ACOUSTIC COMMUNICATION

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Electroacoustic Communication: Breaking Constraints

We began part I with a brief account of the traditional energy transfer model that is the basis of the formal study of sound, and suggested that the impact of electronic technology in this century, in creating the concepts of the audio signal and signal processing, has been based on a parallel model, namely that of signal transfer. The basis of electroacoustics, as reflected in the term itself, is the transfer of sound energy from its physical form, i.e., the sound wave, into an electrical form, the audio signal. This signal is intended to be exactly analogous to the sound wave and can be converted back into it via a loudspeaker. The points of conversion are called transduction processes, and everything that happens to the audio signal from the time it is created until it is transferred back to acoustic form comes under the heading of signal processing, e.g., storage, transmission, manipulation, mixing, and so on.

However, we also pointed out that signal processing operates on the implicit basis of what we called a "black box" model, that is, a model of neutrality. In theory, at least, audio processing is intended to reproduce the original signal with perfect "fidelity," and all methods of evaluating the result, or any intermediate stage, depend on measuring the quality of the signal according to common standards. As long as the result is "faithful" to the original, the impact of the process is neutralized, and no responsibility has to be taken for the content of the signal or the implications of the way it is used.

Much of the debate surrounding modern technology centers on the conflict between the "neutrality" of the scientific method and the profound implications of its use. Since engineering is traditionally given the task of applying "pure" science, the claim of neutrality is all the more controversial when it arises there. It is sometimes said that technology itself is neutral, but that its organization is not. Exactly who is responsible for the organization of technology, and who controls its development, is not a simple matter of identification. For the public, technology becomes a "fact of life" with strong

psychological implications, as well as a pragmatic necessity. It cannot be neutral; it represents too many things—progress, automation, a way of life, the threat of forces getting out of control, the novelty of the latest toy or technical marvel. We indulge in its innovations or resist them with the same psychological attitudes that were once reserved for decisions of a moral nature, with or without the appropriate feelings of guilt or virtue. Like the problem of noise, audio technology is a highly visible aspect of technology in general and seems to represent another force in the world whose dynamics we do not understand.

The impact of technology on acoustic communication is so profound that our discussion of it here occupies an equal part of the book. However, our goal is to understand the changes that technology brings about from the perspective we have built up in part I about traditional acoustic patterns of communication. Once we understand how the system of sound-listener-environment works traditionally, we can examine the types of changes that the introduction of technology brings to the system. And with such an understanding we hope to be able to control technology better and use it as the tool that it is, i.e., as an extension of human capabilities, for the design of effective forms of communication.

The New Tools: Extensions or Transformations?

In all of the traditional situations in which sound functions, it is constrained by its own physical characteristics and limitations. Acoustic power is relatively small on the scale of energies that are available—its "power" has always derived from its ability to affect the mind, not from its absolute physical power. However, acoustic energy can only travel so far, sustain itself for so long, and distribute its energy in certain ways over the audible spectrum. All acoustic technologies that have been invented to produce or control sound (e.g., instruments, machines, architectural designs, etc.), as fascinating and diverse as they are, operate within the same physical constraints as sound does in the natural environment. These technologies simply shape the sound to be more interesting, more functional or more artistic, but they do not *change* the rules by which the sound functions—they merely refine its behavior.

For instance, the horn and bell are louder than the human voice, they can communicate over a larger distance and travel faster than a person can, at least before the supersonic era. The architectural features of the Greek amphitheater, the mosque, or the cathedral allow reflections of acoustic energy that permit sounds to last longer than in an open space and to be heard farther and more clearly. The ingenious devices of the mechanical instrument maker allow sounds to be produced automatically with their hidden control devices. And, of course, the art of the musical instrument builder over the centuries has been directed at producing sounds of purity, harmonicity, and beauty that surpass those found in the natural environment.

