound has dropped totally below the ambiance? Even the life of the more experienced recordist is often hazardous. On one occasion, for example, a small boy had watched our recording team setting up their sound level equipment and tape recorders to measure and record a particular noon whistle. Just as it began, the boy, who had been carelessly left next to a microphone, said: "Is that the whistle you want, mister?"

One of the recordist's biggest problems is to devise ways of recording social settings without interrupting them. The equipment is conspicuous, and in many situations so is the recordist. Peter Huse catches this in a few lines from his poem *Waves.*

we stagger into a lounge.
Bruce in my leather trenchcoat squeaks
and points the way with his goatee as I,

tweedpocket patched with tape,
floppy beret
wired with earphones, and gold-heavy

Nagra
digging into my shoulder,
cutting two tracks, I

angle the mikes in the handset as if
the machine is off but
the pots are ganged together at 83,

it's on RECORD and hidden inside the leather case
Scotch 206 crosses the heads onto
the take-up reel and we're getting

overlapping heart-shapes of late night
fluorescent ferry atmosphere, a blonde siren
looms toward us.

(Zoom-in jerky, wobbling frame. Engine rumble.
Door swinging. Close-up: her twisted face left
centre looking left. Shuffling, scraping of chairs. A
few slurred voices, hers loudest, grates the most.)

Note bleached hair. Smell her
boozy breath. She's drunk and that and hard up.

(Cut to get whole grouping: Tintoretto/home movie
only harsh lights, blue filter. Two men laugh.)

She waves to us, she is singing
"I wanna hol' your han' . . ."
and we get it on tape.

A Tourist in the Soundscape

The student of acoustic design should keep a soundscape diary, constantly noting interesting variations in sounds from place to place and time to time. The ear is always much more alert while traveling in unfamiliar environments, as proved by the richer travelogue literature of numerous writers whose normal content is acoustically less distinguished. This at least seems to be true of such authors as Thoreau, Heinrich Heine and Robert Louis Stevenson. Returning from a trip to Rio de Janeiro (1969), an American student was able to produce a much more vivid account of the Brazilian soundscape than of the city in which he lived.

Rio de Janeiro	*New York*
Street hawkers	Traffic
Bargaining in the marketplace	Horns of taxis
Live chickens and birds in the markets	Bums on streets in the Village
Man going around swatting flies in restaurants	Busses
Ice being chipped from blocks (no crushed ice)	Subway trains
Cars and wagons on cobblestones	Foreign languages on streets and in restaurants
Street cleaners sweeping by hand	Occasional drunks on streets at night
Strange dial tone, busy signal and ringing of telephones	Police sirens
Predominance of old cars from 40s and 50s	
Singing and dancing in the streets; music echoing through the whole city from amplifiers (Carnival)	
Old hand-operated elevators	
Steam engines in the country	
Total silence in the classroom when teacher enters	
No electrical machines in businesses and banks	
250,000 people shouting together in a stadium	
Cockatoos	
Monkeys	
Cutting of jacaranda	

When one travels, new sounds snap at the consciousness and are thereby lifted to the status of figures. But the acoustic designer must be trained to perceive all aspects of *any* soundscape unmistakably, otherwise how should he be able to adjudicate it properly? How should he be able

to gauge the effect of signals and soundmarks and know the function of keynotes and background sounds?

It is not enough to remain a tourist in the soundscape, but it is a useful stage in the training program. It enables a person to become detached from the functioning environment in order to perceive it as an object of curiosity and aesthetic enjoyment. Like tourism itself, this type of perception is a recent development in the evolution of human civilization. As the American geographer David Lowenthal has written: "Perception of *scenery* is only open to those who have no real part to play in the landscape." Lowenthal illustrates the observation with quotations from Mark Twain and William James.

To Mark Twain's steamboat traveler, the sunset glows eloquently over the rippling silvery water. To the pilot however: "This sun means that we are going to have wind tomorrow . . . that slanting mark on the water refers to a bluff reef which is going to kill somebody's steamboat one of these nights . . . that silver streak in the shadow of the forest is the 'break' from a new snag."

William James, an early tourist in North Carolina, was able to register the defacement of a beautiful forest by the farmers: "But, when *they* looked on the hideous stumps, what they thought of was personal victory. The chips, the girdled trees, and the vile split rails spoke of honest sweat, persistent toil and final reward." To James, however, "The impression on my mind was one of unmitigated squalor. The settler had . . . cut down the more manageable trees, and left their charred stumps. . . . The larger trees he had girdled and killed . . . and had set up a tall zigzag rail fence around the scene of his havoc. . . . The forest had been destroyed; and what had 'improved' it out of existence was hideous, a sort of ulcer, without a single element of artificial grace to make up for the loss of Nature's beauty."

