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The Soundscape and Technology

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ABSTRACT

The separation of musical study from ecological concerns of the acoustic environment is argued as no longer tenable on the grounds that the negative influence of noise affects both the physiological health and the psychological listening ability of musicians and audience. Soundscape studies is proposed as a discipline which is concerned with the relation of man and the environment through sound, and which thereby links the study of musical behaviour to sound comprehension in general. Simon's notion of "sciences of the artificial" is applied to soundscape studies in order to emphasize that such a discipline is concerned with how sound functions within a system of individual and collective understanding. Activities of the World Soundscape Project of Simon Fraser University are briefly outlined, including a summary of recent work. The notion of the acoustic community is introduced as a model of a naturally evolved and balanced soundscape. Criteria and strategies for acoustic design that are suggested by the model are presented.

In his novel, *The Glass Bead Game,* Hermann Hesse (1969) characterizes the relation of music to society by a quotation, supposedly taken from an ancient Chinese source:

> Therefore the music of a well-ordered age is calm and cheerful, and so is the government. The music of a restive age is excited and fierce, and its government is perverted. The music of a decaying state is sentimental and sad, and its government is imperiled.

The implication of this statement is that music and society are totally integrated, each reflecting and in turn influencing the other. But perhaps more interesting than a survey of instances where such a parallel has existed is the fact that we are able to postulate an alternative model, that of the independence of music as a purely auditory, aesthetic

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experience. In fact, in western society, many aspects of the professional attitude toward music, its very existence as a legitimate field of study within the university, for instance, suggest our acceptance of music, and in particular scores, as artifacts which may be studied outside the social context.

By way of contrast, the ethnomusicologist will emphasize the integration of music within other cultures, particularly those without systems of musical notation. In these cultures it is also often true that it is the same energy source, that of human energy, that is responsible for both musical performance and the sounds that characterize the acoustic environment. In Western industrialized society, we know the opposite to be true: the vast majority of the sound to which we are exposed is the result of changing forms of energy, the new sounds and rhythms of a changing technology. With music kept isolated from the sound environment of society, it falls victim to that environment constantly increasing, as it now is, in intensity, vulgarity, redundancy and potential danger to health and well-being.

This situation leads me to ask whether today the study of music, in particular that of contemporary music, can continue in isolation from the sound environment in which we live? Can we as musicians continue to ignore the deterioration of that environment and its consequent effects on present and future society?

The answer to these questions, I feel, is unquestionably negative, if only on the following basically physiological grounds. First of all, we cannot claim that we are not affected by noise. There is no escape from it. The basic physiological effects are involuntary and apply to the pulse rate, breathing rate and nervous system, stimulated predominantly by intensity, rhythm and tempo, a fact put to commercial use by the Muzak corporation and many radio stations who plan the pattern and selection of tempi throughout the day to control workers and consumers alike. Exposure to low frequency and infrasonic vibration in planes, trains, buses, stores and other buildings due to motor and ventilation systems, has a similarly involuntary effect on the body which acts like a resonator to these low frequencies. Most dangerous of all is the threat of hearing loss due to prolonged exposure to intense sound. Analogous to the protection provided by the eye against bright light, the hearing mechanism provides protection against both impact sounds and high noise levels by what is called a temporary threshold shift. With prolonged exposure and few periods for recovery of normal hearing levels, the threshold shift becomes chronic, then permanent, a slow form of deafness now taken so much for granted that the term presbycusis, signifying loss of hearing with age, was until recently thought to be natural and unavoidable. After Samuel Rosen's discovery (1962) of a tribe in the Sudan living in a relatively noise-free society where excellent hearing was maintained even in old age, the issue of the effect of rising noise levels on the general hearing ability of people in our society has been made somewhat clearer.

In brief, increased noise exposure affects everyone, bringing with it decreased sensitivity to sound and eventually a permanent loss of hearing ability. The teaching of music, then, cannot ignore the fact that attempts to increase students' sensitivity to sound inside the classroom are seriously affected by their sound experience outside it. Ironically, the anachronistic convergence today of two factors, that of the use of instruments that were improved in the 19th century to provide the large amount of sound needed to fill the new concert halls, and the architectural use of small enclosed spaces

for most music classrooms, now results in an enormous increase of cases of hearing damage, nervous disorders and early retirement with music teachers, particularly in high schools, not to mention the possible effects on the students. It may well be that the average music student today is the most aurally deficient of any to have ever studied the subject.