From the perspective of physics, we may say that all of these inventions are constrained by the rules of vibratory motion and energy conservation. Within these rules, endless variation is possible, but the system remains bounded by physical constraints. Consider the phenomenon of "amplification" for instance. The term is used in physical acoustics without any contradiction to the law of energy conservation because in all acoustic systems, no additional energy is *added* to the system through natural acoustic methods of amplification. Instead, the acoustical energy within the system is made more efficient in its transfer. If the physical sound source is damped, its energy is dissipated quickly, whereas if it is attached to a resonator, the energy transfer is improved (i.e., it sounds louder, or amplified) and the sound lasts longer. Since both resonance and reverberation prolong sound energy, they are often confused in everyday speech. Though the way in which they work is different, both result in a slower dissipation of energy. But no matter what the situation, all physical acoustic systems have a relatively short lifetime for producing sound. The beauty of sound is in its transience, and hence in its inevitable relation to silence. The "eternal sound" is a powerful symbol for the mind, a Platonic ideal whose purity can only be approached in the acoustical world through repetition.

The electroacoustic process changes the groundrules for acoustic behavior, first of all, by changing the *form* of the sound's energy from physical and mechanical to electrical, and secondly, by *adding* energy to it. The resultant audio signal, representing patterns of voltage in time, takes on the characteristics of electricity, for instance, the ability to travel with the speed of light, nearly a million times faster than sound! Moreover, the adding of energy to the signal produces a new sense of the term "amplification," one that allows the actual physical magnitude to increase beyond its original level by nearly any amount. With the constant addition of electrical energy, a sound (particularly a synthesized one) may have any loudness and may even be prolonged indefinitely to achieve an "immortality" that is impossible within the physical, acoustic world!

Therefore, we can see that at its very basis, the electroacoustic process is not merely a simple extension of the capabilities of sound, but rather a fundamental *transformation* of how it works. The change is not only quantitative, in the sense of extending the range of a variable by some amount, but is also qualitative in the way that it permits totally new concepts to operate. It is little wonder that such fundamental change has had a profound impact on society, and that its arrival was greeted with wonderment at the magical

or supernatural power it suggested. In Francis Bacon's famous "sound-houses" quotation from 1600, such marvels were to be found in the utopian *New Atlantis* of the future:

> We represent small sounds as great and deep; likewise great sounds, extenuate and sharp; we make divers tremblings and warblings of sounds, which in their nature are entire. . . . We have also divers strange and artificial echoes, reflecting the voice many times, and as it were tossing it; and some that give back the voice louder than it came, some shriller and some deeper; yea, some rendering the voice, differing in the letters or articulate sounds from that they receive. We have also means to convey sounds in trunks and pipes, in strange lines and distances.[1]

Space and Loudness

Before the advent of electroacoustic technology, every sound was closely bound to its source and limited to a relatively small area over which it could be heard, an area we will call its "profile." The ability of a signal to be heard over some distance made it a useful means of communication. Unless there are substantial obstacles, sounds of medium to high frequency tend to be heard better over long distances, and therefore the raised voice, a high-pitched horn, bells, whistles, and other devices were commonly used historically for signalling. However, sound propagates in all directions simultaneously unless funnelled in a particular one, and therefore it encompasses an area. The fact that everyone within that area can hear the same sound provides the basis of a sense of community for those people.

The church parish has traditionally been defined in relation to the acoustic profile of its bells. In Fig. 12 we see the profile of the Holy Rosary Cathedral bells in Vancouver, as quoted in *The Vancouver Soundscape*. The profile today extends only for a few city blocks, whereas the reports of those recalling its sound from 50 years ago indicate that it could be clearly heard 10 to 15 miles away. This shrinkage, which can only be accounted for by the rise in ambient noise level and the presence of newer buildings acting as obstacles, reminds us that the acoustic profile, and hence the communicative power of a sound, is extremely vulnerable to noise and environmental change. The only solution, one which has been followed by emergency warning signals, is a continual increase in sound level in order to keep a favorable signal-to-noise ratio within the environment.

[1]F. Bacon, *New Atlantis*, London: Oxford University Press, 1906, pp. 294–295; Oxford, England: Clarendon Press, 1974, p. 244.