Because of his dependence on visual stimuli, modern man has allowed himself to be led by the tourist industry into believing that tourism consists simply of sightseeing. But the sensitive human being knows that environment is not merely what is seen or possessed. A good tourist inspects the whole environment, critically and aesthetically. He never merely "sightsees"; he hears, smells, tastes and touches. A tourist of the soundscape would demand not *Sehenswürdigkeiten* but *Hörenswürdigkeiten*. With increased leisure all men could become tourists of the soundscape, remembering affectionately the entertainment of soundscapes visited. All it would take is a little travel money and sharp ears.

Soundwalks

A listening walk and a soundwalk are not quite the same thing, or at least it is useful to preserve a shade of distinction between them.

A listening walk is simply a walk with a concentration on listening. This should be at a leisurely pace, and if it is undertaken by a group, a good rule is to spread out the participants so that each is just out of earshot of

the footsteps of the person in front. By listening constantly for the footsteps of the person ahead, the ears are kept alert; but at the same time a privacy for reflection is afforded. Sounds heard and missed can be discussed afterward.

The soundwalk is an exploration of the soundscape of a given area using a score as a guide. The score consists of a map, drawing the listener's attention to unusual sounds and ambiances to be heard along the way. A soundwalk might also contain ear training exercises. For instance, the pitches of different cash registers or the duration of different telephone bells could be compared. Eigentones could be sought in different rooms and passages.* Different walking surfaces (wood, gravel, grass, concrete) could be explored. "If I can hear my footsteps as I walk, I know I am in an ecological environment," said a student. When the soundwalker is instructed to listen to the soundscape, he is audience; when he is asked to participate with it, he becomes composer-performer. In one soundwalk a student asked participants to enter a store and to tap the tops of all tinned goods, thus turning the grocery store into a Caribbean steel band. In another, participants were asked to compare the pitches of drainpipes on a city street; in another, to sing tunes around the different harmonics of neon lights.

A series of ingenious soundwalks ought to be of interest to the tourist industry, and it would be of great value also in introducing ear cleaning into schools.

Exercises such as these are the root of the acoustic design program. Yet they require no expensive equipment and they do not camouflage simple acoustic facts with pictures or statistical displays which, being silent, are *not acoustic information.*

When a school of acoustic design worthy of the title finally comes into existence, ear cleaning must be its basic course.

**Eigenton* is the German word used to refer to the fundamental resonance of a room, produced by the reflection of sound waves between parallel surfaces. It can be located empirically by singing different notes. The room (particularly an empty one) will resonate quite loudly in unison with the voice when the right note is sounded.

	Auckland, New Zealand 113 People Tested		Vancouver, Canada 99 People Tested		Port Antonio, Jamaica 72 People Tested		Zurich, Switzerland 217 People Tested	
	Pleasant	*Unpleasant*	*Pleasant*	*Unpleasant*	*Pleasant*	*Unpleasant*	*Pleasant*	*Unpleasant*
TRANSPORTATION (*continued*)								
Aircraft	1	4	0	5	7	0	2	36
Trains	0	1	3	1	1	0	4	6
Sounds of Accidents	0	6	0	1	0	4	0	1
MACHINERY AND MECHANICAL								
Machinery (General)	0	23	1	19	0	0	2	46
Construction	0	11	0	10	0	0	0	15
Jackhammers	0	15	0	13	0	0	0	14
Dentist Drills	0	12	0	13	0	0	0	5
Power Lawnmowers	0	18	1	0	0	0	0	3
Sirens	0	15	0	25	0	0	0	26
Other	1	12	0	27	0	0	0	18
OTHER SOUNDS								
Bells	2	0	8	0	1	0	54	2
Loud Impact (Gunshot, etc.)	0	8	0	7	1	4	1	13
Hammering	0	4	0	7	0	0	0	1
Chalk Squeaking on Blackboard	0	38	0	32	0	1	0	13
Miscellaneous	4	8	11	1	1	4	2	2
Silence	8	0	15	0	0	0	1	1

Glossary of Soundscape Terms

The following short list of terms includes only neologisms or acoustic terms which I have adapted and given special meanings to for the purpose of this book. The list does not include general acoustic terms employed in the customary manner, definitions of which may be found in standard works of reference.