Beyond the relatively simply measured incidence of hearing loss, is what appears to be a decreasing ability and inclination to listen on the part of the general public. In fact, listening skills seem to be the crucial factor in altering the downward trend of the run-away syndrome: high noise levels leading to the indiscriminate "blocking out" of both good and bad sound by people, leading to increased toleration of higher noise levels, which in turn allows further increases in those levels without significant complaint. As long as we spend more energy shutting out sound, albeit for the worthy cause of preserving our sanity, than in listening, we forfeit the state of clairaudience, excellent hearing acuity commonly reported in the past, for instance, by ships' captains who found their way through the fog by listening to the subtle differences in the echoes of their whistles off nearby shorelines (a method, called echolocation, employed by the blind unless obstructed by high ambient noise), or by the early settlers of this country to whom every sound yielded information needed for their difficult struggle for survival. The only way to begin to combat noise is to exercise one's listening ability. As suggested by Murray Schafer (1974) in his essay, "Music of the Environment", we need "ear cleaning in the schools to avoid audiometry in the factories."

In a crisis situation such as I have outlined, it seems useful to re-examine the entire system of relationships involved with music, sound and society. In fact, the climate for such a re-examination is set already in this century by the tremendous expansion of the sound repertoire of contemporary music, though this is ironically made possible by the same technology that produces much of the sound sewage that is causing the deterioration of listening and hearing ability, and that may eventually lead to universal deafness. It is at this critical juncture, then, that we introduce the idea of the soundscape as not only a general term for a sonic environment, but also as a concept that emphasizes the relationship of man to any such environment, whether musical, synthesized or natural.

By putting the emphasis on man's relationship to his sound environment, we immediately raise questions of a broad nature concerning human sound comprehension in general. On this basis, musical understanding will be conceived as a special and rather highly developed kind of sound cognition, but also as one that becomes integrated with all other types of sound experience, and thereby related to human activity in general.

An important distinction made by Herbert A. Simon is crucial to understanding the implications of the soundscape idea, namely that between natural science and what Simon (1969) calls the sciences of the artificial, the term 'artificial' being used in the sense of pertaining to an artifact, that is, something manmade, as opposed to the natural. Whereas a natural science essentially describes how things are, sciences of the artificial deal with how artifacts are designed to function in a certain way to achieve goals.

With sound, the field of acoustics may be called a natural science, in that it describes how sound behaves, but music, as Simon observes is "one of the most ancient of the

sciences of the artificial" (1969, p. 81), in that it deals with how sounds are structured (by both sender and receiver), that is, how they are designed to communicate meanings which we call musical. Obviously, music is not independent of acoustics, any more than an aircraft is independent of the natural laws of gravity. The aircraft, however, can be analyzed both as part of a system of natural forces, and also as a system designed to function in a certain manner within a certain environment. Similarly, music is subject to laws of acoustics, but it is primarily a matter of human design, created to function within certain human task environments.

Soundscape studies may also be called a science of the artificial inasmuch as it emphasizes how human beings operate within a sound environment, and therefore design it in terms of their understanding of it. The related discipline, termed sonology by Otto E. Laske (1974), emphasizes sound comprehension in terms of musical understanding and performance. As with all sciences of the artificial, soundscape studies are concerned with how things "ought to be", how sound should be designed to function adequately in a human environment. Acoustic or soundscape design is the name we give to this new field. Just as the artists of the Bauhaus contributed to the establishment of what was called 'industrial design', composers and musicians today can give leadership to the design of the soundscape.

Composition is the design science of music, but the knowledge used by its practitioners today is generally only operationally defined in terms of an artistic environment, closed off from other sound contexts. The composer's knowledge has not been generalized or formalized enough for it to apply to the broader case of the soundscape. Ironically, however, the composer's own work to design imaginative and complex sound structures is developing in direct opposition to his audience's ability to listen to or even hear them.