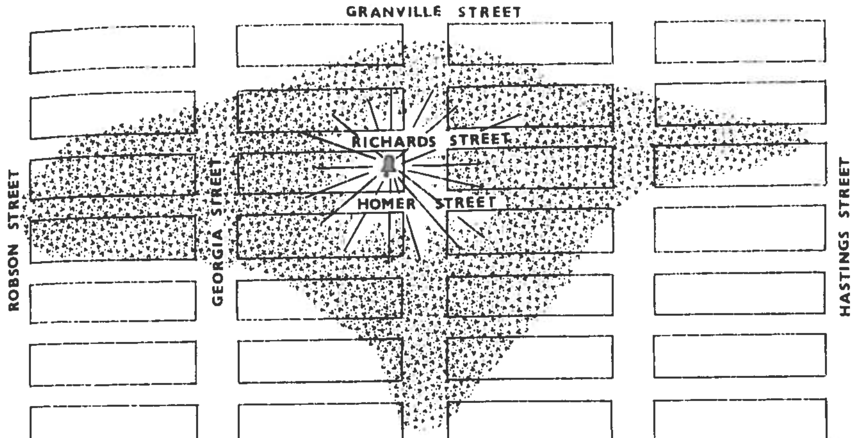

Fig. 12. Acoustic profile of the Holy Rosary Cathedral bells, Vancouver, British Columbia, made June 16, 1973 by the World Soundscape Project (from *The Vancouver Soundscape*, R.M. Schafer, ed., Vancouver, British Columbia, A.R.C. Publications, 1978).

In contrast, the *electroacoustic* profile for the contemporary radio station, examples of which are shown in Fig. 13, is on the order of magnitude of hundreds of kilometers, and is obviously not affected by acoustic forms of noise. The change, as with all electroacoustic phenomena, is so dramatic that it generates a new concept—the mass audience. For commercial purposes, the "community" within the radio profile becomes a mass market. When we consider cable and satellite transmission as well, we see that the bounds have reached such proportions that space can hardly be called a constraint. Access to receiving equipment, not distance from the source, is the key requirement.

The telegraph, dating from 1838, was the first instance in which sound, or at least audible clicks, could be heard over a distance larger than that possible acoustically. But it remained until the telephone and wireless radio made the transmission of voice a reality that the true impact of the phenomenon was felt. Hearing a disembodied voice coming from a great distance—a phenomenon previously available only to mystics and saints—was the experience that generated the most wonderment. Only sounds of apocalyptic dimensions or supernatural origin had ever been heard over such distances, so even the voice of a mortal took on a special aura when heard electroacoustically, an aura of authority that even today has not entirely disappeared with familiarity. The image of a nation with its attention fixed to the voice (and picture) of a man on the moon still captures some of the awe associated with the conquering of distance. Later unmanned missions to more distant planets have been impressive, but silent.

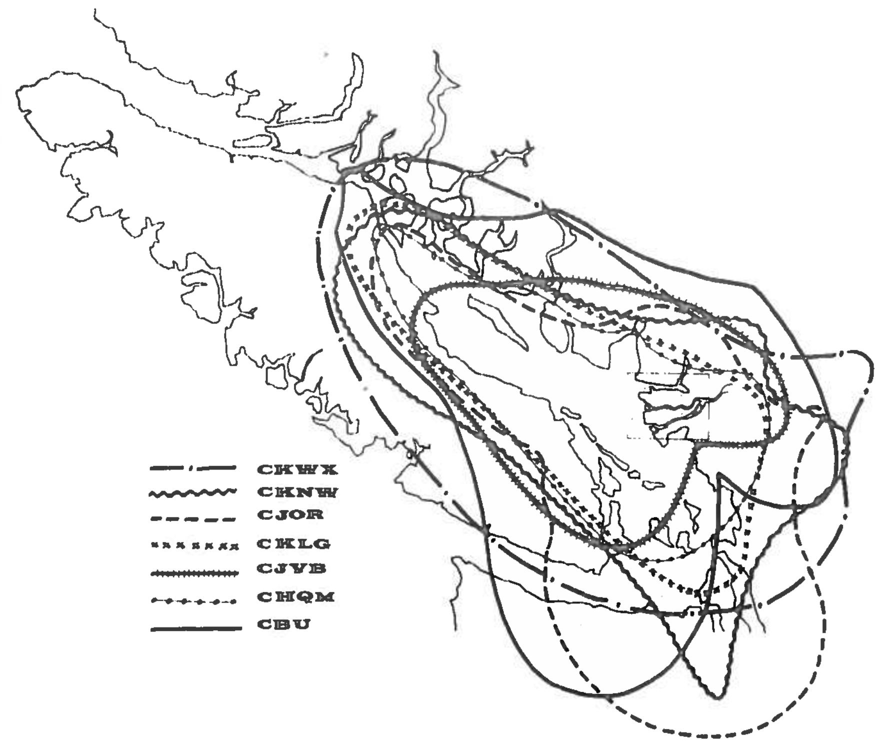

Fig. 13. Electroacoustic profiles of seven AM radio stations, Vancouver, British Columbia (from *The Vancouver Soundscape*, R.M. Schafer, ed., Vancouver, British Columbia, A.R.C. Publications, 1978).