ACOUSTIC DESIGN: A new interdiscipline requiring the talents of scientists, social scientists and artists (particularly musicians), acoustic design attempts to discover principles by which the aesthetic quality of the acoustic environment or SOUNDSCAPE may be improved. In order to do this it is necessary to conceive of the soundscape as a huge musical composition, ceaselessly evolving about us, and to ask how its orchestration and forms may be improved to bring about a richness and diversity of effects which, nevertheless, should never be destructive of human health or welfare. The principles of acoustic design may thus include the elimination or restriction of certain sounds (noise abatement), the testing of new sounds before they are released indiscriminately into the environment, but also the preservation of sounds (SOUNDMARKS), and above all the imaginative placement of sounds to create attractive and stimulating acoustic environments for the future. Acoustic design may also include the composition of model environments, and in this respect it is contiguous with contemporary musical composition. Compare: ACOUSTIC ECOLOGY.

ACOUSTIC ECOLOGY: Ecology is the study of the relationship between living organisms and their environment. Acoustic ecology is thus the study of the effects of the acoustic environment or SOUNDSCAPE on the physical responses or behavioral characteristics of creatures living within it. Its particular aim is to draw attention to imbalances which may have unhealthy or inimical effects. Compare: ACOUSTIC DESIGN.

ACOUSTIC SPACE: The profile of a sound over the landscape. The acoustic space of any sound is that area over which it may be heard before it drops below the ambient sound level.

AURAL SPACE: The space on any graph which results from a plotting of the various dimensions of sound against one another. For convenience in

reading usually only two dimensions are plotted at once. Thus time may be plotted against frequency, frequency against amplitude or amplitude against time. Aural space is thus merely a notational convention and should not be confused with ACOUSTIC SPACE, which is an expression of the profile of a sound over the landscape.

CLAIRAUDIENCE: Literally, clear hearing. The way I use the term there is nothing mystical about it; it simply refers to exceptional hearing ability, particularly with regard to environmental sound. Hearing ability may be trained to the clairaudient state by means of EAR CLEANING exercises.

EAR CLEANING: A systematic program for training the ears to listen more discriminatingly to sounds, particularly those of the environment. A set of such exercises is given in my book *Ear Cleaning.*

EARWITNESS: One who testifies or can testify to what he or she has heard.

HI-FI: Abbreviation for high fidelity, that is, a favorable signal-to-noise ratio. The most general use of the term is in electroacoustics. Applied to soundscape studies a hi-fi environment is one in which sounds may be heard clearly without crowding or masking. Compare: LO-FI.

KEYNOTE SOUND: In music, keynote identifies the key or tonality of a particular composition. It provides the fundamental tone around which the composition may modulate but from which other tonalities take on a special relationship. In soundscape studies, keynote sounds are those which are heard by a particular society continuously or frequently enough to form a background against which other sounds are perceived. Examples might be the sound of the sea for a maritime community or the sound of the internal combustion engine in the modern city. Often keynote sounds are not consciously perceived, but they act as conditioning agents in the perception of other sound signals. They have accordingly been likened to the ground in the figure-ground grouping of visual perception. Compare: SOUND SIGNAL.

LO-FI: Abbreviation for low fidelity, that is, an unfavorable signal-to-noise ratio. Applied to soundscape studies a lo-fi environment is one in which signals are overcrowded, resulting in masking or lack of clarity. Compare: HI-FI.

MOOZAK (MOOZE, etc.): Term applying to all kinds of schizophonic musical drool, especially in public places. Not to be confused with the brand product Muzak.

MORPHOLOGY: The study of forms and structures. Originally employed in biology, it was later (by 1869) employed in philology to refer to patterns of inflection and word formation. Applied to soundscape studies it refers to changes in groups of sounds with similar forms or functions when arbitrarily arranged in temporal or spatial formations. Examples of acoustic morphology might be a study of the historical evolution of foghorns, or a geographical comparison of methods of telegraphy (alphorn, jungle drums, etc.).

NOISE: Etymologically the word can be traced back to Old French (*noyse*) and to eleventh-century Provençal (*noysa, nosa, nausa*), but its origin is uncertain. It has a variety of meanings and shadings of meaning, the most important of which are the following:

1. *Unwanted sound.* The Oxford English Dictionary contains references to noise as unwanted sound dating back as far as 1225.
2. *Unmusical sound.* The nineteenth-century physicist Hermann Helmholtz employed the expression noise to describe sound composed of nonperiodic vibrations (the rustling of leaves), by comparison with musical sounds, which consist of periodic vibrations. Noise is still used in this sense in expressions such as white noise or Gaussian noise.
3. *Any loud sound.* In general usage today, noise often refers to particularly loud sounds. In this sense a noise abatement by-law prohibits certain loud sounds or establishes their permissible limits in decibels.
4. *Disturbance in any signaling system.* In electronics and engineering, noise refers to any disturbances which do not represent part of the signal, such as static on a telephone or snow on a television screen.

