

R. MURRAY SCHAFER



One of Canada's younger composers, R. Murray Schafer received his musical education at the Royal Conservatory in Toronto where he studied composition with John Weinzwieg and later on a Canada Council grant in England and Europe. In 1962 he returned to Canada where he helped to found the celebrated Ten Centuries concert series in Toronto, and became its first president.

His compositions have been performed in Canada and abroad. He is also the author of numerous articles on music, several of which have been anthologized and translated, and is the author of the book *British Composers in Interview*.

# THE NEW SOUNDSCAPE

R. Murray Schafer



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# THE NEW SOUNDSCAPE

A Handbook  
for the Modern  
Music Teacher

R. Murray Schafer



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To Keith Bissell

## PREFACE

Overheard in the lobby after the première of Beethoven's *Fifth*: "Yes, but is it music?"

Overheard in the lobby after the première of Wagner's *Tristan*: "Yes, but is it music?"

Overheard in the lobby after the première of Stravinsky's *Sacre*: "Yes, but is it music?"

Overheard in the lobby after the première of Varèse's *Poème électronique*: "Yes, but is it music?"

A jet scrapes the sky over my head and I ask: "Yes, but is it music? Perhaps the pilot has mistaken his profession?"

## Yes, but is it Music?

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MUSIC: Art of combining sounds with a view to beauty of form and expression of emotion; sounds so produced; pleasant sound e.g. song of a bird, murmur of a brook, cry of hounds.

The Concise Oxford Dictionary, Fourth Edition, 1956

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It was practically my first day in the music room. In the interest of finding out what we were supposed to be doing there, I set the class a problem. Innocently I asked: "What is music?"

We spent two solid days groping around a definition. We found that we had to reject all the customary definitions because they weren't inclusive enough, and you can't have a definition that doesn't embrace *all* the objects or activities of its class. The definition we did come up with and the transcript of our thinking-path is reported in the first volume of this series, *The Composer in the Classroom*. Numerous thoughtful people have pointed out inadequacies in that definition. I agree with their criticisms.

The simple fact is that as the growing edge we call the avant-garde continues its explorations along the frontiers of sound, any definition becomes exceedingly difficult. When John Cage opens the door of the concert hall and encourages the street noises to intersect his compositions he ventilates the art of music with fresh and seemingly shapeless concepts.

Nevertheless, I did not like to think that the question of defining the subject to which we are devoting our lives was totally impossible. I did not think John Cage would think so either, and so I wrote him and asked him for *his* definition of music.

His reply:

*"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 20th 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 non-pitched and a-rhythmic sounds; then through the introduction of aleatoric procedures in which all attempts to organize the sounds of a composition rationally are surrendered before 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.) Finally in the practices of *musique concrète* it becomes possible to insert any sound from the environment into a composition via tape; while in electronic music the hard-edge sound of the tone generator may be indistinguishable from the police siren or the electric tooth-brush. 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 new musicians: anyone and anything that sounds!

There is a shattering corollary to this for all music educators.

For music educators are the custodians of the theory and practice of music.

*And the whole nature of this theory and practice is now going to have to be completely reconsidered.*

The teaching of traditional music has its special targets: the technical mastery of instruments such as the piano, the trumpet or the violin for the performance of a literature existing back over several hundred years. For the purpose of understanding the shapes of this music a theoretical vocabulary has been developed enabling the student to gloss any piece of Western music written between the Renaissance and our own time.

There is nothing permanent or perfect about this practice or theory, of course, and the music of the Middle Ages or of China cannot be measured by the rules of Classical theory any more than it can be performed on the instruments of the classical orchestra. The historical and geographical cultural sweepout that characterizes our time has made us very conscious of the fallacy of controlling the temperament of all musical philosophies by the same tuning fork.

The new musical resources I shall try to bring into focus in the following pages will require quite new attitudes of study-stress. New

studies are needed in the curriculum and they will carry us far out into the shifting contours of interdisciplinary knowledge.

The new student will have to be informed in areas as diverse as acoustics, psychoacoustics, electronics, games and information theory.

It is these last-named together with a knowledge of the form-building and form-dissolving processes as observed in the natural sciences that will be necessary to register the shapes and densities of the new sound-configurations of today's and tomorrow's music.

More music is heard today by means of electro-acoustic reproduction than in its natural form, which leads one to ask whether music in this form is not perhaps the more "natural" to the contemporary listener; and if so should not the student understand what happens when music is so reproduced?

The basic vocabulary of music will change. We will perhaps speak of 'sound objects,' of 'envelopes' and 'onset transients' instead of 'triads', 'sforzando' and 'appoggiatura'. Single sounds will be studied more attentively with attention paid to the formants of their overtone spectra and to their onset and decay characteristics.

Students will perhaps be trained to describe music in terms of exact frequencies or frequency bands rather than in the limited nomenclature of the tonal system. Dynamics too might better be described in relation to some standard reference such as the phon (loudness) or the decibel (intensity) rather than in terms of a few ancient Italian intuitions on the subject.

The psychology and physiology of aural pattern perception will supersede many former musical studies in which musical soundings were rendered mute by paper exercises. (Traditional theory books deny all life to sounds, considering them as stationary cadavers.) Ultimately somewhere work might begin on a much-needed history of aural perception to show us how different periods or different musical cultures actually hear *different* things when listening to music.

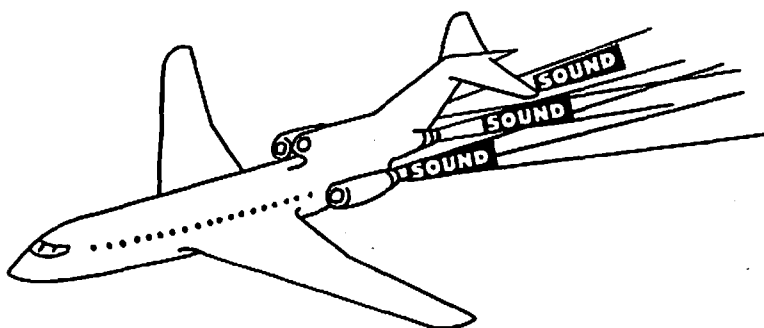
One of the purposes of this booklet is to direct the ear of the listener towards the new soundscape of contemporary life, to acquaint him with a vocabulary of sounds he may expect to hear both inside and outside concert halls. It may be that he will not like all the tunes of this new music, and that too will be good. For together with other forms of pollution, the sound sewage of our contemporary environment is unprecedented in human history.

This brings me to my other purpose. In recent years the science of medicine has seen a dramatic shift of emphasis from the curing of disease to its prevention. This shift is so pronounced that the term

"preventative medicine" needs no explanation. I am about to suggest that the time has come in the development of music when we will have to be concerned as much with the prevention of sounds as with their production. Observing the world sonograph the new music educator will encourage those sounds salubrious to human life and will rage against those inimical to it. It will be more important for him to know about pain thresholds than to be concerned whether the devil still inhabits the tritone. It will be more in his interest to take up membership in the International Society for Noise Abatement than in his local Registered Music Teachers' Association.

If this suggestion strikes the reader as a joke I can only hope that the remainder of this booklet will sober him up; for I have come to regard the whole matter of sound prevention as inevitable and urgent.

This booklet is not technical. It consists of some preliminary thought-excursions along the lines of the questions I have just raised. From time to time some of my first-year university students may get into the act. Why not? They are around me as I write.



## II

### The Sonic Environment

Anything in our world that moves vibrates air.

If it moves in such a way that it oscillates at more than about 16 times a second this movement is heard as sound.

The world, then, is full of sounds. Listen.

Openly attentive to whatever is vibrating, listen.

Sit quietly for a moment and receive.

The class had done this for four days running, ten minutes each day, chairs turned to the wall, receiving sound-messages.

On the fifth day they were asked to describe what they had heard. Everyone had by that time heard quite a lot of sounds — footsteps, breathing, chairs moved, distant voices, a bell, a train etc. But were they *describing* what they had heard? Was it not merely a list of common words? Everyone knows what a footstep or a cough or a bell sounds like. But the difference between my footstep and yours, or his cough and hers, how were we to describe that? One or two tried to express the difference by drawing pictures. Not too helpful.

If the new orchestra is the sonic universe, how do we differentiate between the instruments? How could we write the complete biography of a footstep in such a way that we would know it was your footstep's story and not mine?

One determined girl went down to a street corner on Saturday and tried to work out a descriptive notation for the different feet of the passers-by. She watched and listened to the choreography of the feet and noted the size of shoe or boot; the pitch of its step, high or low; the timbre of its sound, metallic, shuffling or clodhoppery; and the tempo of its movement from the deft tick-a-tack of heel points to the muted drag of vagrant feet.

The sounds of the universal orchestra are infinitely varied. Everyone was asked to spend ten minutes a day listening at home, in a bus, on the street, at a party. Lists of sounds heard were prepared. More lists were turned in, still underscriptive.

But one thing we discovered we could tell. The sounds heard could be divided into sounds made by nature, by humans, and by electric or

mechanical gadgetry. Two students catalogued the sounds. Did people always hear the same sounds as we do? To make a comparative study, everyone was asked to take a historical document and note down all the sounds or potential sounds in it. Any document would do: a painting, a poem, a description of an event, a photograph. Someone took *The Battle Between Carnival and Lent* by Peter Breughel the Elder and gave us the sounds of a 17th-century Dutch townscape. Someone else took a passage from an Arnold Bennett novel and gave us the sounds of an industrial North-of-England city in the 19th century. Someone else took a North-American Indian village, another a biblical scene, and so on.

We only sampled at random, of course, but perhaps certain conclusions could be drawn. For instance, we found that at first when men were scarce and lived a pastoral existence the sounds of nature seemed to predominate: winds, water, birds, animals, thunder. Men used their ears to read the sound-omens of nature. Later on in the townscape men's voices, their laughter and the sound of their handi-craft industries seemed to take over the foreground. Later still, after the Industrial Revolution, mechanical sounds drowned out both human and natural sounds with their ubiquitous buzz and whirr. And today? Here are some of our tables:

	Natural Sounds	Human Sounds	The Sounds of Tools and Technology
Primitive Cultures	69%	26%	5%
Medieval, Renaissance and Pre-Industrial Cultures	34%	52%	14%
Post-Industrial Cultures	9%	25%	66%
Today	6%	26%	68%



Peter Breughel's *The Battle Between Carnival and Lent*. In the 17th-century town human sounds still occupied the foreground of the soundscape.



The modern hard-edged soundscape of the city masks the voices of its human inventors.

### III

## Concerning Silence

With the intensity of the sound barrage going on all around, it has become fashionable to speak of silence. Therefore, let us speak of silence.

We miss it.

In the past there were muted sanctuaries where anyone suffering from sound fatigue could go into retirement for recomposure of the psyche. It might be in the woods, or out at sea, or on a snowy mountainside in winter. One would look up at the stars or the soundless soaring of birdcraft and be at peace.

It was understood that each human being had an inalienable right to stillness. It was a precious article in an unwritten code of human rights.

Leaning on our stout oaken walking sticks, our sacks on our backs, we climbed the cobbled road that led to Karyès, passing through a dense forest of half-defoliated chestnut-trees, pistachios, and broad-leaved laurels. The air smelled of incense, or so it seemed to us. We felt that we had entered a colossal church composed of sea, mountains and chestnut forest, and roofed at the top by the open sky instead of a dome. I turned to my friend; I wanted to break the silence which had begun to weigh upon me. "Why don't we talk a little?" I suggested. "We are", answered my friend, touching my shoulder lightly. "We are, but with silence, the tongue of angels." Then he suddenly appeared to grow angry. "What do you expect us to say? That it is beautiful, that our hearts have sprouted wings and want to fly away, that we've started along a road leading to Paradise? Words, words, words. Keep quiet!"

Even in the hearts of cities there were reservoirs of quiet. Churches were such sanctuaries, and libraries too. In the concert hall even now a hush comes over the audience when the music is about to begin so that the music may be affectionately placed in a container of silence.



As long as these traditions existed the concept of silence was real and had dignity. Silence was thought of figuratively rather than physically, for a physically silent world was as highly improbable then as it is now. The difference was that the average ambient sound level was low enough to allow a man to contemplate without a continuous recital of sonic incursions into his thought-stream. (The sentences of our thoughts have undoubtedly grown shorter since the invention of the telephone!)

But to contemplate an absolute silence, that is a negative and terrifying thing. Thus when the infinity of space was first suggested by Galileo's telescope, the philosopher Pascal was deeply afraid of the prospect of an infinite and eternal silence.

Le silence éternel de ces espaces infinis m'effraye.

When one goes into an anechoic chamber — that is, a completely soundproof room — one feels a little of the same terror. One speaks and the sound seems to drop from one's lips to the floor. The ears strain to pick up evidence that there is still life in the world.

When John Cage went into such a room, however, he heard two sounds, one high and one low.

When I described them to the engineer in charge, he informed me that the high one was my own nervous system in operation, the low one my blood in circulation.

#### Cage's conclusion:

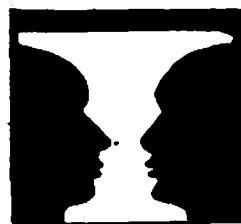
There is no such thing as silence. Something is always happening that makes a sound.

Cage had detected the relativity of silence and in choosing *Silence* as the title for his book he emphasized that henceforth any use of this word must be qualified or assumed to be ironical.

The myth of silence has been exploded. From now on in traditional music, for instance, when we speak of silence we will not mean absolute or physical silence, but rather merely the *absence of traditional musical sounds*.

In the psychology of visual perception one talks of the alternation between figure and ground, either of which can become the visual message for the eye depending on what it wants to see. In certain drawings the identical forms combine to produce two subjects either of which may be seen in relief against a neutral ground. For a long time we may see only one image, then with a sudden flicker the relationship is reversed. Similarly the sound engineer speaks of the difference between signal and noise, the wanted sounds from the unwanted. Behind every piece of music lurks another piece of music

The minuscule world of sound events which we have carelessly assumed to be 'silent'. The moment these events flash into the foreground we call them noise. Any reappraisal of music will have a good deal to say about noise; for noise is sound we have been trained to ignore.



## Symphony No 8

I

Allegro con brio L. van Beethoven, Op. 55  
1770-1827

No. 408

E. H. 8028 Ernst Eulenburg Ltd., London Zürich

The figure-ground relationship in vision also applies to the ear.