The control of spatial communication, as H. A. Innis (1972) has made us aware, is essential to centralized power and domination. Therefore, acoustic power, amplified through the loudspeaker, or in the form of any loud sound, is linked to the domination of space. The loudest sounds have always been associated with the most powerful forces in the world, whether they represented physical or political power. Because of the extreme amount of physical energy required to produce low frequency sound in great quantities, the natural elements at their most violent were the source of the most powerful sounds for primitive society, e.g., thunder, earthquakes, typhoons, hurricanes, and fire. The *psychological* power associated with low frequency sound remains with us today. Like Prometheus, urban man "stole" noise from the gods, and ever since, the most powerful institutions have produced the most powerful sounds. R. M. Schafer (1977) has termed those that are immune from social proscription as "sacred noise."

Electroacoustic power represents the ultimate democratization of acoustic power—anyone can compete on the decibel scale. Manufacturers even capitalize on the aggressive implications of their portable audio products by giving them such names as "The Loudmouth," and in current parlance, a certain style of portable radio is called a "ghetto blaster" or "boom box." The commercial use of amplification is not recent, however. The first noise study from New York in 1929–1930 reported home radios to be the third most prevalent noise complaint, and those used commercially (broadcasting from stores onto the street) to be the fifth most common, after trucks, car horns, and elevated trains (Noise Abatement Commission, 1930, p.27). Over 12% of the complaints arose from electroacoustic sources, in comparison to deliveries, construction, whistles, bells, and vocal sounds which all ranked less. Sound levels of loudspeakers in the streets were measured at 79 dB (Noise Abatement Commission, 1930, p.36), and as a result, a city ordinance banned their use. Other early noise by-laws also mention the use of loudspeakers outside stores as targets for suppression.

The amplified voice, whether it is that of the advertiser, politician, demagogue, or simply that of the speaker who has the floor, carries with it an authority unattainable by the unaided voice. Part of that power is the ability to be heard farther and by more people (an extension of the spatial concept), and part of it is the physical power that is always associated with acoustic energy. However, other factors specific to the type of voice and the image it projects may be important. Most public address systems tend to emphasize the low frequencies of the voice which are normally stronger in an enclosed space anyway because of room resonances. Hence, the speaker may seem to have a richer, more resonant voice than normal (assuming nervousness has not resulted in a poor timbre to start with). In addition, the dynamic range of the voice that is possible is enlarged with amplification. The smallest whisper or dropping of voice level is audible and dramatic. A whispered sound, close to a mike, conveys a paradoxical intimacy at a distance that can be very effective. The raised voice, more distant from the mike, combined with traditional rhetorical skills, is a formidable weapon for persuasion. The power of the voice can be greatly enhanced through amplification, just as its faults will become more conspicuous.

Time and Repetition

Once it was realized that the pattern of a sound wave could be stored in a physical medium, an idea that lagged several decades behind the invention of photography, the constraint of a sound being fixed in time was broken. No

developed on the basis of detecting slight differences that reflect variations even in repetitions, but now a sound could be repeated *exactly*. Because of the extreme transience of aural phenomena, the "freezing" of sound and its preservation seems of far greater significance than that of visual images which at least have other kinds of representations.

The stored sound immediately becomes historical. It is an artifact as soon as it is recorded, and therefore it creates the possibility of an "aural history" preserved on tape. No other culture has had access to the actual sounds of the past. Repeated performance of stories, music, poetry, and drama have been required to keep them alive for people to experience. Does our present ability to document something for all time contribute or detract from the experience of tradition? Does not all of the recorded past simply become part of the present?