One of the implications of the use of the computer for music is that the musician is required to be thoroughly explicit, as never before, about processes that were once left completely intuitive, or at best simplified into methods for theory textbooks. The implication of soundscape studies is similar to that of the computer. It demands an understanding about sound and sound environments, both as to how they are structured and as to how they are perceived and understood, that is more explicit and general than ever before. Leaving the sound environment to the acoustical engineer is to treat it as a natural science, where even the most elaborate measurement scheme devised (and their numbers are enormous) cannot distinguish one sound from another in terms of how it is understood, with what associations or symbolism, within what structure or context, or even with what intrinsic interest as sound.

As a science of the artificial, soundscape studies are concerned with the relation of the inner environment of thought and understanding to the outer physical reality. This relationship may be derived from the two contrasting Greek myths regarding the creation of music (see Schafer, in press), that of it originating with Hermes plucking the strings of the tortoise shell, and that of its creation by Athena as emotional comfort to the sisters of the beheaded Medusa. With the former, music reflects the natural structure of the world, the external order, whereas in the latter the emphasis is on its expressiveness designed for human understanding. The dynamic balance between the two, to be found in the best music, is increasingly lacking from the soundscapes of society, and our understanding of them.

The main implication that I am drawing from the theme of the soundscape and technology is that the crisis brought on by the technologically caused deterioration of the soundscape forces us, if only for our self-preservation as musicians and as sane individuals within society, to re-evaluate the traditional isolation of musical enquiry from ecological and environmental concerns. Further thought leads us to realize that both musical and environmental concern requires a more basic understanding of man's sound comprehension abilities as a part of the wider range of human problem-solving activity. Since the study of contemporary music already expands our notions of sound repertoire, syntax and semantics, soundscape studies is an appropriate part of the contemporary music curriculum, as well as being an urgent concern of any musician.

The second implication of the theme that I can only briefly cover here is that recent technology furnishes us with tools for research in the field of soundscape studies. (Would that all problems provide such generous tools for their solution!) To illustrate these developments I intend to give a brief summary of the activities of the World Soundscape Project, located at Simon Fraser University, founded in 1969 and directed by composer R. Murray Schafer (Truax, 1974).

Activities of the Soundscape Project include a great deal of field recording, studio analysis and the preparation of documents and other pedagogical tools for the presentation of soundscape studies to the public. Various kinds of lecture-demonstrations at all educational levels, as well as for the general public and professional groups, are a common part of the group's activities. Group members also teach various sound courses in the Dept. of Communication Studies at Simon Fraser, following the general soundscape approach and utilizing the facilities of the Sonic Research Studio in the department.

The stereo tape recordings which we have made throughout Canada and Europe form one of the important data bases which we have. Classification and studio analysis of envelope and spectrum of these sounds allows us to compare and analyze many varieties of the same type of sound, and in many cases trace their historical development, since one emphasis in recording has been to collect old, or what we call 'disappearing sounds'. Besides its archival and analytic value, the tape library is the source of material for various composed documents, such as *The Vancouver Soundscape* study which presents representative sound features and environments of that city. Since examples of malfunctioning soundscapes abound today, we often use the tape medium to create new, and in a sense model environments in the form of compositions based on material recorded in existing locations. Several examples of this new type of composition were heard in the series "Soundscapes of Canada", ten one-hour programs prepared for CBC-FM Ideas in late 1974. Also included in that series was a 24-hour field recording made on the summer solstice and providing an example of a new technique for observing the larger cycles and rhythms of a soundscape.

A historical data base is derived from archive material and also what we call "earwitness accounts", reminiscences and reports of sound experience in the past. Besides interviews, sound references in literature provide a large source of information about soundscapes of the past. The data from these sources is catalogued and classified, and stored by a computer program. The program, currently being developed, allows data retrieval and also analysis of trends among specific sounds or types of sounds in any time and geographical region. After the tape recording, the computer program is likely

to be the next most valuable tool provided by technology for soundscape research. Besides its basic use at present in data ordering, one can envision its future application in simple types of simulation problems, in the way that Simon characterizes simulation as a primary method of a science of the artificial to deal with the investigation of functions, processes and behaviour within a system.