If one listens carefully to the spaces between the cyclopean chords that open Beethoven's Eroica symphony he will discover a dense population of quite 'unheroic' sound events — coughs, shufflings, record scratches or whatever. Like the distinction between figure and ground in a drawing, we may also now distinguish between figure and ground in music listening. Try, for instance, to listen to a musical performance focusing not on the music itself but on all the extraneous non-musical sounds that surround the music and crowd forth during its momentary pauses. My class did this. It is a strangely sensitizing exercise to refocus the ear.

But we began by speaking of quiet sanctuaries, a student reminds us. Should we not try to protect great music from intrusions by continuing to build better rooms for its performance and demanding more scratch-free records?

Indeed. Perhaps, another student suggests, the new concert hall will be the stereo set in the living room.

Certainly it is a new concert hall. Then doesn't it follow that our living room or music room should receive the same careful attention to insulation and acoustics as the present concert hall? How many of us have soundproof rooms in our houses? How much would it cost builders to create them? And so we found ourselves an assignment: to approach the building trade to discover what the present soundproofing regulations are and how they could be improved.

After our investigation we found we had learned a lot about soundproofing materials, sound transmission through wood, glass and other materials. We discovered, for instance, in our city that there are no minimum regulations for the acoustic treatment of walls in houses and apartments. We decided that in our 'ideal home' we should be able to specify to the builder what noise level we were prepared to tolerate indoors. So we took a sound meter\* deep into the woods to measure the quiet there. At first, peace; then an airplane buzzed us. After it left, we took a reading: 15 decibels.

Then we went to the home of Jeff B., who said he lived in a terribly noisy apartment, to measure the noise level there. A radio was playing in the next apartment. Children were shouting in the hall. Our reading: 64 decibels.

Then we got into an argument about whether that was noise or not. There were five of us: Barbara, Donna, Jeff, Doug and myself. Barbara liked the music on the radio . . .

\* A sound meter is a device for measuring the intensity of sound in decibels with 0 db established as the threshold of hearing.

## IV

## A New Definition of Noise

We walked around for a while talking about noise. Doug carried the sound meter, measuring, measuring. At a residential street corner (35 db) we stopped and I asked Jeff why he regarded his neighbour's radio as noise.

— Because it goes on all day, and I don't like their choice of programs.

— Well I didn't find it disagreeable, Barbara reaffirmed (at 40 db).

— Well then, I said, how would *you* define noise?

— Ugliness, she replied.

A bus passed by (80 db).

— Did you find it ugly? I asked after a while.

— What?

— That bus.

— Well, it was loud but not nearly as ugly as the sounds in that piece you played to us the other day. (We had been listening to Edgar Varèse's Déserts.

Jeff thought that was very funny and laughed (68 db).

— What makes a sound ugly, I persisted.

Just then we were passed by a motorcycle going all out (98 db).

— That's a Harley-Davidson, Jeff said, who knew about motorcycles...

— Sixty-two horsepower. What a beauty!

— Ugly? I asked.

— No, *beootifull*

— Oh!

For a while we walked without speaking. Turning a corner we entered a park and sat down (35 db). From the distance the saw-tooth sound of a lawn mower proceeded towards us pushing the meter up to 75 db. I began to think of the many confusions surrounding the word

noise. Was it a matter of dissonance, of loudness, or simply of personal displeasure? The great nineteenth-century physicist Hermann von Helmholtz had little difficulty in distinguishing 'music' from 'noise'. This is what he says in his famous book *On the Sensations of Tone*:

The first and principal difference between various sounds experienced by our ear, is that between noises and musical tones . . . . We perceive that generally, a noise is accompanied by a rapid alternation of different kinds of sound . . . . Think for example, of the rattling of a carriage over granite paving stones, the splashing or seething of a waterfall or of the waves of the sea, the rustling of leaves in a wood. In all these cases we have rapid, irregular, but distinctively perceptible alternations of various kinds of sounds, which crop up fitfully . . . . Those regular motions which produce musical tones have been exactly investigated by physicists. They are oscillations, vibrations or swings, that is, up and down, or to and fro motions of sonorous bodies, and it is necessary that these oscillations should be regularly periodic. By a periodic motion we mean one which constantly returns to the same condition after exactly equal intervals of time.

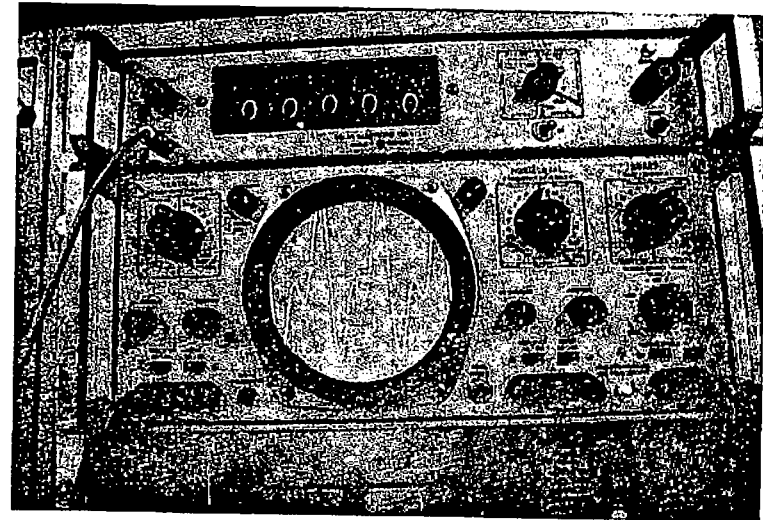
Then he formulates his definition:

The sensation of a musical tone is due to a rapid periodic motion of the sonorous body; the sensation of a noise to non-periodic motions.

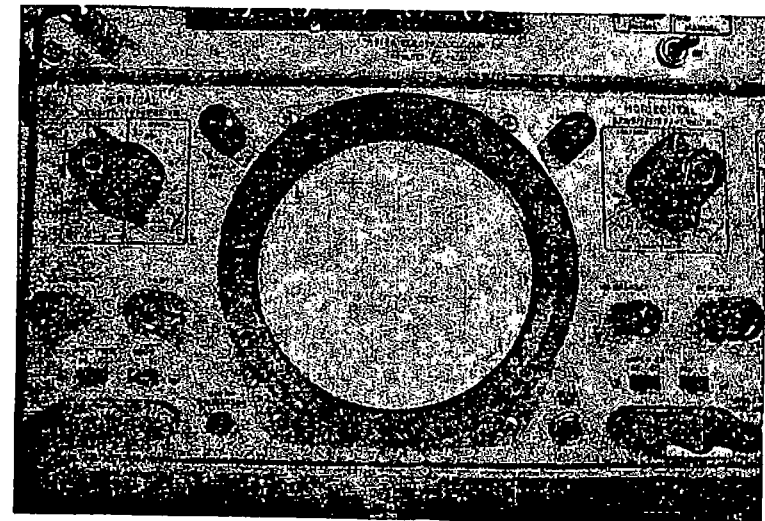
You can see this easily enough on an oscilloscope, an instrument for presenting sound pictorially to assist in its analysis. There is a branch of mathematics known as 'harmonic analysis' which is concerned with the problems of analyzing the curves which appear on an oscilloscope to determine the ingredients of a sound. In a 'musical tone' all the harmonics are proportionate to its fundamental and the pattern produced on the oscilloscope will be regular and periodic as in the first illustration. A 'noisy' sound (to retain Helmholtz's distinction) is much more complex, consisting of many fundamentals, each with its own harmonic superstructure and these sound in disharmonious competition with each other. In its oscillographic picture a whole riot of lines results in which it is difficult or impossible to see any regularity or pattern.

But is this a satisfactory definition? Have we not already examined enough problems and paradoxes to force a re-examination of Helmholtz's classical proposition?

For instance, by Helmholtz's definition, the motorcycle we heard could not be considered noisy at all but rather 'musical' for as a mechanical machine it must be periodic. You don't get very far on a non-periodic machine. And can we ignore amplitude in examining noise? The motorcycle was 98 decibels by our reading. Colloquially



Helmholtz's 'musical tone'



Helmholtz's 'noise'

We may still speak of periodic and non-periodic sounds to distinguish between two quite different qualities of sound; but we must reserve judgment as to whether they are *music* or *noise* until we determine whether they constitute part of the message intended to be heard or are miscellaneous interferences to it.

*Noise is any undesired sound signal.*

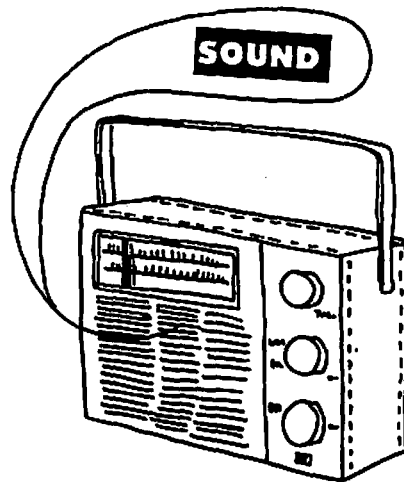
A few days later a popular music band was playing on the mall of our school full out with guitars and amplifiers. Jeff measured it at 101 db.

— How can you stand it? I screamed at a girl standing beside me.

— Huh?

— Never mind, I said.

— I can't hear you, she replied.



## Sound Sewage: A Collage

### Noise: Any Undesired Sound Signal

*The building is on a military installation somewhere in the United States . . . Inside are nightmares.*

*In one of the large laboratory rooms, two physicists and a biologist stand about a heavy metal table. They wear thick ear pads. On the table is a dial-covered device about the size and shape of a television set, with a trumpet-like horn protruding from its face. The device is a kind of siren, designed to produce high-frequency sound of outrageous intensity. The scientists are studying the effects of this sound on materials, animals and men. They are wondering if sound can be used as a weapon . . . .*

*One of the physicists begins the demonstration by picking up a wad of steel wool with a tonglike instrument on a long pole. He holds the steel wool in the invisible beam of sound that issues from the horn. The steel wool explodes in a whirling cascade of white-hot sparks . . . .*

*The biologist has brought a white rat into the room in a small cage. The rat is running around the cage, looking unhappy about all the noise. But his worries don't last long. The biologist lifts the cage into the sound field. The rat stiffens, rises up to the full stretch of his legs, arches his back, opens his mouth wide and falls over. He is dead. An autopsy will reveal that he had died of instant overheating and a massive case of the bends. There are bubbles in his veins and internal organs.<sup>2</sup>*

\*

*The National Aeronautics and Space Administration wants to know what loud rocket noises do to people around a launching-pad, and why such noises occasionally cause nausea, fainting and epileptic-like fits.<sup>2</sup>*

\*

*Scientific tests . . . reveal that changes in the circulation of the blood and in the action of the heart take place when a person is exposed to a certain intensity of noise. Even snatches of loud conversation are enough to affect the nervous system and thereby provoke constrictions in a large part of the blood circulation system . . . Workers in a boiler factory, for instance, thus suffer from a constantly impaired circulation in the epidermis.<sup>3e</sup>*

\*

*Professor Rudnick and his colleagues built the most powerful siren ever conceived to that date. It made what was, as far as anybody knew, the loudest continuous sound ever heard on earth up to that time: 175 db, some 10,000 times as strong as the ear-splitting din of a large pneumatic*

riveter. The frequency range of this enormous howl was from about 3,000 cycles per second (near the top range of a piano) to 34,000 cps, in the ultrasonic range.

Strange things happened in this nightmarish sound field. If a man put his hand directly in the beam of sound, he got a painful burn between the fingers. When the siren was aimed upwards, 3/4 inch marbles would float lazily about it at certain points in the harmonic field, held up and in by the outrageous acoustic pressure. By varying the harmonic structure of the field, Professor Rudnick could make pennies dance on a silk screen with chorus-like precision. He could even make one penny rise slowly to a vertical position while balancing another penny on its edge. A cotton wad held in the field would burst into flame in about six seconds. "To satisfy a skeptical colleague", reports Professor Rudnick, "we lit his pipe by exposing the open end of the bowl to the field."<sup>2</sup>

Researchers at the Max Planck Institute in West Germany want to know why workers in noisy places such as iron foundries have more emotional and family problems than those in quieter places.<sup>2</sup>

But of all the noises of Mexico City the loudest and most individual was made by the mechanical pile-driver opposite the Opera House. Thud-shriek, thud-shriek; it worked day and night; the hammer fell, the compressed air escaped and the great tree trunks sank foot by foot into the soft sub-soil. While, in the general slump, other major works were at a stand-still, this infernal machine pounded on incessantly, dominating a whole quarter of the city.<sup>4</sup>

The science of sound began to get some attention during World War Two with the development of military applications such as sonar (Sound Navigation and Ranging) for tracking enemy vessels at sea. In the 1950's studies of other sonic phenomena began to disappear one by one behind a cloud of military secrecy — perhaps the most sincere honor that can be granted to any research project.<sup>2</sup>

... the effort now being made by the aeronautical industry to persuade us that we shall enjoy the din of supersonic airliners. Public relations machinery and techniques are working on an unsuspecting public with the slogan "learn to live with the boom."<sup>3a</sup>

James Watt once rightly remarked that to uneducated persons noise is suggestive to power. A machine which operates silently or without vibration is obviously far less impressive than a noisy one.<sup>3b</sup>

There are people, it is true — nay, a great many people — who smile at such things, because they are not sensitive to noise; but they are just the very people who are also not sensitive to argument, or thought, or poetry, or art, in a word, to any kind of intellectual influence. The reason of it is that the tissue of their brains is of a very rough and coarse quality. On the other hand, noise is a torture to intellectual people.<sup>1</sup>

The familiar exclamation . . . "quiet please" can be translated into scientific terminology as follows: "My work demands great concentration and I must therefore preserve the connective functions of my cerebral cortex. I cannot afford to weaken the inhibitory processes and I have to preserve the working capacity of my nervous system."<sup>3b</sup>

If you cut up a large diamond into little bits, it will entirely lose the value it had as a whole; and an army if divided up into small bodies of soldiers, loses all its strength. So a great intellect sinks to the level of an ordinary one, as soon as it is interrupted and disturbed, its attention distracted from the matter in hand; for its superiority depends upon its power of concentration — of bringing all its strength to bear upon one theme, in the same way as a concave mirror collects into one point all the rays of light that strike upon it.<sup>1</sup>

Advancing civilizations will create more noise, not less. Of that we are certain. In all probability the noise level will grow not only in urban centres, but, with increasing population and the proliferation of machines, noise will invade the few remaining havens of silence in the world. A century from now, when a man wants to escape to a quiet spot, there may be no place left to go.<sup>3c</sup>