The concept of linear, historical time is denied, if not actually eliminated, by the electroacoustic media. If a particular sound can be preserved and embedded within that originating from any other time, the concept of a linear flow of time becomes an anachronism. Our experience of the present may operate in the same way, no matter when the sound we are hearing originated, but often we know that what we are experiencing *in* the present is not *of* the present. We may refer to this arbitrariness of time sequences as the "embedding" of time. It occurs even in such a common media event as the news. We assume that the person reporting the news is doing so live, and that various "parentheses" can be opened whereby we step into some past event ("here is a report from. . . . ") whose commentator can lead into still another past event ("here is an interview made yesterday. . . . "), and so on. As long as the parentheses of these various time segments close again in reverse order, the entire sequence seems logical to us, assuming we know how to interpret its punctuation.

Occasionally, our notions of linear cause and effect in time can get mixed up. The Canadian Broadcasting Corporation operates a series of delayed signals across the various time zones of the country, so that each program seems to be occurring live, and so that announcements of time are accurate. However, only the news items are actually done live on the network. In one instance, the news report that a certain decision had been announced was followed by a delayed program segment that discussed the possible outcomes of the same decision which was still in the future. It is the attempt of the medium to create the illusion of a linear time flow that results in such paradoxes.

The possibility of exact repetitions of a sound event makes information processing simpler for the brain in the sense that it is easier to make a match with a stored pattern. There are few complicating differences between sounds (except those that depend on the coloration by the immediate acoustic enneeded). Instead of detecting differences, the main aspect of the processing is matching a pattern. The type of listening we have described in part I as occurring in response to repeated patterns is background listening, such as that which operates with keynote sounds. Electroacoustic repetition encourages this kind of listening, and in fact makes it easy for the brain to adopt a background listening attitude. What may be of concern is that mental energy is not being devoted to active evaluation of the environment and the formation of new concepts, but to template matching.

The templates of listening—patterns with stencil-like repetitions—can clearly be exploited for the commercial purpose of "brand loyalty." One simply has to fix a pattern in the mind of the listener and reinforce it with enough repetitions for the brain to recognize it quickly and link it to whatever (presumably positive) associations always surround it. From this point of view, the supposed "complexity" of modern life is in fact reduced to the relative simplicity of pattern matching. The opening bars of a popular music tune are the most critical for its success, because they must fix in the mind to identify the song. At a live concert, the group need only sound the first chord or two of a hit song before the audience identifies it and bursts into an applause of recognition. Because repetition of the pleasurable quickly becomes the motivating force in this kind of listening, the audience will be dissatisfied if the group cannot produce live what they have come to expect through countless repetitions of the original recording. The sophistication of modern recording studio techniques cannot, in fact, be easily reproduced live; hence, the frequent dissatisfaction when the live experience cannot match the prerecorded one which the listener has come to prefer, and perhaps idealize as well.

The concept of musical theme or "leitmotif" (a short musical pattern that can easily be remembered) has been transformed into the commercial jingle. But whereas the musical theme was the basis for variation, and the ease of remembering it was to make its transformation and counterpoint with other themes more evident (i.e., to permit complexity and sustain coherence), the commercial version is *never* varied, and the result is deliberately kept simple. In the 1930s, products began to be advertised in radio commercials with accompanying short motifs (the aural equivalent of the trademark). Typically, these first ones were associated with the product name, in fact, quite literally. *Lifebuoy* soap had a descending pitch motif produced by a foghorn-like sound that represented the two syllables of its name, and played on the aural pun of the "life-buoy." *Jello* used an ascending pitch pattern to spell its name: J E LL—O, which I am sure that most readers can easily recall if they say the letters with the correct rhythm. These literal, musical interpretations reinforced the brand name as a word, and were supported by corresponding visual patterns on the packages. Later, once product names

were established, advertisements moved to a concern for the image surrounding the product, but we will leave this development to be picked up in chapter 11.