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The current work of the World Soundscape Project centres around the concept of the *acoustic community* and its consequences for *acoustic design.* These concepts were brought into focus during the field work in 1975 that studied five European communities (in press), each in the 1500 to 3000 population range. They were Skruv, an industrial village in south-western Sweden; Bissingen, a farming community near Stuttgart; Cembra, a northern Italian mountain village; Lesconil, a fishing port in Brittany; and Dollar, a scool-town in Scotland. Each of these villages showed a different degree of assimilation of 20th century technology, and as a result had differing degrees of traditional character and modern, urban-style problems. Noise, then, although a growing problem in each community, was not its over-riding feature, and in fact, each village showed different aspects of how traditional communities have had a positive acoustic orientation, and what the impact of technology has been on each of them. Taken as a group, the five have had a significant influence on the development and testing of new concepts of soundscape studies, including criteria for acoustic design.

How can acoustic design be used to counteract the negative effects of technological and economic growth within a community? Our analysis of the evidence from the European study (and the current work we are doing in a British Columbia community) arrived at a model of the traditional village soundscape which is rich in information and patterns of interaction. A wide variety of sounds function in a complex social interaction, and the whole system is balanced by natural forces as well as those of the social institutions which define the community. Such a system seems adaptable to considerable change in acoustic population, but not to change in the balancing or control structure that organizes it, unless new levels of control are introduced as well. With economic growth and the introduction of technological sounds, we observe both a degeneracy in the variety and complexity of community sounds and a break-down in the balancing forces that once organized the community. The strength of a previously balanced soundscape does not preserve it from this kind of destruction.

It appears that such change is irreversible in the sense that no natural process will restore the original balance to a degenerate soundscape. Nothing can prevent the continual increase of sound intensity, and for the individual, noise-induced hearing loss and social alienation are the limiting responses to such an unchecked increase. Since we regard this natural "solution" as non-acceptable, we must look to the development of a scientific discipline, called acoustic design, which will concern itself with techniques for the analysis and improvement of existing soundscapes and the creation of new ones. The basis of the discipline is a concern for *behaviour* — individual, social, economic, cultural — and from it develops a study of the systematic relationships between behaviour, sound and the environment. Our analysis provides a guiding principle for the practice of acoustic design. Techniques need to be developed for (1) increasing variety within a soundscape, (2) promoting a complexity of relationship and function,

and (3) establishing controls which will act to balance the soundscape on the larger scale.

We may look first to the technology itself to determine whether it may be used to promote these goals. Since technology itself is neutral, and it is only its organization that is biased, we should look for methods of using technology to bring about solutions. It is probably true that small scale changes may be made within the current structure of technology, but that large scale reform will only come about through basic political and social change. Thus, in order for it to be applied effectively, acoustic design must assume a political and social responsibility. Since we also recognize the dependence of the soundscape upon individual and public attitudes, we must look for techniques of analyzing and influencing these through experiment and education. The relevance of soundscape studies to music must also be brought forward since it is apparent that this form of acoustic education is not concerned as yet with environmental problems. In fact, acoustic design needs to be applied in all disciplines related to sound, and therefore professional people in government, law, medicine, planning, architecture and engineering need to be made aware of acoustic problems such that they can individually and collectively exert a positive influence.

Soundscape studies takes a positive approach to the problems of environmental sound, as opposed to the primarily negative approach of most noise studies. It seeks to make people aware of the positive benefits of sound and the listening attitude, and to encourage acoustic design as the means by which desirable improvements are made. In contrast, noise studies, as they have proliferated in the last 15 years particularly, are solely concerned with numerical and statistical representations of noise levels and correlated public annoyance. A typical result of such a survey shows the degree of public annoyance and protest given a certain measured noise level. No thought is taken for the social impact of the noise, or the long-term deterioration in physical and psychological well-being. Such studies are conducted as if the public's relation to sound were unchanging. Their results, at best, specify 'acceptable' levels of noise with no consideration of what would be a desirable environment, or how an existing one could be improved. At worst, they merely justify economic expansion which allows noise levels to increase at the slow rate (about half a decibel per year in North America) that people can adapt to negatively through gradual deafness and increased tension.

The soundscape approach concerns not only the problems of pollution, but also the larger questions of *acoustic ecology,* the balanced relationship of individuals and communities with their sonic environment. It is clear that humans cannot adapt as rapidly as changes in the environment necessitate without adapting negatively. Conscious effort must be made, therefore, both informally on the individual level of listening and making choices about personal living spaces, and formally as a non-exploitative design science, if we are to restore our acoustic environment to a humane, balanced state.

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