But just over ten years ago organizations were set up in a number of European countries to wage campaigns against the spread of noise. These bodies . . . decided to unite their action and in 1959 formed the International Association Against Noise . . . Since its directorate has always comprised a physician, an engineer, a specialist in acoustics and two jurists, the International Association is in a position to give prompt and authoritative opinions on questions of international scope within its field.<sup>3a</sup>

The most inexcusable and disgraceful of all noises is the cracking of whips — a truly infernal thing when it is done in the narrow resounding streets of a town. I denounce it as making a peaceful life impossible; it puts an end to all quiet thought . . . No one with anything like an idea in his head can avoid a feeling of actual pain at this sudden, sharp crack, which paralyzes the brain, rends the thread of reflection, and murders thought.<sup>1</sup>

Motorcycles are our greatest problem. There is one motorcycle or motor-scooter for every 12 persons in our city . . . In Cordoba, we have studied some of the psychological aspects of noise offences. Why, for example, do drivers, and especially motorcyclists, remove or modify the mufflers on their vehicles? Is it because a personality defect makes them enjoy excessive noise? Or does the noisy urban environment give them a kind of 'thirst for noise'?<sup>3d</sup>

There is something even more disgraceful than what I have just mentioned. Often enough you may see a carter walking along a street, quite alone, without any horses, and still cracking away incessantly; so accustomed has the wretch become to it in consequence of the unwarrantable toleration of this practice.<sup>1</sup>

In 1964 we set up Argentina's first Noise Abatement Council . . . Firstly, our new anti-noise municipal regulation distinguishes between 'unnecessary' and 'excessive' noise. It classifies over 15 unnecessary noises which can be penalized without recourse to noise level measurement or analysis. Since the application of the anti-noise law we have classified as unnecessary noises all public address systems that can be heard outside enclosed premises, including music, publicity and speeches.<sup>3d</sup>

Ling Electronics of California makes a noise generator whose gigantic howl, loud enough to tear electronic equipment apart, is used to test the toughness of space-flight hardware.<sup>2</sup>

How many great and splendid thoughts, I should like to know, have been lost to the world by the crack of a whip? If I had the upper hand, I should soon produce in the heads of these people an indissoluble association of ideas between cracking a whip and getting a whipping.<sup>1</sup>

The growth of motor transport in the past 20 years has led many countries to revise their traffic codes — sometimes in the face of public opinion. The decision to forbid the use of motor horns in Paris was one such controversial move, and motorists in particular predicted that street accidents would increase. In practice the measure was remarkably successful. With a show of self-restraint that surprised the Parisians themselves the honking and blaring of horns was stilled from one day to the next. Paris now wonders how it ever managed to endure such a futile and nerve-racking din.<sup>3</sup>

With all due respect for the most holy doctrine of utility, I really cannot see why a fellow who is taking away a wagon-load of gravel or dung should thereby obtain the right to kill in the bud the thoughts which may happen to be springing up in ten thousand heads — the number he will disturb one after another in half an hour's drive through the town.<sup>1</sup>

Another of our findings is that well educated people (scientists, scholars, artists and members of the liberal profession) are far more susceptible to the noise of traffic than relatively uneducated people.<sup>3d</sup>

In August 1956 the use of motor horns was made illegal in Moscow and the noise level in the streets immediately dropped by eight to ten phons.<sup>3b</sup>

France forbids the playing of transistor radios on rail, bus and metro transport as well as in streets and public places such as parks and beaches. Nor is their use tolerated in restaurants and similar establishments.<sup>3</sup>

A New York skyscraper completed last year proved that buildings can be constructed quietly. People working in offices near the new 52 storey building reported that power lawn mowers buzzing around their suburban

homes were more disturbing than the construction job. Blasting was muffled by special steel mesh blankets weighing several tons each. Spread over the blast site by cranes, they absorbed most of the sounds of the explosions, and also kept flying debris safely within a confined area. All the joints on the 14,000 tons of steel in the frame were welded silently to eliminate the hideous, shattering racket of conventional riveting or bolting.<sup>3</sup>

The aim of technical development should be to serve man, to make his life more agreeable and enrich it. So logically, technical progress should lead to less noise, not more.<sup>3e</sup>

Still, superscreams are now being generated in military labs. Robert Gilchrist, president of Federal Sign and Signal tells of tantalizing rumors that have circulated in the noisemaking business over the past few years. "We just heard about a siren of some kind, supposedly intended for Vietnam", he says. "It's said to produce something like 200 decibels". That would be several hundred times as powerful as Professor Rudnick's monstrous screamer.<sup>2</sup>

A sudden, very loud noise, such as gunfire, lasting only fractions of a second, may damage a person's hearing mechanism and produce a lasting loss of hearing or partial deafness. But exposure to noise levels quite common in industry — and indeed characteristic of certain branches of heavy industry such as forging and metal cutting — leads, progressively to 'perceptive deafness', depending in each case on the intensity of the noise and duration of exposure. Once a hearing defect of this kind has set in, nothing can be done. Protective devices can help to postpone it and to slow down its development, but once the damage is done, it is irreparable.<sup>3e</sup>

In the U.S.A. it is estimated that approximately 1,000,000 workers have serious hearing loss due to high noise levels in their places of work.<sup>3</sup>

#### DEAR STUDENTS:

IT IS TIME TO GET ACQUAINTED WITH A NEW SUBJECT: FORENSIC ACOUSTICS, THE STUDY OF THE GROWING NUMBER OF NOISE-NUISANCE AND EAR-DAMAGE CASES TAKEN TO COURT. YOUR OLD TEACHER HOPES THAT YOU MAY ALSO BE INTERESTED IN LEARNING ABOUT THE WORK OF YOUR LOCAL NOISE ABATEMENT SOCIETY, OR, IF YOUR COMMUNITY DOES NOT YET POSSESS ONE, THAT YOU MIGHT YOURSELVES FORM SUCH A SOCIETY. ADDRESS OF THE INTERNATIONAL SOCIETY AGAINST NOISE: SIHLSTRASSE 17, ZURICH, SWITZERLAND

## VI

## Three Thresholds of the Audible and One of the Bearable

One day we spoke of clavichords. Clavichords make such tiny dulcet sounds that you can scarcely hear them. Heads cocked over the strings we listened to its tremulous vibrato.

— Ssh, said Barbara.

No one dared breathe as out of the egg-shell box a tiny musical message was whispered to us.

— And you say Bach actually preferred this to the organ and the piano? Doug asked after the recital was over.

— He did.

— Why?

— It was more subtle and he was a sensitive man.

— But it is so soft you have to listen so hard.

— Yes.

— Perhaps they had more acute hearing in Bach's days.

— Perhaps. They did seem to be more satisfied with soft and moderately loud sounds. One of the interesting things we discover when we look at history is that music keeps getting louder. All the famous old violins by Stradivarius and the others were strengthened during the 19th century so that they could produce stronger sounds. The piano replaced the harpsichord and the clavichord largely because it produced stronger sounds. Today, as the electric guitar and the contact microphone demonstrate, we are no longer content with natural sound at all, but want to boost it up to 'bigger than life' size. Amplifiers are now available of sufficient strength to push sounds right past the threshold of pain.

— What's that?

— That's when the sound pressure becomes so strong on the ear drums that it gives you physical pain or may even make your ears bleed. Ultimately you grow deaf.

Everyone looked a bit puzzled and scared. The amplifier as a lethal weapon through which music could conceivably destroy the human

organism instead of bringing pleasure to it? But with the memory of our recent dance band still causing the adrenalin in my ears to bubble, I realized how close we were in fact coming to the pain threshold of bearable sound, which is around 120 decibels.

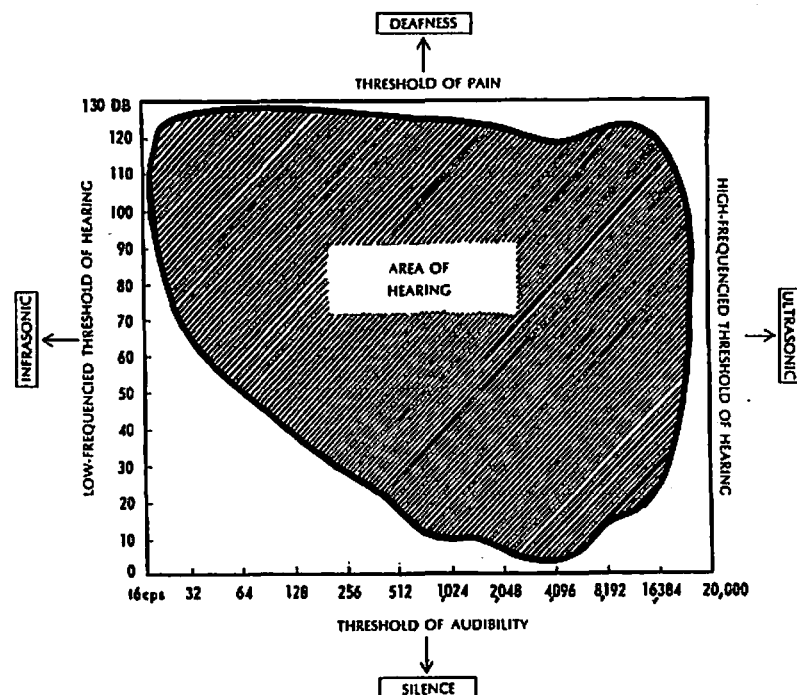
There has always been a certain malevolent streak among composers to 'shock' the audience, a certain tendency toward pugilism bordering at times on brutality which is evident in composers as diverse as Beethoven, Berlioz, Stravinsky and Stockhausen. I recalled that the critic Susan Sontag, speaking of the theatre of Happenings, noted that its most striking feature was its abusive treatment of the audience. During the Middle Ages the Pied Piper of Hamelin lured his victims off to their destruction by the irresistibly sweet tones of his flute. Today's sadist with his amplifier can kill his victims on the spot.

My class reacted suspiciously to my remarks. I *was* getting carried away. But I did not think (and as I write this, still do not think) that my pessimism and fear were unjustifiable. That extremely loud noises seem to glut the brain's sensation-receiving capacity making it impossible for the human being to function, is known by police departments which now use sirens to bring riots to a standstill. Deafness, of the kind found in the iron foundry, may indeed soon cease to be merely an occupational disease. At any rate, a society which experiments with sounds of humanly destructive intensities in the military lab cannot seriously expect the nastier of its private citizens not to participate in these vengeful amusements in whatever ways are at hand.

There is one threshold of the bearable and there are three of the audible. We can have sounds so soft they cannot be heard by the human ear. For instance, if we strike a tuning fork and listen the sound soon seems to die away although we can see the fork vibrating; and if we amplify it by placing the fork on a table top we can hear it again, proving that it was still generating sound all along even though the sound was, before the resonance given it by the table, below the threshold of audibility for the human ear.

We also have sounds so high or so low that they cannot be heard. At about 16 cycles per second we cease to hear low sounds and begin to feel them as massive vibrations which may shake the room. At 20,000 cycles per second or less, high sounds disappear as they pass out of the human hearing range. These things can be demonstrated with an oscillator, and young people are always a little proud when they discover that they can hear sounds somewhat higher than old people — a purely physiological fact resulting from youth. Many animals can out-hear men, of course, both in their sensitivity to very soft sounds and in their ability to hear higher frequencies. The cat, for instance, can hear sounds as high as 60,000 cps.

We can draw a chart showing the perimeter of the humanly audible. The ordinate shows the intensity of the sound in decibels with 0 db fixed at the threshold of audibility; while the abscissa shows the frequency range.



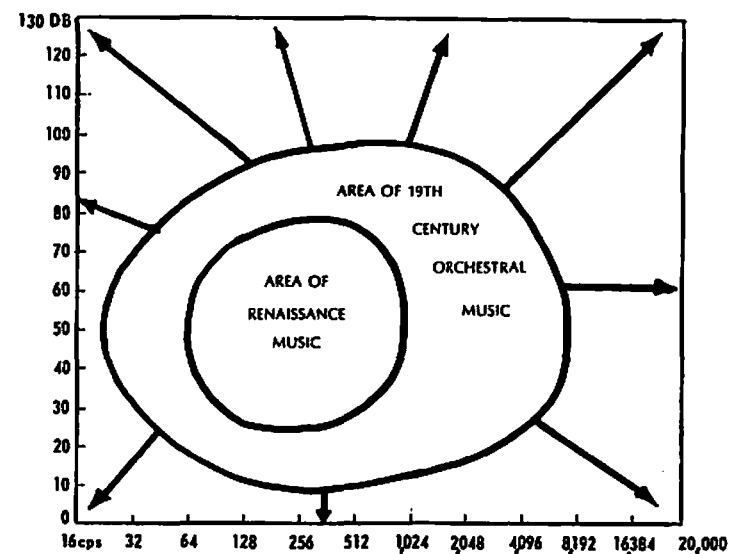
History shows that music is constantly getting louder. In reaction it has been getting softer too. Anton Webern wrote diminutive pieces in which there are sounds bordering on the threshold of audibility, (they are so soft). And you can speculate on how soft Morton Feldman intends the sound to be when he instructs a percussion player to play chimes and vibraphone with the fleshly part of his fingertips.

The same thing has happened to the pitch range of music. It has been pushed out gradually to the limits of perceptibility. Up to the Renaissance vocal music predominated and since the human singing voice from bass to soprano (excluding harmonics) extends roughly across the frequency range from 100 cycles to 1,000 cycles, most music was confined to this central frequency register. As instruments were invented which were more versatile in performance this range was expanded greatly. We now have electronic sounds which take us right

to the audible limits in both directions, or as close to them as our recording and reproduction equipment permits us to go.

It is easy to see that those instruments we call warm or lyrical (the cello, the viola, the horn, the clarinet) are precisely those which most closely approximate the range of the human voice. But if a composer wishes to suggest a sublime or superhuman event or sensation he makes considerable use of those instruments which lie far outside the human vocal range. This is the most evident in church music where the extremely high and low notes of the pipe organ can be used to suggest the voices of God and the celestial beings. Today if electronic music sounds eerie to some people it is partly because of its predilection for 'transcendental' extremities in the frequency range.

Speaking approximately, we may say that while up to the Renaissance, or even up to the 18th century, music occupied an area in intensity and frequency range such as that shown in the core of our graph, since that time it has progressively pushed out so that it is practically coincidental with the shape representing the total area of humanly audible sound!