The breaking of the time constraint has profoundly changed the nature of acoustic communication. We have almost come half circle from the time in which every sound was an original to the point where we probably expect it to be a repetition. As with Kuhn's scientific paradigms[2] we have to be jolted by blatant inconsistency before we note differences between sound-alikes. The very experience of time becomes a paradox. We have access to sounds of the past, but all of them seem to be part of the present in some great collage of juxtapositions. And yet, we are emotionally susceptible to the bringing back to life of a sound, perhaps a familiar voice, that has long since been silenced. We understand a picture to be merely that, a representation which we have never experienced until we see it (because there are differences between the way a camera lens "sees" and the way we do). But a recorded sound, even if imperfect in its reproduction, is close enough to our own experience to be capable of bringing back all of the original context and the feelings associated with it. Therefore, to many people, a sound recording seems a more powerful link to the past.

Objectification and Commodity

The process of storage, which we have just discussed from the perspective of breaking the time constraint, is essentially a process that objectifies sound. We transform something that occurs in time to a physical medium—an object in fact—that exists in space. By transforming time into space we make it accessible to visual and tactile inspection. Whether we wind up the spatial representation on a reel, or spiral it into the grooves of a record, we create an equivalence of space and time: inches per second or revolutions per minute.

The implications of this reification are, first of all, that the subject, now an artifact, is available for analysis, i.e., scrutiny outside of time. Such analysis is obviously important for the scientific study of sound and leads to new forms of its visual representation. Earlier forms of notation, whether musical or scientific, were symbolic and mnemonic, that is, a representation of what we hear or can produce. New kinds of analysis, on the other hand, such as the spectrograph, show microscopic details of the internal structure of the sound that are inaccessible to the ear, even if the analysis reflects that performed by the auditory system itself.

For ethnomusicologists and anthropologists, the possibilities presented

[2]T. S. Kuhn, *The Structure of Scientific Revolutions*, Chicago: University of Chicago Press, 1962.

by the early cylindrical phonograph to document music in the field were enormously useful (Nettl, 1964, p. 16 ff). The archival potential of such recordings came at a time when many indigenous cultures were already severely threatened, or had already disappeared, ironically as a result of the same Western industrialization that produced the technology used for the documentation. Such ethnomusicological collection dates from the turn of the century, and although the quality of the early recordings is poor by modern standards, the fact remains that the technology provided a literal documentation that surpassed the results of even the most sensitive transcriber. We know, for instance, that many early ethnomusicologists were so conditioned by Western musical practice that they interpreted what they heard and transcribed it according to Western musical notation, ignoring the microtonal variations that can still be heard on original recordings. Therefore, such objective documentation can be said both to preserve the aural artifacts of a culture, and to provide the means whereby its sensibilities and practices may be absorbed through repeated listening. There is no guarantee that one can ever bridge the gaps between cultures, but the perspective of time and familiarity can certainly clear away some of the veils that obscure a culture from us.

The equivalent type of documentation for our own history, as it survives in the memories of living people, only began in earnest after the Second World War, with the oral history project at Columbia University (Shumway, 1970; Waserman, 1975). People who had played an important part in society were interviewed, and these tapes, following the bias of historians to have written documents, were transcribed and sometimes even edited for readability. It was only later that the practice of interviewing anyone with memories of the past (Grele, 1975) and emphasizing the actual sounds on tape—what is called "aural history" to signify that emphasis—became an important part of archival, museum, and broadcasting activities. Today, the possibilities offered by the documentation process are very important, and we will return to them in some detail in chapter 13.

Like most processes, objectification of sound has another side to it. To objectify something makes it a commodity which can be bought and sold. The evanescence of sound previously kept it relatively immune from commerce. One could pay to have the experience of a sound in concert, but one could not actually own the sound itself, only copies of its notation. Therefore, it is not surprising that the advent of the mass-produced sound artifact, cylinders, and records, quickly became part of the "music industry" in the early years of the century.

The stage had been set for such commoditization, however, by the advances in mechanical musical devices up to the end of the 19th century (Buchner, 1959). Mechanical organs date back to the 16th century and

sophisticated devices that encoded control patterns on paper or metal disks (the predecessors of the phonograph record) could be bought for home entertainment. The sophistication of such mechanical devices as the nickelodeon, the forerunner of the modern juke-box, was amazing. Some metal disks even anticipated stereophonic recordings by providing a double set of playing mechanisms, and the range of sound extended over five octaves. Within a few years of the introduction of the electrical reproduction of live sound—no matter that it was of poorer quality—the mechanical devices became collector items.