The most satisfactory definition of noise for general usage is still "unwanted sound." This makes noise a subjective term. One man's music may be another man's noise. But it holds open the possibility that in a given society there will be more agreement than disagreement as to which sounds constitute unwanted interruptions. It should be noted that each language preserves unique nuances of meaning for words representing noise. Thus in French one speaks of the *bruit* of a jet but also the *bruit* of the birds or the *bruit* of the waves. Compare: SACRED NOISE.

SACRED NOISE: Any prodigious sound (noise) which is exempt from social proscription. Originally Sacred Noise referred to natural phenomena such as thunder, volcanic eruptions, storms, etc., as these were believed to represent divine combats or divine displeasure with man. By analogy the expression may be extended to social noises which, at least during certain periods, have escaped the attention of noise abatement legislators, e.g., church bells, industrial noise, amplified pop music, etc.

SCHIZOPHONIA (Greek: *schizo* = split and *phone* = voice, sound): I first employed this term in *The New Soundscape* to refer to the split between an original sound and its electroacoustic reproduction. Original sounds are tied to the mechanisms that produce them. Electroacoustically reproduced sounds are copies and they may be restated at other times or places. I employ this "nervous" word in order to dramatize the aberrational effect of this twentieth-century development.

SONIFEROUS GARDEN: A garden, and by analogy any place, of acoustic delights. This may be a natural soundscape, or one submitted to the

principles of ACOUSTIC DESIGN. The soniferous garden may also include as one of its principal attractions a Temple of Silence for meditation.

SONOGRAPHY: The art of soundscape notation. It may include customary methods of notation such as the sonogram or sound level recording, but beyond these it will also seek to register the geographic distribution of SOUND EVENTS. Various techniques of aerial sonography are employed, for instance, the isobel contour map.

SONOLOGICAL COMPETENCE: The implicit knowledge which permits the comprehension of sound formations. The term has been borrowed from Otto Laske. Sonological competence unites impression with cognition and makes it possible to formulate and express sonic perceptions. It is possible that just as sonological competence varies from individual to individual, it may also vary from culture to culture, or at least may be developed differently in different cultures. Sonological competence may be assisted by EAR CLEANING exercises. See O. Laske, "Musical Acoustics (Sonology): A Questionable Science Reconsidered," *Numus-West,* Seattle, No. 6, 1974; "Toward a Theory of Musical Cognition," *Interface,* Amsterdam, Vol. 4, No. 2, Winter, 1975, *inter alia.*

SOUND EVENT: Dictionary definition of *event:* "something that occurs in a certain place during a particular interval of time." This suggests that the event is not abstractable from the time-and-space continuum which give it its definition. The sound event, like the SOUND OBJECT, is defined by the human ear as the smallest self-contained particle of a SOUNDSCAPE. It differs from the sound object in that the latter is an abstract acoustical object for study, while the sound event is a symbolic, semantic or structural object for study, and is therefore a nonabstractable point of reference, related to a whole of greater magnitude than itself.

SOUNDMARK: The term is derived from *landmark* to refer to a community sound which is unique or possesses qualities which make it specially regarded or noticed by the people in that community.

SOUND OBJECT: Pierre Schaeffer, the inventor of this term (*l'objet sonore*), describes it as an acoustical "object for human perception and not a mathematical or electro-acoustical object for synthesis." The sound object is then defined by the human ear as the smallest self-contained particle of a SOUNDSCAPE, and is analyzable by the characteristics of its envelope. Though the sound object may be referential (i.e., a bell, a drum, etc.), it is to be considered primarily as a phenomenological sound formation, independently of its referential qualities as a sound event. Compare: SOUND EVENT.

SOUNDSCAPE: The sonic environment. Technically, any portion of the sonic environment regarded as a field for study. The term may refer to actual environments, or to abstract constructions such as musical

compositions and tape montages, particularly when considered as an environment.

SOUND SIGNAL: Any sound to which the attention is particularly directed. In soundscape studies sound signals are contrasted by KEYNOTE SOUNDS, in much the same way as figure and ground are contrasted in visual perception.

WORLD SOUNDSCAPE PROJECT: A project headquartered at the Sonic Research Studio of the Communications Department, Simon Fraser University, British Columbia, Canada, devoted to the comparative study of the world SOUNDSCAPE. The Project came into existence in 1971, and since that time a number of national and international research studies have been conducted, dealing with aural perception, sound symbolism, noise pollution, etc., all of which have attempted to unite the arts and sciences of sound studies in preparation for the development of the interdiscipline of ACOUSTIC DESIGN. Publications of the World Soundscape Project have included: *The Book of Noise, The Music of the Environment, A Survey of Community Noise By-Laws in Canada* (1972), *The Vancouver Soundscape, A Dictionary of Acoustic Ecology, Five Village Soundscapes* and *A European Sound Diary.*