The composer can now journey anywhere throughout the soundscape of the audible.

We tried to sense this by following various pieces of recorded music through this graph of expressive potentials with the tip of our pencils,



registering all the fluctuations in pitch and dynamics. Then by drawing an enlarged version of the graph on the board and using a number of different sound-producers we tried to follow a moving pointer in order to reproduce these sensations at least in a general way.\*

By jumping the pointer from one extreme position to another on our chart (say, very loud and high to very soft and low) we led ourselves into the whole matter of *contrast*.

Any theory of music will sooner or later develop a sweeping series of studies dealing with contrast. Traditional tonal music had many kinds of contrast, of which that produced by the flickering alternation (I nearly wrote altercation) between consonance and dissonance inspired the most theorizing.

Every dissonance demanded its resolution in a consonance. Every consonance demanded a dissonance to disturb its boring life. The two were intimate enemies.

In the early days of atonal music it was thought that dissonance had murdered consonance and had imposed itself as the absolute despot of music. We realize now that this was an illusion and that sounds are only relatively consonant or dissonant depending on their context.

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\* At the moment, of course, this is a horribly inexact exercise, for none of us have much feeling for pitch recognition based on the frequency scale or loudness recognition based on the decibel or phon scale. This would have to be learned. The new theory of music will have to develop some descriptive method of identifying and measuring perceived sound and it would seem natural that one conforming to the scientific measurement of sound would be the most appropriate, for it would give us the necessary flexibility for describing our perceptions of all sounds, which the traditional vocabulary of music theory does not do. After all, there is nothing sacred about a few Italian intuitions on the subject of dynamics or a handful of alphabetical symbols to designate pitch.

To have perfect pitch would then be to have perfect frequency, i.e. to know the difference between 440 and 466 cps. Sound clusters could be learned by their approximate band widths.

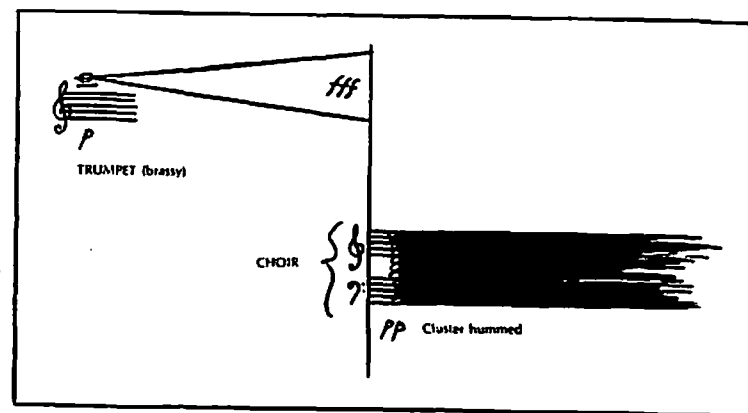
Frequency might also give us the clue to measuring tempo and rhythm, for frequency tells us the number of cycles per second. If the second were adopted as the basic temporal module in the new solfège, we could quickly speak of rhythmic octaves (doubling the speed), and the ratios between would give us all the rhythmic nuancing necessary.

The advantages of working out a solfège along the lines I am suggesting would be that all sounds could thereby be described and these descriptions could be checked quickly and accurately with electronic test equipment.

Dissonance is tension and consonance is relaxation. Just as the human musculature tenses and relaxes alternately, you cannot have the one activity without the other. Thus, neither term has absolute meaning; each defines the other. Anyone who does not realize this should try clenching his fist tightly for the rest of his life.

Consonance and dissonance are like two elastics, one stretched more tightly than the other. Their relativity is clarified by the addition of a third elastic, stretched more tightly than the first two. Now describe the role of the middle elastic vis-à-vis each of its neighbors.

No matter what happens to music the words consonance and dissonance will still be central to our theoretical vocabulary and they will apply to any set of opposites, not just tonal contrasts. A short sound, for instance, is dissonant by comparison to a sustained one. If you want some neutral words try Yin and Yang but you will always need some vocabulary to describe and measure contrast, for that is inevitable. But if we stick with the words consonance and dissonance we must expand the strictly limited meanings they had when applied to tonal music only. For instance, a single example:



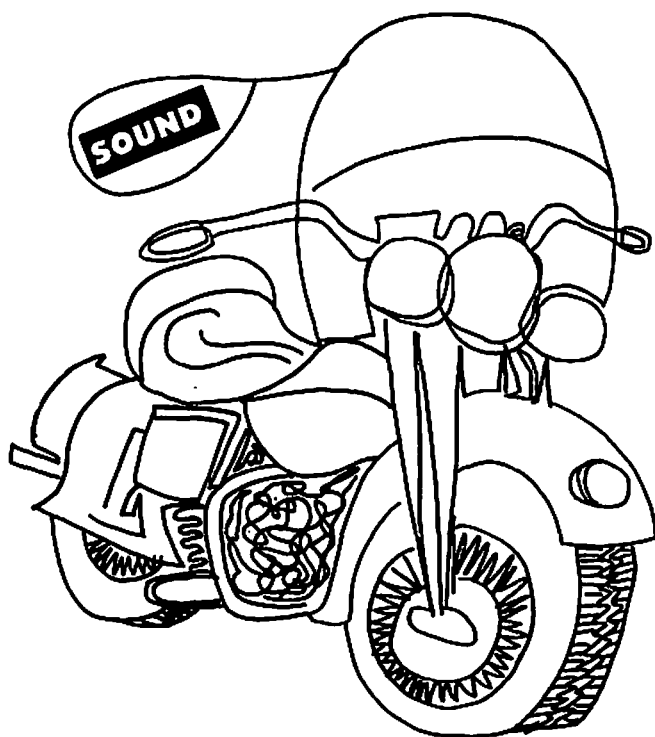
Quite contrary to what the traditional theorist would say, this single brazen trumpet sound with its asymmetrical harmonics is a dissonant event which finds its resolution in the soft velvet of the vocal tone cluster. Try it and you will hear this immediately. If you analyze some recent music in terms of its dissonances and consonances, tensions

and relaxations, your instinct will show how desperately the textbooks need revision.

Thus, to conclude, we can make three important observations:

- 1) The concept of the threshold now becomes important for musicians because it divides in a very real sense the audibly possible from the audibly impossible.
- 2) We need to develop a new means for describing the sounds we perceive . . . I suggest this might be in line with the acoustic measuring standards of electronic instruments, which we could use to check our subjective sensations.
- 3) Any sound complex can be analyzed in terms of its relative consonance and dissonance within its acoustic neighborhood. Consonance and dissonance refer to variations in intensity, pitch, duration or tone color anywhere within the perimeters of the audibly possible.

The class was pensive. I began to feel like a theory teacher.



## VII

### Beyond the Audible

— What about the audibly impossible? asked Donna, smiling irresistibly. We saw what happened if you went beyond the pain threshold. What about the other directions?

— OK, I said. We need an interlude, so let's indulge in some wild speculations. If you go very low, below about 16 cycles you no longer have a sensation of pitch but rather of vibratory tremblings. We call this the infrasonic range, as distinct from the range above about 20,000 cycles which we call the ultrasonic. You know the experience when a very deep pedal note on the organ gets the whole church vibrating. You could possibly imagine a kind of massage-music resulting from these very deep frequencies, for this is the area where the sense of hearing and the sense of touch overlap. I've known some young composers who became interested in this land of musical massage and they claim to have composed pieces using only these deep frequencies.

— What are they like?

— I've never felt them.

— It must be something like the 'feelies' that Aldous Huxley talks about in *Brave New World*.

— Certainly various parts of the body resonate at various frequencies, some in the audible range and some below or above.

For instance, it has been discovered that the average human anal sphincter resonates at about 77 cycles. If it resonates hard enough it can no longer be controlled. Police have experimented in the control of mobs by employing very loud sounds of this frequency.

An intriguing use of infrasonic waves forms the basis of a piece of music by the American composer Alvin Lucier. This uses the alpha waves of the brain as its sound-generating source. Alpha waves occur when one closes one's eyes and indulges in non-visualizing thought. A low-voltage brain-wave current, the alpha-wave signal is about 10 cycles. In Lucier's piece the performer has electrodes implanted on his skull to pick up these waves. You may imagine how theatrical the performance preparations could be! The waves are then amplified and fed to a number of loudspeakers before which are placed some musical

instruments such as gongs which resonate sympathetically with these very low signals.

**Doug:** *Now that's a piece I'd really like to hear!*

**Schafer:** What you really hear are the harmonics of the gongs. You can't hear the alpha waves themselves; they are too low. Perhaps, as I just mentioned, the most interesting aspect of the performance would be the fascinating spectacle of a solo performer sitting on the stage with electrodes on his skull, closing and opening his eyes to start and stop the sounds, for alpha waves are only present when the eyes are closed — and sometimes not even then, to the misfortune of some attempts to perform the piece.

**Donna:** *What about high-frequency sounds, beyond 20,000 cycles?*

**Schafer:** You remember we mentioned that cats could hear sounds up to 60,000 cycles, which gives them quite an edge on us. It may seem a little bizarre, but it's conceivable that compositions could be created in these upper frequency bands and performed on electronic generators exclusively for the appreciation of cats and their friends. Using electronic instruments you could easily write a symphony for cats that would be completely inaudible for us, and I suppose some day someone will have the bright inspiration of doing just that, though the indifferent cats will probably not make very good patrons of such music. Many animals can hear much higher sounds than we can.

Barbara, perhaps for tomorrow you could try to find out something about the hearing ranges of some of these animals and insects. Jeff, you and Donna see what you can find out about music under the microscope. I was talking to Dr. E. J. Wells in the chemistry department about this the other day. I think he may have something interesting to tell you in connexion with his recent research. Then maybe Doug could find out something about the Music of the Spheres . . .

**Doug:** . . . *the what?*

**Schafer:** The Music of the Spheres. Have a look in some music history books. Then try some books on astronomy.

**Doug:** *Sounds wild!*

**Schafer:** It is a bit. See you tomorrow.

---

Tomorrow. All were present, shuffling their notes, clearing their throats, anxious to begin.

**Schafer:** Barbara?

**Barbara:** *One of the most interesting kinds of hearing ability in the — what did*

*you call it? — the ultrasonic range is that of the bat. Bats use ultrasonic echoes at about 50,000 cycles to fly around obstacles without crack-ups. They bounce cries off obstacles and thus are warned to beware of them. They do this at an amazing rate of 50 echoing ultrasonic cries per second.*

*I also found something about the hearing of grasshoppers. Some of them have little circular membranes like ears on their forelegs. The females are courted by the males who chirp or sing to them. If a male chirps into a telephone, a female at the other end can be made to jump up and down even without seeing him. Sex appeal among the grasshoppers definitely seems to have to do with hearing rather than seeing.*

Mating call of the Beatle



Schafer: Charles Darwin thought that even our music was nothing but a highly developed form of the mating call.

Donna: *(smiling debonairly): There are a lot of love songs in all music.*

Seeing no neat way to terminate this discussion it was my turn to shuffle my papers and light my pipe. Then, "What did you find out from Dr. Wells?"

Jeff: *We listened to nuclear music in his laboratory.*

Schafer: You tantalize us. What does it sound like?

Donna: *It makes little pinging sounds, very clear little pings, sharp at first then dying away. I've never heard anything quite like it before.*

Schafer: Did Dr. Wells explain to you how he was producing it?

Jeff: *Yes he did, and then he wrote out a little account. Perhaps I could read it. It's called Nuclear Music.*

All matter is composed of molecules. Molecules are built from atoms. An atom consists of a very small nucleus carrying a positive charge, and a much larger charge cloud built of electrons, so that the total atom is electrically neutral. The atoms in a molecule are held together by chemical bonds, which are nothing more than directional electron clouds. Thus a molecule resembles a plum pudding — the nuclear plums are immersed in an electron cloud dough.

Now some nuclei spin on their own axis like tops. Those that do (the nuclei of the atoms of hydrogen, fluorine and phosphorus are examples) then behave like tiny magnets. As such they can be lined up in a large magnetic field, just as a small compass needle is aligned in the magnetic field of the earth. However, the alignment of the axis of spin of a single spinning nucleus with the magnetic field is not perfect. It turns out that for a single spinning nucleus, the axis of spin rotates about the field direction with a frequency proportional to the field strength. The motion is called precession and the frequency is the precessional frequency. For a given field strength, this frequency is a natural, well-defined nuclear frequency.

Now in a good strong laboratory magnet different kinds of nuclei precess in different frequency regions scattered through the radio-frequency spectrum. In an electromagnet with a field strength of 14,000 gauss the nuclei of hydrogen precess at about 60 million cycles per second, those of fluorine at about 56 million cycles, and those of phosphorus at about 24 million cycles. Moreover the characteristic frequency of a single kind of nucleus is modified slightly by two subtle types of interaction with the surrounding electron cloud. It is found that the nuclear frequency depends slightly on the density of the electron cloud surrounding the nucleus, i.e. on the thickness of the dough around each plum in our pudding model. This effect is of interest to chemists since all chemistry is due to the electron dough. Then if a molecule contains several nuclei of the same type, but in different architectural positions within the molecule, these nuclei will have a precessional frequency charac-

teristics of their position, and the molecule has a characteristic fingerprint nuclear magnetic frequency spectrum.

If you want to hear a guitar you pluck the string. When it is plucked it is removed briefly from its undisturbed position of equilibrium. In doing so it emits its own characteristic note or frequency, which depends on the string tension, and the loudness of the note is damped, or decays in time, due to the frictional losses from the vibrating string to the surrounding air.

Returning to our molecules, the nuclei acting in concert also can be 'plucked' away from their low energy orientation along the magnetic field by a short pulse of radio-frequency with frequency close to the natural nuclear frequency. From this high energy state the nuclei return to equilibrium and in doing so they emit their own damped characteristic precession frequency as a radio signal. The damping process here is quite different from that of the guitar string, but the result is quite similar. By standard radio-frequency techniques it is possible to heterodyne out the high radio-frequency carrier signal, and to make audible the small frequency differences between the various nuclei in our sample.

In general the more complicated the molecule the more complicated is the nuclear frequency spectrum, and hence the more complex and more audibly interesting the modulated envelope of the time spectrum. This modulation envelope is a pure molecular property, and in a very real sense the method which produces 'nuclear music' provides a new vehicle for impressing a unique characteristic of a molecule on the ear. And since understanding comes from the complete human interaction, any method which increases the number of senses that can be brought to bear can give new illumination.