The history of recordings as commodities up to the present is long and intricate (Gammond & Horricks, 1980). Novelty and technical innovation have been the key elements. The industry has grown to billion dollar proportions (see chapter 12), and is closely allied with the manufacture of the audio products used for reproducing sound. The word "stereo" has gone from being an adjective to its new status as a noun, an object that one owns and seemingly cannot be without. Likewise, our vocabulary has been enriched by such concepts as the audiophile, the hit single, the LP, the soundtrack, multi-track studios, component systems, direct-to-disk, and the Walkman, not to mention the endless technical terms that have sprung up around the industry. But perhaps more important than the way in which all of it touches our pocketbooks is the way it has changed our listening attitudes. In short, the listener becomes the *consumer* of sound as a commodity. And such consumption, as we will see in chapter 10, is characterized by the same dynamics and economic implications as all other types.

Finally, objectification leads to control, manipulation, and distortion of the sound (Kaegi, 1971). The manner of storage determines the kind of control that can be exercised over it. For instance, the early wire recording could not be easily or effectively spliced, nor could the original disk recordings be edited. The latter, however, could be mixed, albeit laboriously with two turntables of source material and a third for recording. Therefore, editing and the associated techniques of montage had to wait until the invention of tape in the 1930s, and until after the Second World War for it to be commonly available. Among the first attempts to use prerecorded sounds as musical material was John Cage's *Imaginary Landscape No.1* from 1939 which used existing test recordings. The modern period of musical applications begins in 1948 with Pierre Schaeffer's work as a radio producer in Paris (Cross, 1968). He originally worked with disk recordings, and after 1951 with tape when it became available. The work was first termed *musique concrète* because it worked with "found" sounds in a manner reminiscent of Marcel Duchamp's found-object "readymades" and "concrete poetry" experimentation with words and syllables. After that came the concept of "tape music," i.e., music created purely through the manipulation of sound on tape, with chevsky's experimentation at the Columbia–Princeton Studio. From these beginnings has arisen a rich tradition of what can best be generalized as "electroacoustic music," the possibilities of which we will return to in chapter 13.

Schizophonia

When we discussed the "black box" model of electroacoustics in chapter 1, we contrasted the conventional notion of fidelity—which compares only input and output signals—with a communicational model which shows that the *context* of the original signal is completely different from that of the output signal. The comparison of signals ignores the obvious split in context, and when context is ignored, most of the communicational subtlety of a message is lost. Comparisons based on signal quality alone imply absolute, universal standards which can be applied under any circumstances. Most functional artifacts, on the other hand, are designed with consideration for the environment in which they are to function. A car that is suited for highway driving may be inefficient in urban traffic, for instance. H. A. Simon refers to this matching of artifact and environment as achieving a homeostasis, or equilibrium, between the inner and outer environment (Simon, 1969, p. 9).

A simpler way to define the problem is to refer to the split between an original sound and its electroacoustic reproduction as "schizophonia," a term coined by Schafer (1969) and used by the World Soundscape Project. Use of the Greek "schizo," meaning split or separation, emphasizes the difference in context which characterizes electroacoustic manipulation. Schafer points to the word as being "nervous" and makes a comparison to the psychological aberration of schizophrenia. We have already described in this chapter some implications of the breaking of traditional acoustic constraints, and we will elaborate on these considerations in the following chapters. However, it should be clear that, like most tools, electroacoustic technology is a double-edged sword that provides benefits and conceals dangers. Schizophonia is an inevitable fact of audio technology, but our concern with it will be to understand its implications, not condemn its existence altogether.

The challenge of the schizophonic situation for the listener is to make sense out of the juxtaposition of two different contexts. In many cases, the "sense" becomes conventional acceptance. We come to expect that voices should appear from the walls and ceilings in public places such as airports and train stations to give us information. We think nothing of hearing music (even of a 100-piece orchestra!) emanating from the smallest places. We come to depend on radio and television for information, entertainment, and distraction. However, in other cases, the schizophonic discontinuity may strike us as being inappropriate—the sound of a radio "blaring" in an

centration are desired, strikes most people as an infringement of their personal space.

