PHENOMENOLOGICAL LISTENING:

phe – nom – e – ‘nol – o – gy

phe – nom – e – ‘nol – o – gy

1) the description of the formal structure of objects in abstraction from interpretation or evaluation

2) the typological classification of a class of phenomena

3) an analysis produced by phenomenological investigation

The Components of Listening

Amplitude: the loudness of a sound

Frequency: the pitch of a sound

Duration: how long a sound lasts

Timbre: the tonal characteristics or qualities of a sound

Morphology: how a sound changes over time; morphology is frequently described as the “envelope” of a sound component, articulated as an ADSR (attack, decay, sustain, release) graph

Spatialization: the location and/or movement of a sound in your perceptual field

These components, ultimately, are unified in the perception of a sound. A change in one domain will very likely create perceived changes in one or more other domains. And, as variation is the root of perception, these domain changes over time allow us to follow with interest the auditory world, whether that is a fabricated auditory world (a composed one) or simply the auditory world resultant in the sounding of environmental events.

N.B.Aldrich 2004

THE FUTURE OF MUSIC: CREDO

John Cage, 1937

Perhaps the single most influential of Cage's written texts, this was first delivered as a lecture in 1937 in Seattle, but not published until 1958 in the brochure accompanying George Avakian's recording of Cage's 25-Year Retrospective Concert.

I BELIEVE THAT THE USE OF NOISE

Wherever we are, what we hear is mostly noise. When we ignore it, it disturbs us. When we listen to it, we find it fascinating. The sound of a truck at 50 m.p.h. Static between the stations. Rain. We want to capture and control these sounds, to use them, not as sound effects, but as musical instruments. Every film studio has a library of "sound effects" recorded on film. With a film phonograph it is now possible to control the amplitude and frequency of any one of these sounds and to give to it rhythms within or beyond the reach of anyone's imagination. Given four film phonographs, we can compose and perform a quartet for explosive motor, wind, heartbeat, and landslide.

TO MAKE MUSIC

If this word “music” is sacred and reserved for eighteenth- and nineteenth-century instruments, we can substitute a more meaningful term: organization of sound.

WILL CONTINUE AND INCREASE UNTIL WE REACH A MUSIC PRODUCED THROUGH THE AID OF ELECTRICAL INSTRUMENTS

Most inventors of electrical musical instruments have attempted to imitate eighteenth- and nineteenth-century instruments, just as early automobile designers copied the carriage. The Novachord and the Solovox are examples of this desire to imitate the past rather than construct the future. When Theremin provided an instrument with genuinely new possibilities, Thereministes did their utmost to make the instrument sound like some old instrument, giving it a sickeningly sweet vibrato, and performing upon it, with difficulty, masterpieces from the past. Although the instrument is capable of a wide variety of sound qualities, obtained by the mere turning of a dial, Thereministes act as censors, giving the public those sounds they think the public will like. We are shielded from new sound experiences.

The special property of electrical instruments will be to provide complete control of the overtone structure of tones (as opposed to noises) and to make these tones available in any frequency, amplitude, and duration.

WHICH WILL MAKE AVAILABLE FOR MUSICAL PURPOSES ANY AND ALL SOUNDS THAT CAN BE HEARD. PHOTOELECTRIC, FILM, AND MECHANICAL MEDIUMS FOR THE SYNTHETIC PRODUCTION OF MUSIC

It is now possible for composers to make music directly, without the assistance of intermediary performers. Any design repeated often enough on a sound track is audible. 280 circles per second on a sound track will produce one sound, whereas a portrait of Beethoven repeated 50 times per second on a sound track will have not only a different pitch but a different sound quality.

WILL BE EXPLORED. WHEREAS, IN THE PAST, THE POINT OF DISAGREEMENT HAS BEEN BETWEEN DISSONANCE AND CONSONANCE, IT WILL BE, IN THE IMMEDIATE FUTURE, BETWEEN NOISE AND SO-CALLED MUSICAL SOUNDS.

THE PRESENT METHODS OF WRITING MUSIC, PRINCIPALLY THOSE WHICH EMPLOY HARMONY AND ITS REFERENCE TO PARTICULAR STEPS IN THE FIELD OF SOUND, WILL BE INADEQUATE FOR THE COMPOSER WHO WILL BE FACED WITH THE ENTIRE FIELD OF SOUND.

The composer (organizer of sound) will not only be faced with the entire field of sound but also with the entire field of time. The "frame" or fraction of a second, following established film technique, will probably be the basic unit in the measurement of time. No rhythm will be beyond the composer's reach.

NEW METHODS WILL BE DISCOVERED, BEARING A DEFINITE RELATION TO SCHOENBERG'S TWELVE-TONE SYSTEM

Schoenberg's method assigns to each material, in a group of equal materials, its function with respect to the group. (Harmony assigned to each material, in a group of unequal materials, its function with respect to the fundamental or most important material in the group.) Schoenberg's method is analogous to modern society, in which the emphasis is on the group and the integration of the individual in the group.