Donna: *What does 'heterodyne' mean? I got lost in Dr. Wells' notes somewhere around there.*

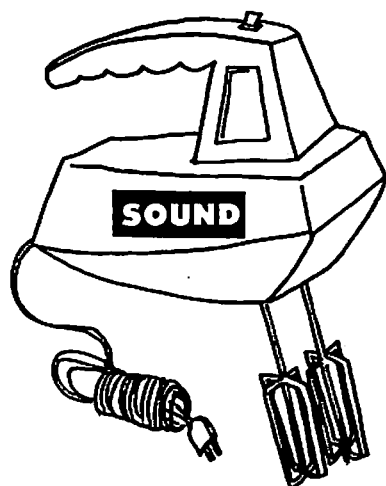
Schafer: It refers to a practice of combining frequencies in the radio-frequency range in such a way as to produce beats whose frequencies are the sum and difference of the original frequencies. In the audio range this phenomenon is also well known, producing what are called *difference* and *summation* tones. It would take us well off course to go into the mathematics of this, but a good book on acoustics will explain it to you. It's enough to understand that the difference tone between two frequencies of, say, 1,000 cycles and 100 cycles would be 900 cycles, and the summation tone would be 1,100 cycles. Many difference tones can be heard quite easily with the naked ear; summation tones are usually rather more obscure.

Remember that the precessional frequencies of Dr. Wells' molecular nuclei are in the radio-frequency range; they oscillate at a speed of millions of cycles per second. He has made them audible by plucking them with another radio pulse of almost, but not exactly, the same frequency, thus producing a *difference* tone in the audio range. He

has found it useful to store these sounds on recorded tapes for later analysis.

We might have thought that the world under the microscope would be a silent one, but even here we find that we can, with the aid of electronic equipment, discover sounds.

So much, then, for the microcosmic world of molecules. What about the macrocosmic world of stars and planets? Doug, what did you discover about the Music of the Spheres?



## VIII

### The Music of the Spheres

Doug began with alacrity.

— *The Music of the Spheres is a very ancient theory; it goes back at least to the Greeks, particularly to the school of Pythagoras. It was thought that each of the planets and stars made music as it travelled through the heavens. Pythagoras, who had worked out the ratios between the various harmonics of a sounding string, found that there was a perfect mathematical correspondence between them, and as he was also interested in the heavens and noted that they too moved in an orderly way, he conjectured that the two things were merely aspects of the same perfect mathematical law which governed the universe. If this was the case then obviously the planets and stars must make perfect musical sounds as they moved just as the vibrating string gave off perfect harmonics.*

Barbara: Did he ever hear the Music of the Spheres?

Doug: He is supposed to have heard it, according to his disciples. But no one else ever heard it.

Barbara: But I don't understand how the stars made music.

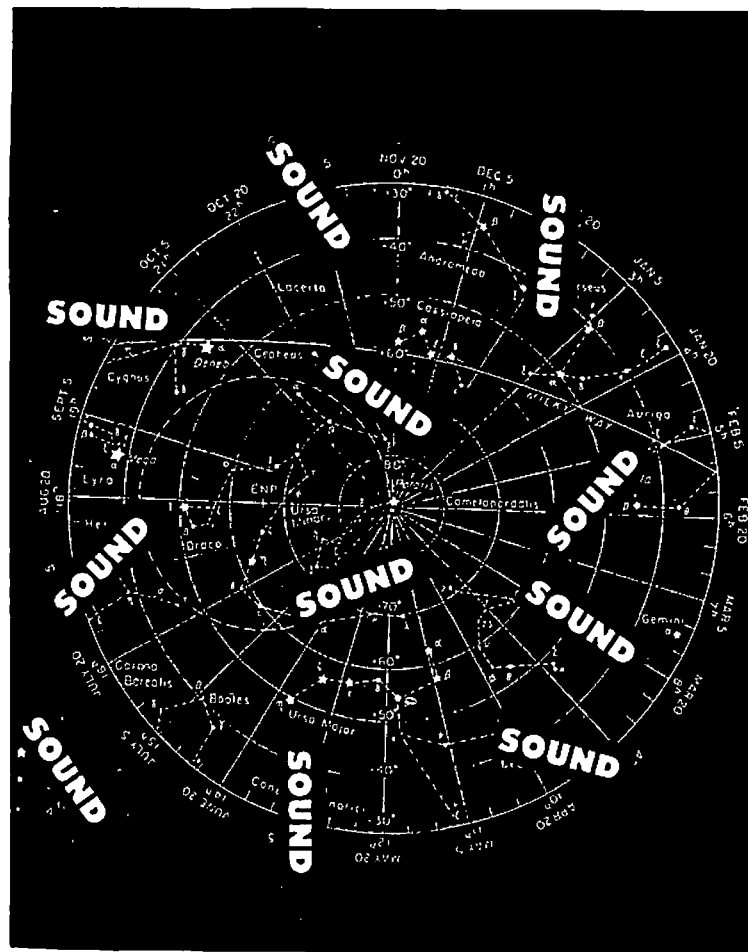
Schafer: You've all seen children's tops so you know that when you spin them they give off a certain tone. If you spin them harder what happens?

Barbara: The pitch rises.

Schafer: And if I had a large top and a small top and spun them both at the same speed what would be the difference?

Barbara: The large one would produce a lower sound.

Schafer: Then you should be able to determine the sound any spinning body sends out if you know its volume and the speed at which it is revolving. And as the heavens consist of millions of planets and stars, all different sizes and spinning at different rates, you can see how the Ancients thought there must be a whole symphony of such sounds. If you had enough planets spinning around on themselves and in



different orbits so that from wherever you listened they would constantly be changing their speed and distance from you, you would have a celestial harmony in stereo that was forever changing.

Barbara: But I don't hear it. How can we hear it?

Doug: Ssh! Listen!

(Long pause)

Barbara: You're just fooling. I don't hear anything.

Doug: Well, apparently you're not supposed to be able to hear anything. I don't know exactly why. But almost everyone in ancient times seems to have believed there was a Music of the Spheres. I was reading about this in a medieval writer, Boethius, who lived from 480 to 524 A.D. He said there were three kinds of music: vocal music, instrumental music, and Music of the Spheres. Here is what he said about the Music of the Spheres:

How indeed could the swift mechanism of the sky move silently in its course. And although this sound does not reach our ears, as must for many reasons be the case . . .

though he doesn't give his reasons

. . . the extremely rapid motion of such great bodies could not be altogether without sound, especially since the courses of the stars are joined together by such a natural adaptation that nothing more equally compacted or united could be imagined. For some are borne higher and others lower, and all are revolved with just impulse, and from their different inequalities and established order of modulation cannot be lacking in this celestial motion.

I also came across a reference to it in Shakespeare's *Merchant of Venice*:

Look how the floor of heaven  
Is thick inlaid with patines of bright gold;  
There's not the smallest which thou behold'st  
But in his motion like an angel sings . . .  
Such harmony is in immortal souls;  
But, whilst this muddy vesture of decay  
Doth grossly close it in, we cannot hear it.

Schafer: The astronomer Kepler was a contemporary of Shakespeare. Did you find any reference to Kepler's interest in the Music of the Spheres? He was infatuated with it.

Doug: That's the best part. I was saving it. Kepler tried to compute the various sounds given off by the different planets depending on their rate of velocity and their mass — just like the tops. He actually came up with some tones for each of the planets. Here they are:



Everyone was anxious to hear these sounds, so we played them on the piano.

Barbara: *Is that all that Kepler heard? It's very disappointing.*

Schafer: I don't think he actually heard it. He merely computed it mathematically and conjectured that if you could hear the planets they might sound like that.

Barbara: *But didn't anyone hear them? Why can't you hear . . .*

Jeff: *Because there is no air in outer space and sound waves need air in which to travel.*

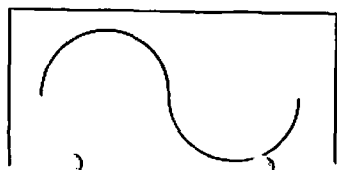
Schafer: What would music sound like on the moon?

Jeff: *It wouldn't.*

Schafer: Because there is no atmosphere there. Sound waves need a physical medium in which to move. You must have done the experiment in high school physics where you put a tuning fork in a jar and then pumped out all the air. You can't hear the tuning fork any more.

But I've often wondered whether there isn't another reason too. Let me try to explain without getting too technical.

If we want to speak of the most elementary sound possible we will have to consider what is called the sine wave. The mathematician Schillinger has described this eloquently: 'One sine wave is the limit of simplicity in action'. The sine wave is the wave formed by a pure tone without any harmonics. It is the sound of the tuning fork and looks like this on an oscilloscope:



According to the French mathematician Fourier, any periodic sound, no matter how complex, is capable of being resolved into a number of these absolutely elementary sine waves; and the process of this investigation is called harmonic analysis. But Fourier also stated that the perfectly pure (mathematically defined) sine wave exists as a theoretical concept only. Because the moment you switch on the generator or strike the tuning fork you create little distortions called *onset transient distortions*. That is to say, the sound first has to overcome its own inertia to be set in motion, and in doing this little imperfections creep into it. The same thing is true of our ears. For the ear drum to begin vibrating it too has first to overcome its own inertia, and accordingly it too introduces more transient distortions.

Barbara: *Couldn't you get rid of them by starting the sound a long time ahead?*

Schafer: Well, we're speaking purely speculatively today. The question is, how far ahead? In order to get rid of onset transient distortion completely you'd have to start the sound before you were born. The universe started before any of us were born. Maybe there are mathematically perfect sounds in the universe which have always been sounding. And if so, perhaps we could never hear them just because they are so perfect. All the sounds we hear are imperfect; that is to say, they start and they stop. And so they have tiny transient distortions in them. Is it not possible that there might indeed be some kind of Harmony of the Spheres which we can't hear because we are imperfect beings?

Doug: *That's just what the medieval writers thought.*

Schafer: We have for a long time dismissed this as a foolish thought. But sometimes it seems people have mysteriously intuited an idea without knowing exactly why it should be valid, and only later has it been rehabilitated and validated by science. What I'm saying is merely what these ancient scholars believed, that a perfect sound would be perceived by us as *silence*!

There was a moment of quiet as that crazy idea sank in.

Schafer: If something is with you all your lives you take it for granted because you can't get outside to measure it. For instance, we've all been breathing air since birth, but what is the smell of air? It seems perfectly natural and odorless to us because we can't get away from it. All we can smell is the impurities in it. Well, perhaps it's somewhat the same with the Music of the Spheres. It is perfect and our music is just an imperfect human attempt to recreate it.

Donna: *It sounds religious.*

Schafer: Is that bad?

Jeff: But there have been unidentified sounds picked up from outer space, haven't there?

Schafer: Tell us about them.

Jeff: I don't really know except I've heard people mention that mysterious radio signals have been picked up from outer space.

Schafer: There's an observatory in town. Why not phone up an astronomer and ask him about it?

Jeff did this and fifteen minutes later he was ready to report back.

Jeff: Astronomers have picked up signals from outer space but they are electromagnetic radiations, not sound waves. Electromagnetic radiations do not require a medium for their propagation and thus can pass across the vacuum of space. They are of much higher frequency than the sound waves you have been talking about, impossible for the human ear to hear. But they are still the longest of an entire range of radiations progressing through micro-waves, radiant heat waves, infra-red, visible light, and ultra-violet waves, then to the X-ray spectra and finally to cosmic waves which are the shortest and highest frequency yet known to exist. All these waves move with the speed of light and are about 100,000 times faster than sound waves.

In 1955 the first radio waves were heard from Jupiter and those were the first heard from any planet in our solar system. They seemed to be organized but according to astronomers this does not mean that they were transmitted by outer space creatures. In fact, they are believed to have been caused by disturbances in the atmosphere of Jupiter similar to our thunderstorms. They sounded just like bursts of static on the radio.

Schafer: We certainly covered a lot of ground in our fanciful quest for music under the microscope and beyond the telescope. Are there any questions before we break up?

Barbara: How does the radio work? I mean, I've always wondered how it's possible to have someone talking in one place and being heard in another without wires.

The rest of our session that day and the next consisted of an enquiry into how the radio worked. When we got confused we invited a radio technician to the class to straighten us out. It wasn't music, but it was fascinating.

## IX

## Schizophonia

We left the radio on. The voice of a disc jockey puffed along:

Hey men, the Big Boss with the hot sauce's gotta secret!  
It's the Stevie Pinkus giveaway time. (blip-bloop-bleep)  
Yessir, Big Stevie's giving away free, free prizes again!  
Hold on men, we might be calling youhoo (fanfare).

— Schizophonic, I said.

— Schizo-what? the group asked.

— Schizophonic. It's a word I invented. You know that *phono* pertains to sound. The Greek prefix *schizo* means split or separated. I was thinking of Barbara's wonder at how a voice or music could originate one place and be heard in a completely different place miles away.

... And now for all the buddies on the buddy-line here's the number one song in the nation at 4:10 p.m. 'Wah Wah Wah' ...

— Mind if I turn it off? (They did but I turned it off anyway). The radio and the telephone have not always existed, of course, and before they did this miracle of the instantaneous transmission of sound from one place to another was quite unknown. Your voice only travelled as far as you could shout. Sounds were tied indissolubly to the mechanisms that produced them. In those days every sound was an original, repeated only in its immediate vicinity.

Now all that has changed. Since the invention of electronic equipment for the transmission and storage of sound, any natural sound, no matter how tiny, can be blown up and shot around the world, or packaged on tape or record for the generations of the future. We have split the sound from the makers of the sound. This dissociation I call *schizophonia*, and if I use a word close in sound to *schizophrenia* it is because I want very much to suggest to you the same sense of aberration and drama that this word evokes, for the developments of which we are speaking have had profound effects on our lives.

Let me suggest some of the drama of *schizophonia* by telling you a story which is supposed to be true. But even if it is apocryphal it won't matter.



You have all heard about Dracula, the vampire. This is supposed to be the origin of that legend:

About the turn of the century a certain Rumanian count went to Paris and fell madly in love with a young opera singer there. The young lady was quite famous and had made some recordings of operatic arias. But to the count's great grief she died quite suddenly and he despondently returned to his castle in the Carpathian mountains with a few recordings of her remarkable voice as his only souvenir. He had a statue of the lady sculpted in white marble and placed beside the fireplace of his drawing room, where in solitude each evening he played the recordings. The count had many peasants on his estate. These peasants, who, of course, had never seen a record player, peered into the windows on hearing a woman's voice, but saw only the count alone before the shadowy statue, and they were terrified. The count immediately became known as Dracula — *dracul* in Rumanian means 'devil'. All the other evil associated with the name springs from this simple misunderstanding.