In many situations, electroacoustic sound *imposes* its character on an environment because of its ability to dominate, both acoustically and psychologically. Muzak and other forms of programmed background music are specifically designed to impose a mood on an environment and to have predictable effects on the behavior of those within it. Similarly, many individuals prefer some form of background sound in their own personal environments, for reasons that we will go into later. The question of when such practices are simply exercises of free will and when they become public infringements is, of course, both important and controversial. In every case, however, the mood of the environment becomes that imposed by the electroacoustic sound, and therefore mood becomes a designed, artificial construct. Whether one likes or dislikes the effect is not important to the discussion. Instead, we should be concerned about the long-range effects when (and if) most environments that people experience have predictable, perhaps stereotyped moods associated with them. Does "happiness" become what you feel when you shop in an environment with happy music in it? If so, emotion does not arise from within our relationships to people and environments, but instead, is a property *of* the environment and yet another commodity to be experienced, and therefore consumed.

The imposition of one environment on another now includes the "embedding" of an environment within another through use of portable, lightweight headphones—the so-called "Walkman" phenomenon. The schizophonic split between electroacoustic and natural environments becomes nearly complete in this situation. The *choice* of audio environment has the attraction for the listener of being entirely one's own. The psychological "shutting out" of the environment that we described in part I as being typical of the lo-fi environment, now becomes an objective and highly visible reality. Whereas no one seems to be offended by the non-listener's introversion in the lo-fi situation, it is remarkable to note the public outcry against people who blatantly shut themselves off with portable sound systems. People who dislike intrusive noise usually regard headphone listening (for others) with grateful relief ("just as long as they don't bother me"). Society is now faced with the visible evidence that such self-isolation can occur anywhere and at will. The audio advertiser's exhortation to "Shut out the city!" with their stereo products is now being answered by the walk-person's logical response, "Shut out everybody!" It becomes the electroacoustic answer to noise pollution, as well as a psychological listening habit made profitable.

In conclusion, our brief survey of the basic implications of electroacoustic technology on listener–environment relationships shows that fundamental changes are at work. Traditional acoustic patterns of behavior we come to depend less and less on acoustic information because fewer sounds we experience are meaningful (an alternative definition of noise pollution), electroacoustic technology extends the world of listening possibilities as much as it exploits the listener's habits and creates psychological dependencies. The issues become difficult to discuss objectively because, first of all, everyone is personally involved in the changes. Investigations of listening habits to the media are often treated by people as attacks against their personal lifestyle. It is easy to be subjective and respond by saying, "But I like it," or "You can't stop progress," or "I can do what I want"—responses that are also typical of the public's response to noise. Electroacoustic listening preferences represent psychological investments, and people are often as sensitive about them as they are to what they wear or the way they look. In the face of such personal involvement, it will be our task in the next few chapters to document the behavioral changes we observe in the new environments of electroacoustic communication as carefully and objectively as possible.

9

Electrification: The New Soundscape

We normally think of the technological impact on sound in terms of the audio media. However, the widespread use of electrical power as a source of energy has altered the character of the soundscape as much as audio technology has. All energy forms leave their mark on the sounds they produce, either directly or as a by-product of their processes. Human power, horsepower, mechanical power, steam, internal combustion, and diesel motors—all of these sources of power have acoustic implications in terms of such factors as speed, uniformity, attack characteristics, timbre, and so on. Beyond changes in the sounds themselves are the social and economic changes which new forms of energy bring about, and which inevitably result in differences in community life and patterns of communication. R. M. Schafer (1977) provides a fascinating account of the historical changes in soundscape character in *The Tuning of the World*. Here we will consider the implications of electrification on cognitive and perceptual processes that are involved in acoustic communication systems.

Redundancy and Uniformity

The use of electricity as a means of power provides a nearly unchanging source of energy that allows a machine to be driven at high, uniform speeds. The sounds made by such machines, termed "flatline" sounds by Schafer, have a corresponding uniformity and invariance, both in intensity and spectrum (Fig. 14). We often describe the sound of a machine as a "whir" or "whine"; the former reflects a constant intensity level, perhaps combined with the modulatory grain of a rolled "r" sound, and the latter suggests the presence of high frequency components. The onomatopoeia of such words is not accidental. Both words can be prolonged into a machine-like drone, and "whine" has the added connotation of a human vocal expression that is annoying because of its persistent and irritating high frequency components. The high speed of revolution of electrically powered machines typically pro-