You mustn't imagine Dracula with a hi-fi set. He probably had very poor quality cylinder recordings, for although the phonograph was invented in 1877, just a year after the telephone, it took many decades before its quality had improved and the records sounded anything like natural. Radio is even more recent. It dates from the invention of the triode amplifier tube in 1906, and it also took many years before it was in everyday use and you could listen to it without earphones and without making complicated adjustments. In spite of that, some people soon realized its possibilities: the first public amplification of a political speech occurred in 1919, undoubtedly to the great satisfaction of politicians everywhere, whose plangent voices could now reach limitless numbers of voters.

Modern life has been ventriloquized.

Through broadcasting and recording the binding relationship between a sound and the person making it has been dissolved. Sounds have been torn from their natural sockets and given an amplified and independent existence. Vocal sound, for instance, is no longer tied to a hole in the head but it is free to issue from anywhere in the landscape. Now we can tune in on sounds originating from all over the world in our homes, in our cars, in the streets, in our public buildings, anywhere and everywhere. And as the cry broadcasts distress, the loudspeaker communicates anxiety.

To catch and preserve the tissue of living sound is an ancient ambition of man. In Babylonian mythology there are hints of a specially constructed room in one of the *ziggurats* where whispers stayed forever. In an ancient Chinese legend a king has a secret black box

into which he speaks his orders, then sends them around his kingdom for his subjects to carry out, which I gloss to mean that there is *authority* in the magic of the captured sound.

— Writing is also a kind of captured sound, Barbara interjected. In ancient times only priests and monarchs knew its secret.

— And precisely because of this they managed to hold their power, Jeff added.

— Perhaps, I continued, something similar has happened in music. As musical notation became more and more precise the composer became more and more powerful. The composer of the early part of the 20th century tended to regard even the performers as push-button automata; everything was specified exactly in the score. The pages of such scores are black with editorializing.

Today we have the means for achieving even greater precision: recording. So important is the recording of music that it has come to replace the manuscript as the authentic musical utterance. Igor Stravinsky recognized this when he decided a few years ago to record all his music as a documentary guide to future conductors.

But no recording is an exact reproduction of living sound. Distortions are introduced in both its production and its playback. Even on the simplest home equipment there are devices for influencing the sound. By twisting the volume control knob the diminutive sound of the clavichord can be made to bulk up to the dimensions of a full orchestra; or an orchestra may be reduced to the whisper of the grass. Most hi-fi setups also have filters for reducing or boosting bass or treble frequencies. In these ways selectivity is introduced into the act of music listening and the listener is able to influence and control matters which in the past conformed to natural laws and were quite beyond his control.

What makes such a development spectacular is this: it is more *natural* for us today to listen to electrically reproduced music than to listen to live music, which begins to sound quite *unnatural*.

With tape recorders many other kinds of sound manipulations are possible which may lead to unrecognizable transformation and distortion of original sounds. Cutting and splicing tape, varying speed and frequency range, reversing sounds, and so forth; these are the techniques and they can be performed on most tape recorders.

We spent about an hour experimenting with sound in this way trying to discover the creative possibilities of the tape recorder.

First we had someone record an extended 'sh' very close to the microphone with the speed of the machine at its highest setting. Playing it

back at its lowest speed we discovered we had produced the sound of an enormous steam engine. Then we recorded someone biting into an apple at the same high speed and discovered at a slower speed we had a perfect imitation of a large tree falling in a reverberant forest.

Recording the middle and lower notes of a piano is such a way that the volume control was turned up only after the note had been struck, we were surprised at the organ-like or clarinet-like tones we had on tape.

Reversed sounds gave the group other surprises. On the whole they did not like them. A reversed sound has no natural reverberation; it expands backwards to burst in an echoless explosion. Without reverberation such sounds resemble those heard in an anechoic chamber, sounds which drop lifelessly to the floor. I have concluded the reason human beings find such sounds disconcerting is that they imply a world without air.

Have you ever heard your voice recorded and played back to you? Try it. It's surprising and educating. You can get outside yourself and critically inspect your voiceprint. Is that stammering and quirky sound really me, you say? You are a little more conscious of the way you speak afterwards.

Through recording we can freeze sounds for study. Great progress has been made in the analysis and synthesis of sound since the invention of recording. Before this, pursuing sound was like trailing the wind.

At this point I put on a sound-effects records and asked the group to describe what they heard.

*Barbara: several knocks*

*Donna: knocking*

*Jeff: about a dozen knocks on a wooden door*

*Doug: ten knocks on a heavy door*

If, as in the past, there was no way of repeating that sound we would have to be satisfied with these descriptions, but today — listen again . . .

Listening again we agreed that the sound consisted of six light, rapid knocks on a solid wooden door, followed by a short pause, then three louder knocks. The ability to repeat the same sound pattern not only helps us to study more accurately, but also to study our own process of pattern perception.

Throughout our discussion one factor had been consistent: the cutting free of sound from its natural origins; and it is this which I called schizophonia.

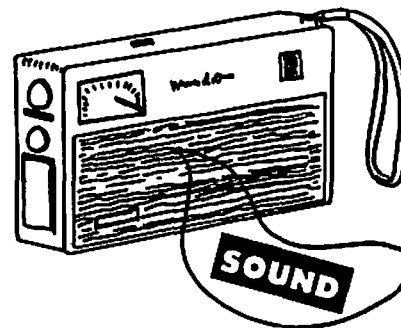
— Are you worried about it? asked Doug.

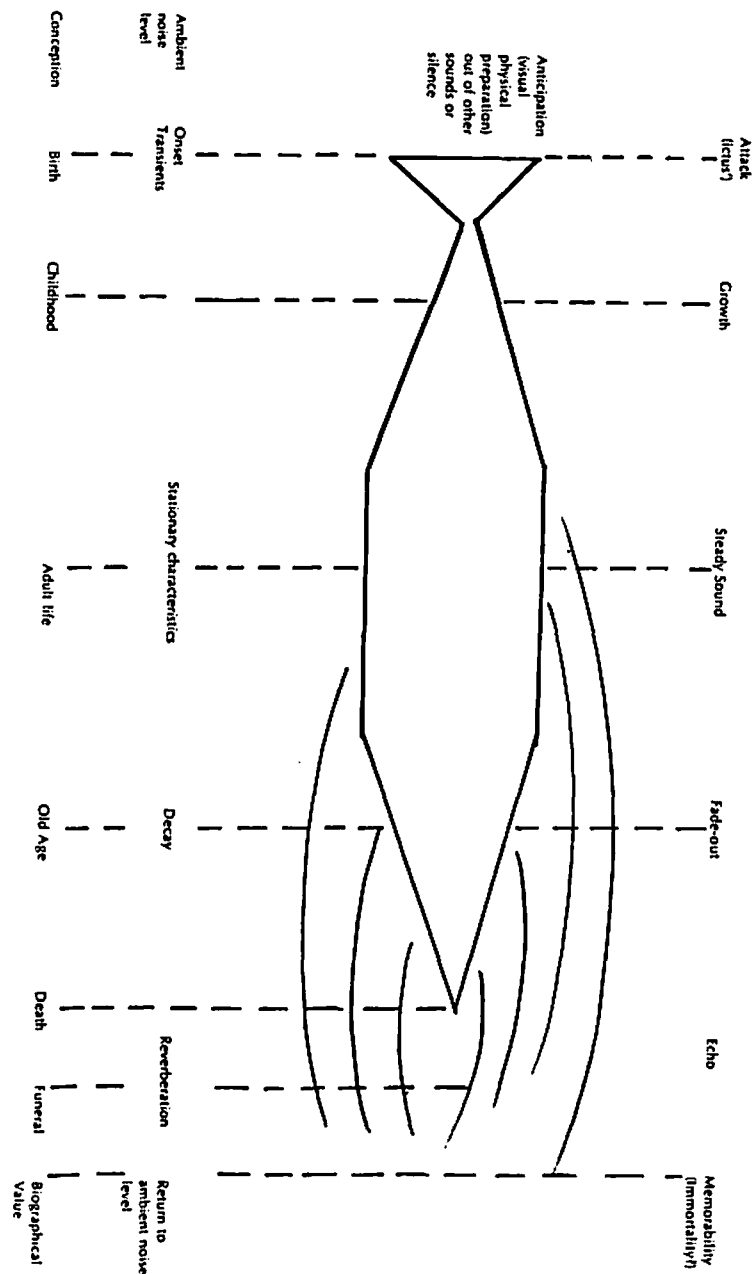
— We *are* living with it, aren't we? Perhaps it will only be possible to look back at a later date and determine whether it did us good or ill. But one matter does concern me. I wonder if I can explain it. Throughout previous life there has always been a correspondence between the physiological activity of producing a sound and the psychological qualities we attribute to it. There is a big energy output in a loud sound, a tensing in a high sound, a relaxing in a low sound and so forth. This is true whether you use your vocal chords or a musical instrument. I would say this has helped us to feel into the depths of sounds with our muscles and nerves. And since we produce these sounds with our bodies we have an instinctive sympathetic feeling when others produce them for our benefit and pleasure.

Today there is no relationship really between turning the volume dial on your radio up or down and the state of affairs that results. Electronic music is composed almost exclusively in this way. The composer sits in front of the dials governing his amplifiers and oscillators, but the tiny pantomimic dancing of his fingers bears little relationship in physical terms to what he may be producing in sound. Will the consequences of this schizophrenic development be positive or negative? I leave you this debate. "Schizophonia" (its inventor says) is supposed to be a nervous word.

(click)

*Well here we are again with the pops tops and the Big Boss with the hot sauce t'spin 'em for ya. (Bloop-blip-bleep) Get set for the nation's choices at 5:10 p.m. this happy afternoon in your town right after this impoooooooooortant message . . .*





X

## The Sound Object

Listen!

Listen to the sound of your own eyelashes fluttering!

What else can you hear? Each of the things you hear is a sound object. The sound object may be found anywhere. It is high, low, long, short, loud, soft, continuous or discrete.

Sound objects may be found inside musical compositions and outside musical compositions.

"Bring an interesting sound to school" is an exercise I often give to a class. And they find sound objects at home, in the street, or in their imaginations.

Let us understand the sound object as one completely self-contained acoustic event. A unique event. It is born, it lives, it dies. In this sense we may speak of the biological life of the sound object.

Often the sound object occurs circumjacent to other sound objects. In this sense we may speak of the social life of the sound object.

When we speak thus, we speak metaphorically, for in reality sound consists of dead mechanical vibrations. It is an anthropomorphic preference which inclines us to speak of music in such big metaphors as the act of bringing sounds to life and giving them social existences.

Sound objects may differ in numerous important ways through variations in: 1) frequency (pitch) 2) intensity (loudness) 3) duration and 4) timbre (tone color).

In older forms of music discrete sound objects called 'tones' were used. Considered abstractly it was noted that tones appeared relatively isomorphic, that is they tended to resemble one another in their prime qualities — like bricks.

When we practise scales we tend to think of tones isomorphically — like bricks.



Big bricks:



Little bricks:



Often when we do theory exercises we tend to think of tones in this way. In an isomorphic system tones live mechanical rather than biological or social existences (if they live at all).



Compared with such a 'rational' theory of music, the multifarious sounds of the new music we have been studying may seem 'irrational'. On the other hand, traditional music theory underestimated the anarchic differences there are between different tones and tone-groupings through its addiction to the playing of scales and insistence on text-book graffiti. Great composers and performers certainly understood that the expressive potentials of tones are not at all the same when played in different registers, or by different instruments, or when attacked and released differently, or with different durations, or with different degrees of loudness.

Supporting the intuitions of master composers and performers, recent work in acoustics and psychoacoustics (from Helmholtz on) has helped to make us all aware of the fascinating variety of the world of sounds and the drama of their social life together.

At the most abstract level there are the studies of mathematical acoustics. Not all of these studies are relevant to the ear. But the sound object is an acoustic event, the features of which can be per-

ceived by the ear. By embracing and subsuming the 'tone' of traditional music, the sound object now replaces it as the term by which we describe the cosmogenic acoustic event. From sound events are soundscapes built.

Every sound object is enclosed in an ectoplasm which we call the sound envelope. Inside is a vibrant existence which we may divide into various stages of bio-acoustic life. The different stages may be given different names depending on how one wishes to view them, but the divisions of the envelope remain more or less the same. I have shown them together on a graph (p. 48).

## PREPARATION

To begin at the beginning.

Every sound has a manner of preparation (the pianist raises his hands, etc.) which is a mimetic advance signal. If it does not have this (a radio suddenly switched on behind one's back) it surprises us as much as would a birth not preceded by pregnancy. The mimetic preparations for a piece may extend right out to the conductor's dressing room. Ceremony, ritual, theatrics.

## ATTACK

Elsewhere I have called the attack the 'ictus', that is, the instant of sound-impact. It ought to be a traumatic experience. The still air is cut with pristine sound. For an instant there is total confusion.

The onset behavior of sound is a fascinating object for study. When a system is suddenly excited a great enrichment of the spectrum takes place giving a sound a rough edge. Technically this is called onset transient distortion. When a sound is attacked more slowly less of this sudden spectral excitement is present and an even tone quality emerges. Any instrument can attack smoothly or sharply; but some instruments have a natural tendency to 'speak' more quickly than others and thus have more dissonance in their attack. (Compare the trumpet and violin).

In classical music ornaments such as the *acciaccatura* were devices for emphasizing onset transient distortion. A nervous twitching at the head of a note. Addition of spice. *Piquer les dormeurs*.

## STATIONARY SOUND

Doesn't exist. In a sound everything is on the move. Nevertheless there may appear to be a period in the mid-life of a sound in which

nothing much is changing (same frequency, same volume etc.) and to the naked ear the sound seems unprogressive and stationary. It would be useful exercise for students to try and measure the duration of what they assume to be the stationary period of different sounds — that is, that portion separate from onset and decay characteristics. Some sounds have simply no stationary condition at all but consist entirely of attack and decay: harp, piano, all percussion instruments.

The most stationary sounds are those of mechanical engines: cars, air conditioners, power mowers, jets etc. A few internal undulations do not compensate for what is essentially a boring life.

### DECAY

The sound wearies; it dies away, perhaps to be followed by new sounds. There are rapid decays and imperceptibly slow decays. It is biologically natural for sounds to decay.

(The sound of the air conditioner does not decay. It receives transplants and lives forever.)

### REVERBERATION

W. C. Sabine, the acoustician, has defined reverberation technically. It is the time that elapses from the instant a sound source is switched off until its energy decays to  $1/1,000,000$ th of its original strength (a drop of 60db). As far as the ear is concerned it is the time it takes for a sound to melt and be lost in the ambient sounds of the room. Obviously the reverberation of the room affects the music played in it. Thus music written for cathedrals (with a reverberation time of 6-8 seconds) is slower than that written for the modern, dry recording studio in which sounds must be quickly forgotten to make way for new ones.

### DEATH AND MEMORY

A sound lasts as long as we remember it. Who, having heard it, has ever forgotten the opening modulation of *Tristan*, haunting the imagination forever? Unforgettable sounds, like unforgettable stories give rise to mythology.

The affectionately remembered sound joins hands with the anticipation of new sounds to form a loop which we call an appreciation for music.

## SOUND MORPHOLOGY

The form and structure of sounds.

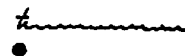
Each single sound has its own internal morphology. Much of this can be heard by the ear when listening is carefully educated.

For the ultimate morphological study of sound objects we must go to the laboratory, or at least to the literature of those who have worked in the laboratory.\*

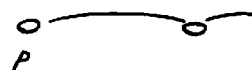
But you may also, accepting the work of acousticians, still continue to believe in the poetry of sound. Scientific investigation does not prevent each sound from having its word-metaphor.



a sudden inspiration



A nervous life (function of the trill: to sustain onset transients)



A serene life of reflection — Tao, Buddha

Pictographs for sounds may be useful. Even the elementary class ought to be able to draw, analyze and classify sound objects by the pictography of their envelopes. Thus:

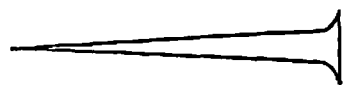


A precocious sound object

\* In this respect I would refer interested readers to the most interesting study by Fritz Winckel, entitled *Music, Sound and Sensation*, New York, Dover Books, 1967, from which I have borrowed numerous thoughts. Winckel works scientifically and the findings of his book may be useful to any musician in corroborating his intuitions.



A well-balanced sound object (natural growth and decay)



A healthy sound object refusing to surrender to the decrepitudes of age, cut down suddenly at the height of his powers.

Anyone can do this. A time-scale can be drawn across the bottom of the page to show the relative duration of the sound object. Relative pitch can be indicated by height; tone color by texturing or coloring the envelope, and so forth. Then the class can set about to analyze all the continuous, interrupted, gliding, steady, long and brief sounds of nature and of their lives.

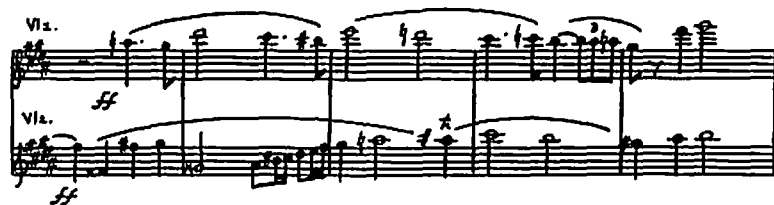
### THE SOCIETY OF SOUND

We have been looking at the lives of single sounds. But these are merely fragments in the larger social life we call composition.

A social psychologist, suspecting that music had discovered something important, asked me to speak to his class about *harmony*. Looking into compositions from the point of view of social systems could be a fascinating exercise. A composition as a pageant of humanity. Each note as a human being, a breath of life.

Some music is sociable with lots of harmonious hobnobbing (Mozart); some is full of belligerent antagonisms (Schoenberg); while some reveals the entanglements of a population explosion (Ives).

Let us look briefly at a detail in the social life of Richard Strauss's *Heldenleben*.



Two noble lives in conflict; who will be victor, who vanquished?



They become belligerent enemies

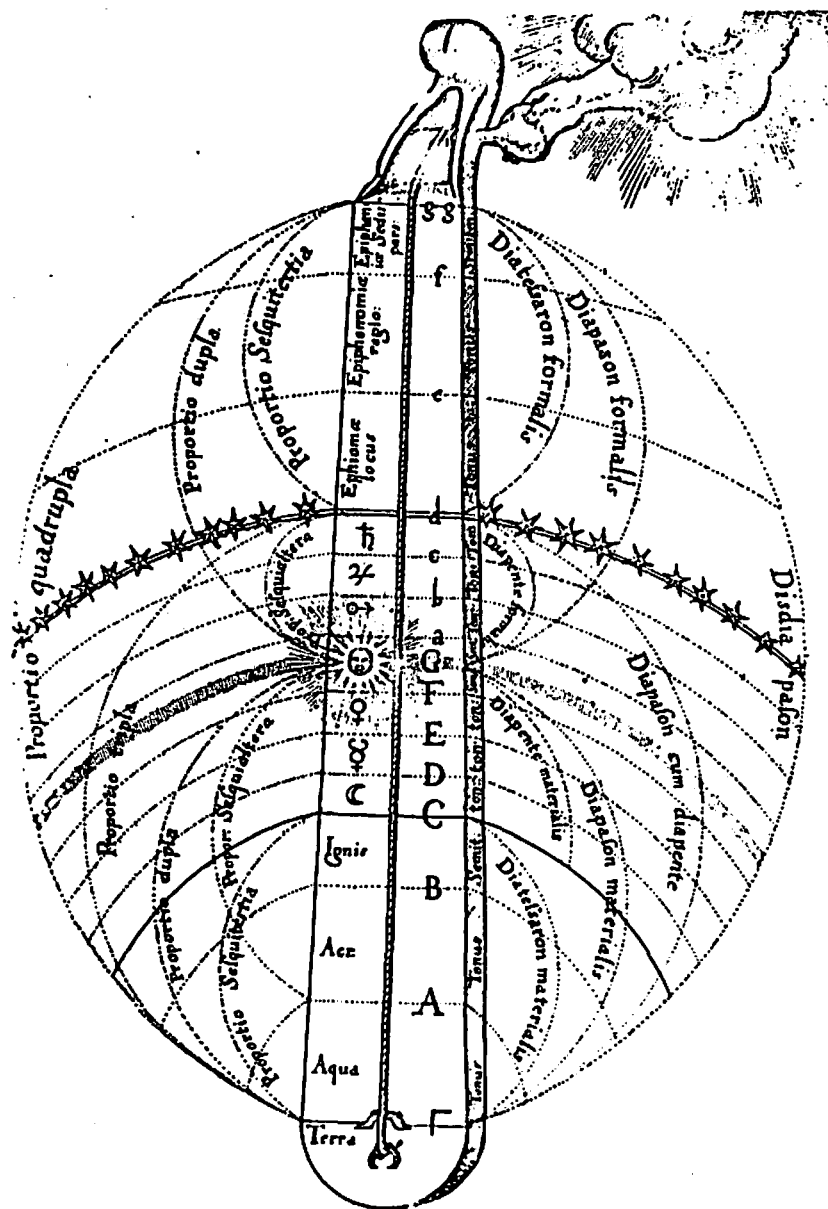


Confrontation at sword-point



But later they discover they have similar ideas and finally join hands in friendship.

Classical music prefers happy endings.



"The Tuning of the World" from Robert Fludd's *Utriusque Cosmi Historia* illustrates the continuing desire of man to find harmony in his environment.

## XI

## The New Soundscape

It would be pleasant to conclude that all soundscapes might prefer happy endings. Or that some might prefer quiet endings. Or that a few might just end.

From somewhere in the middle of the development section of the world soundscape, let us listen carefully to the themes and try to assess where they are carrying us.

Taking Cage's definition of music as "sounds around us, whether we're in or out of concert halls," this booklet has been an attempt to persuade music educators that the most vital "musical" composition of our time is being played on a world stage. If we could reverse the figure-ground relationship, the cloistered hour a week we call the music lesson would be quite displaced by a much bigger music lesson — the very cosmic symphony we have tried to shut ourselves away from.

Music is, after all, nothing more than a collection of the most exciting sounds conceived and produced by successive generations of men with good ears. The compelling world of sounds around us today has already been investigated and incorporated into the music produced by today's composers. The task of the music educator is now to study and theoretically comprehend what is happening everywhere along the frontier of the world soundscape.

In the introduction I suggested that we may now have entered an era in which the prevention of sound may well be as important as its production. It may be that we already have too many sounds in the world for them all to be heard to advantage. It may be that some are ugly, boring or simply unnecessary. Speculate, for instance, on the millions of identical motorized lawnmowers chewing their way over the acreages of suburbia. You may notice that one does not hear the sounds of the birds very clearly behind their mechanical moan. Or consider unmuffled power saws or electrified kitchen gadgetry: could not their plangency be dimmed? Of course. For the cost of a ticket to a concert a manufacturer could attach a muffler to any of these.

Motors are the dominant sounds of the world soundscape. All motors share one important feature: they are low-information, high redundancy sounds. That is to say, despite the intensity of their voices, the

messages they speak are repetitive and ultimately boring. There is a hypnotic suggestibility about motors that makes one wonder whether, as they invade our lives totally, they may not mask out all other sounds, reducing us in the process to acquiescent and dopey bipeds indolently fumbling about in a mute hypnotic trance.

Just as the sewing machine gave us the long line in clothes, so the motor has given us the flat line in sound.

What effect do environmental sounds have? Consider, for instance, two composers, one living in the 18th century and the other in our own. The former travels everywhere in a carriage. He can't get horses hooves out of his mind, and so he becomes the inventor of the Alberti bass. The latter travels everywhere in his own sportscar. His music is remarkable for its drones, clusters and whirring effects. (These may merely be idiosyncratic thoughts).

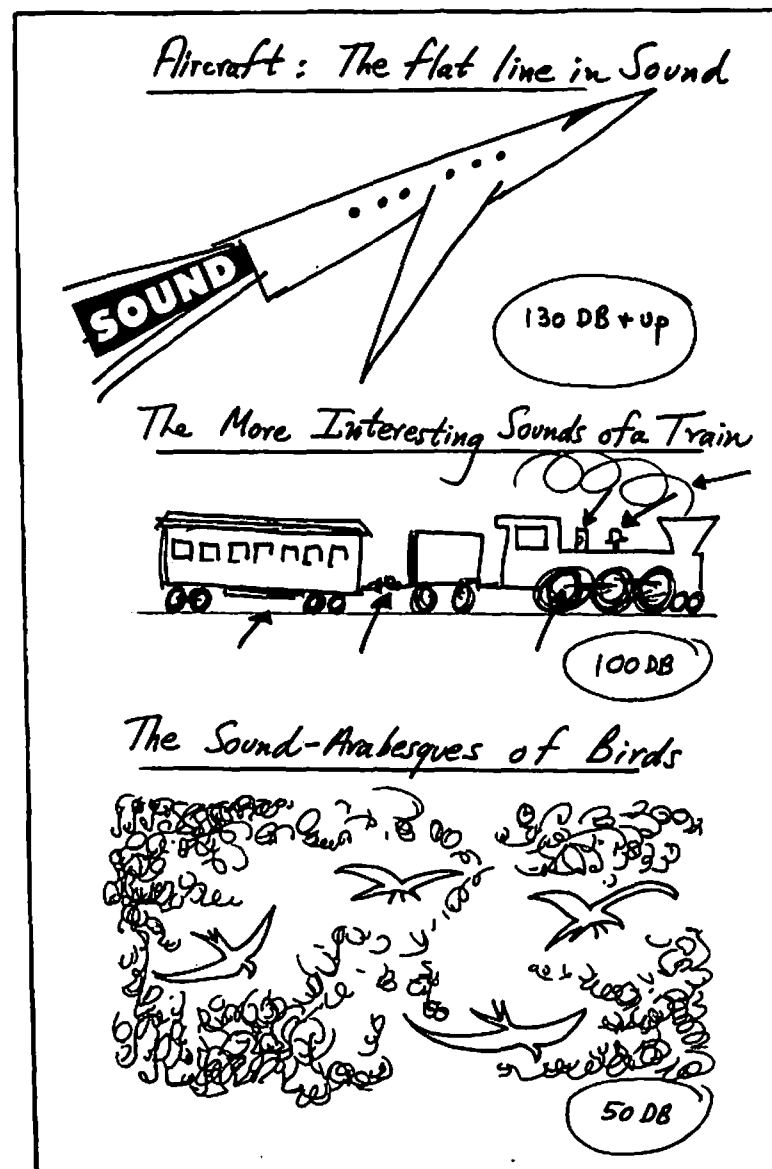
No sound contains less interesting information than that of an airplane. Its only embellishment is the Doppler effect. Compare this with the rich and characteristic sounds of the vehicle it replaced; the steam engine. A train made an informative noise: the whistle, the bell, the puffing of the engine with its sudden and gradual accelerations and decelerations, the squeaking of the wheels on the tracks, the rattling of the cars, the clatter of the tracks.

Or compare the aircraft with the object it imitates: the bird. The arabesque of the sedge-warbler, for instance is so intricate that a hundred hearings would not begin to exhaust its fascination for us. Even the separate notes of the song-thrush are more tuneful than any machine man has thrown into the air. But not so loud, of course. We hold the world's record for that.

If I am insisting rather on sky-sounds it is because these themes are going to dominate the next movement of our world symphony. I once drew a picture of a city of the future on the blackboard for a group of architecture students and asked them what the salient features of this environment appeared to be. There were seven helicopters in the sky of my drawing; yet no student found this particularly salient. I (exasperatedly): "Have you ever heard seven helicopters?"

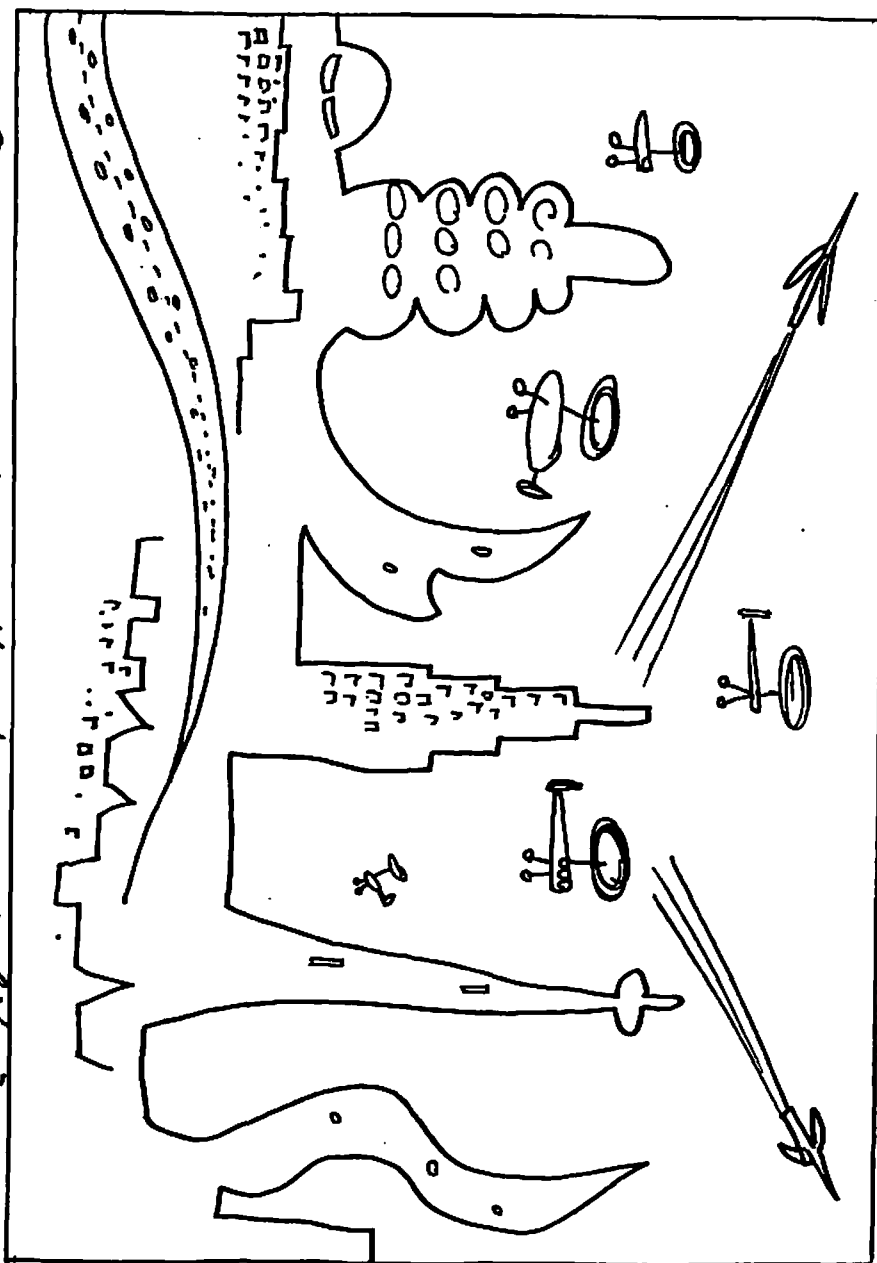
The big sound sewer of the future will be the sky.

Already this is evident. Soon every home and office in the world will be situated somewhere along this new expressway. In recent years some municipal governments have begun to show an interest in the control of nuisance sounds (barking dogs, etc.); but this unimaginative legislation is pathetic when any number of thunderous things can happen in the sky over our heads without restriction as to how frequently or how loudly they may happen.





Question: What will the sky sound like?



The Cityscape of the Future

The whole world is an airport. What are we going to do about it? Objective of a musicians noise abatement society: to eliminate all unnecessary sounds, including those of industry and transportation.

Some chapters ago we spoke of the amplifier as a potentially lethal weapon. The evidence is now beginning to come in and it shows that if we wish to continue to hear at all we will have to become concerned with the forensic aspects of this "musical" development. Research done with teenagers, playing in bands and going to concerts at which the intensity of sound may easily pass 100 db above the threshold of audibility, shows that they are going deaf in numbers significant enough to cause alarm in the medical profession.\*

I have before me some literature put out by the Workmen's Compensation Board on the danger of industrial noise and how to prevent injury to the ears as a result of what is colloquially called 'boiler-maker's disease'. It shows that ear protection is mandatory for workers in sonic environments less loud than the sound produced by the bands which play at my school on occasions too frequent to count.

"We have succeeded in almost totally conquering boiler-maker's disease," a research worker of the Workmen's Compensation Board proudly announced at a recent conference.

Such then are the emphatic leitmotives of the world symphony: aircraft, amplified guitars, the sounds of warfare and power machinery. These are the big blocks of sound, the flat lines of sound, the lethal weapons which now dominate the composition. They demonstrate the crudity of its orchestration.

Next the lesser leitmotives: the ubiquitous radios and television sets, the sounds of street traffic, the telephone (which Lawrence Durrell describes in *Justine* as 'a small, needle-like sound') the sounds of plumbing, of furnaces and air conditioners. These are the jabber-sounds.

And here in the centre of it all, like a viola in the finale of a trumpet and drum allegro, are the sounds of our own voices. We no longer sing in the streets of our cities. Even speaking is often a strain. What should be the most vital sound of human existence is little by little being crushed beneath sounds which we may quite accurately call "inhuman".

Portions of the world symphony have already been played and will not be repeated: the steam engine, the horse-drawn carriage, the

\* Numerous articles have appeared recently on this subject. One which summarizes the finding is that in *Time*, August 9, 1968, p.51.

cracking of whips (which Schopenhauer found so agonizing) the coal-oil lamp. Yes, what did the coal-oil lamp sound like? You will think of others.

A class of elementary school children was given the phrase: "As quiet as . . ." and was asked to complete it with all the hushed similes that perhaps only a class of elementary school children can find behind the cacophony adults are hardened to accept as necessary to the progress of civilization.

Birds, leaves, the cries of animals, varieties of wind and water. Where do these enter into the contemporary world sonograph?

Will there be any more pianissimo movements?

Will there soon be an adagio section?

And so to end with an assignment: Keep a world sound diary. Wherever you go take note of what you hear. We are all in the world symphony. What is not yet apparent is whether we are merely part of its apparatus or the composers responsible for giving it form and beauty.

I have tried to show how the rich universe of sound around us could be the object for a new kind of musical studies, a program that would carry the participants across the party-lines of the conservatory curriculum and sweep them out into the shifting shapes of what we might call the 'middlefields' between many different disciplines.

But if we wish to apply thought to the nerve of what is happening today, where else would we go?

Much has been left open for further development, and the active student will add his own ideas, correcting whatever errors he detects as he plunges deeper into the fields of science, social science and art from which to form the working principles of a whole new theory of music, a theory in pace with the imaginative leaps of the artists who are today carrying music in bold, new synergies quite beyond whatever the dictionaries of the past thought it to be.

The universe is your orchestra.

Let nothing less be the territory of your new studies.

## Epilogue

All this is a long way from the piano. For the past two hundred years the piano has been the focal point of all musical studies: the piano as *Ersatz* orchestra, the piano as tool of accompaniment, the piano as commanding and heroic soloist in its own right, the piano as arch-symbol of a distinct era of music making and of the institutions concerned with its promulgation.

Today, the pianos in suburbia are slumbering.

The fingers of the young have turned elsewhere — to the guitar, the saxophone, the potentiometer. And the piano begins to look like a decorated hearse.

Ah yes, it is true that a few small hands still learn to play *Mistress Mary* for the music festival. Et puis?

"What! sixteen and *still* studying the piano", said an aunt once to a young French girl, who happened to be helping with this book.

Today, the pianos in suburbia are slumbering.

The piano is a drawing room instrument, the sociologist Max Weber pointed out, an amusement devised for the North European winters. All the great piano compositions were written by Northerners. Out of the blood-spitting cold they came to warm their well-kept fingers on the fiery keyboard. The Southerners, whose drawing rooms dissolved into their gardens, preferred portable instruments, the guitar, the mandolin, instruments you could remove to shady groves or moonlit patios.

Today again the concert hall has moved.

The new orchestra is the universe.

The piano concerto is a ghost in its midst. And there is something spooky about the institutions in which many pianos sit.

But let us forever cherish a few great pianos in our company. Your treasure-museum is of great beauty. You will not be forgotten, but will forever enchant us with the reveries of your memorable *amours*.

Tell us:

how Mozart tickled you  
how Beethoven boisterously caroused with you  
how Schumann kept you up late at night  
how Chopin caressed you  
how Listz rode you like a wild stallion  
how Debussy painted you blue

how Stravinsky mistook you for a stop clock  
and how John Cage snapped your garters.

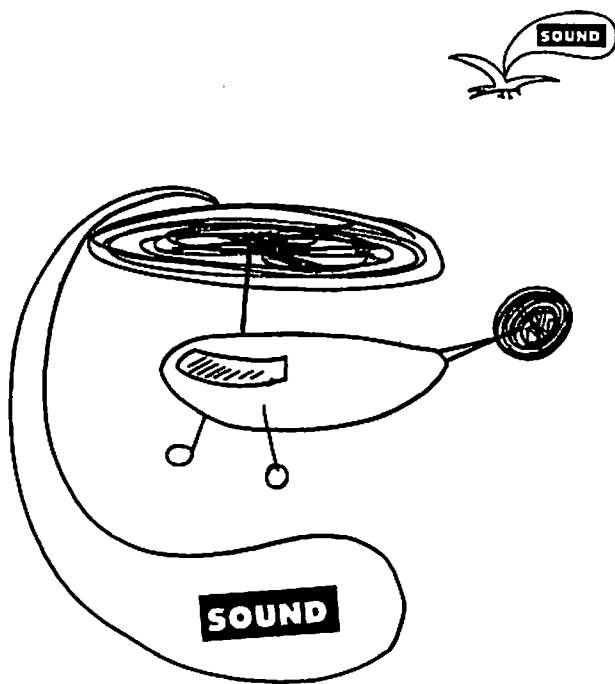
Breathe history into our ears.

For the activity has moved elsewhere, and you are too big to be  
carried there . . .

Farewell slumbering piano . . .

You have stated your case well.

Let now others state theirs.



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## OTHER WORKS IN THIS SERIES BY THE SAME AUTHOR.

### The Composer in the Classroom (A booklet of transcriptions)

If you want to see what can be done to illuminate the mysteries of music for teenagers, get a copy of an extraordinary pamphlet called *The Composer in the Classroom* (BMI Canada; \$1.25) by R. Murray Schafer, purchasable in the U.S. from Associated Music Publishers (609 Fifth Avenue, New York City).

This is a work you can read in an hour, but you will remember it gratefully for the rest of your life.

*The Composer in the Classroom* is a verbatim transcript of what went on some of the time in half a dozen classes while Schafer was teaching. If those entrusted with the musical education of American youngsters were equally imaginative and resourceful, I daresay there would be considerably fewer problems besetting the art than plague us today.

This is, in a modest way, a most important document. I would urge you to read it.

*Irving Lowens, Washington Star, June, 1965*

This stimulating little book, which should be read by every music teacher from junior school to training college and university, is the result of an invitation given to the young Canadian composer R. Murray Schafer to work with music students in schools.

The discussions are vivid, often humorous and utterly convincing as a record of Schafer's work with children. They will undoubtedly inspire many teachers to experiment with sound in similar ways and to explore the creative talents of their children in group improvisation.

*Peter Aston, Music in Education March/April 1967*

### Ear Cleaning — notes for an experimental music course

A few years ago, a young and virtually unknown Canadian musician, R. Murray Schafer, published a short pamphlet called *"The Composer in the Classroom"* (BMI Canada; \$1.25).

Now, in 1967, Schafer has emerged as one of the most significant creative figures on the Canadian scene.

Schafer continues to exercise his witchery as a teacher, and a newly published pamphlet bearing the characteristic title, *"Ear Cleaning"* (BMI Canada; \$1.25), shows the same originality, directness of approach and simplicity which marked his earlier didactic work.

Schafer's lecture notes—one page for each of nine lectures—and exercises, discussions, and assignments are a fascinating exemplification of how to make somebody acutely conscious of the total aural environment. It can be used (and it should be used) as a self-instructor; it is a whetstone for sharpening one's aural acuity.

Even more than *"The Composer in the Classroom,"* his *"Ear Cleaning"* reveals an exceptional teacher at work. It should be required reading for anybody who wants to hear what he is listening to.

*Irving Lowens, Washington Star, October, 1967*

### Statement in Blue (An experimental composition for junior orchestras) score 2.75

(Materials available on rental)

Schafer's score is intended, not as a composition, but as a basis for improvisation. The notation is graphic (and, incidentally, beautifully presented by the publishers) and the symbols used are explained in the preparatory notes. Pitch and duration are free, and although suggestions are made as to possible instrumentation, this is largely left to the discretion, imagination and resources of the performers. Schafer's original intention is fifteen string players (though there may well be more or less), an assortment of woodwind and brass plus piano with pitched and pitchless percussion. The music is a sort of free rondo, with blocks of improvised wind solo and ensemble passages appearing against a continuous string texture punctuated by percussion. The music can equally well be used for any age group and at any level of technical proficiency. Its value is in awakening the child (and the teacher) to the possibilities of creative experiment in the classroom, and it will certainly provide a stimulus for further work in this field.

*Peter Aston, Music in Education March/April 1967*

### Threnody (for youth orchestra, youth choir, speakers and tapes)

(Performance materials and tapes on rental)

*"Threnody,* a new composition by Murray Schafer, left most of the 600 people in North Vancouver's Centennial Theatre furtively dabbing their eyes Sunday night . . . From these forces [the performers], Schafer drew some extraordinary sounds which had powerful emotional and dramatic impact . . . Schafer clearly set out to shock—musically, emotionally, verbally. And in this he succeeded without a doubt . . . Emotionally, the work achieved its greatest impact in its finale. After an enormous crescendo of electronic noise that defies description, the tumult gave way to an ethereal wordless postscript by the choir that was like an echo from another world."

*Robert Sunter, The Vancouver Sun, 1967*

*"Murray Schafer's nuclear aftermath composition Threnody overshadowed everything else at Friday's Community Concert in Queen Elizabeth Theatre . . . Its performance was both harrowing and compelling. This was the second time I had heard Threnody and I can say quite categorically it is the most moving piece of music composed in the last 20 years that I have heard . . . There was no doubt in my mind that the tortured sounds Schafer created, the almost literal representations of bomb blast, searing wind, moaning casualties and mourning, manipulated the emotions of the listeners even more than the descriptions of burnt flesh and shredded skin."*

*Robert Sunter, The Vancouver Sun, 1968*