AND PRESENT METHODS OF WRITING PERCUSSION MUSIC

Percussion music is a contemporary transition from keyboard-influenced music to the all-sound music of the future. Any sound is acceptable to the composer of percussion music; he explores the academically forbidden "nonmusical" field of sound insofar as is manually possible.

Methods of writing percussion music have as their goal the rhythmic structure of a composition. As soon as these methods are crystallized into one or several widely accepted methods, the means will exist for group improvisations of unwritten but culturally important music. This has already taken place in Oriental cultures and in hot jazz.

AND ANY OTHER METHODS WHICH ARE FREE FROM THE CONCEPT OF A FUNDAMENTAL TONE.

THE PRINCIPLE OF FORM WILL BE OUR ONLY CONSTANT CONNECTION WITH THE PAST. ALTHOUGH THE GREAT FORM OF THE FUTURE WILL NOT BE AS IT WAS IN THE PAST, AT ONE TIME THE FUGUE AND AT ANOTHER THE SONATA, IT WILL BE RELATED TO THESE AS THEY ARE TO EACH

OTHER:

Before this happens, centers of experimental music must be established. In these centers, the new materials, oscillators, generators, means for amplifying small sounds, film phonographs, etc., available for use. Composers at work using twentieth-century means for making music. Performances of results. Organization of sound for musical and extramusical purposes (theater, dance, film).

THROUGH THE PRINCIPLE OF ORGANIZATION OR MAN'S COMMON ABILITY TO THINK.

THE THREE LISTENING MODES

by Michel Chion

CAUSAL LISTENING

When we ask someone to speak about what they have heard, their answers are striking for the heterogeneity of levels of hearing to which they refer. This is because there are at least three modes of listening, each of which addresses different objects. We shall call them *causal listening*, *semantic listening*, and *reduced listening*.

Causal listening, the most common, consists of listening to a sound in order to gather information about its cause (or source). When the cause is visible, sound can provide supplementary information about it; for example, the sound produced by an enclosed container when you tap it indicates how full it is. When we cannot see the sound's cause, sound can constitute our principal source of information about it. An unseen cause might be identified by some knowledge or logical prognostication; causal listening (which rarely departs from zero) can elaborate on this knowledge.

We must take care not to overestimate the accuracy and potential of causal listening, its capacity to furnish sure, precise data solely on the basis of analyzing sound. In reality, causal listening is not only the most common but also the most easily influenced and deceptive mode of listening.

Identifying Causes: From the Unique to the General

Causal listening can take place on various levels. In some cases we can recognize the precise cause: a specific person's voice, the sound produced by a particular unique object. But we rarely recognize a unique source exclusively on the basis of sound we hear out of context. The human individual is probably the only cause that can produce a sound, the speaking voice, that characterizes that individual alone. Different dogs of the same species have the same bark. Or at least (and for most people it adds up to the same thing) we are not capable of distinguishing the barking of one bulldog from that of another bulldog or even a dog of a related breed. Even though dogs seem to be able to identify their master's voice from among hundreds of voices, it is quite doubtful that the master, with eyes closed, and lacking further information, could similarly discern the voice of her or his own dog. What obscures this weakness in our causal listening is that when we're at home and hear barking in the back room, we can easily deduce that Fido or Rover is the responsible party.

At the same time, a source we might be closely acquainted with can go unidentified and unnamed indefinitely. We can listen to a radio announcer every day without having any idea of her name or her physical attributes. Which by no means prevents us from opening a file on this announcer in our memory, where vocal and personal details are noted, and where her name and other traits (hair color, facial features - to which her voice gives us no clue) remain blank for the time being. For there is a considerable difference between taking note of the individual's vocal timbre - and *identfying* her, having a visual image of her and committing it to memory and assigning her a name.

In another kind of causal listening we do not recognize an individual, or a unique and particular item, but rather a category of human, mechanical, or animal cause: an adult man's voice, a motorbike engine, the song of a meadowlark. Moreover, in still more ambiguous cases far more numerous than one might think, what we recognize is only the general nature of the sound's cause. We may say, "That must be something mechanical" (identified by a certain rhythm, a regularity aptly called “mechanical”); or, "That must be some animal” or “human sound." For lack of anything more specific, we identify *indices*, particularly temporal ones, that we try to draw upon to discern the nature of the cause.

Even without identifying the source in the sense of the nature of the causal object, we can still follow with precision the causal history of the sound itself. For example, we can trace the evolution of a scraping noise (accelerating, rapid, slowing down, etc.) and sense changes in pressure, speed, and amplitude without having any idea of *what* is scraping against *what*.

The Source as a Rocket in Stages

Remember that a sound often has not just one source but at least two, three, even more. Take the sound of the felt-tip pen with which I am writing this draft. The sound's two main sources are the pen and the paper. But there are also the hand gestures involved in writing and, further, I who am writing. If this sound is recorded and listened to on a tape recorder, sound sources will also include the loudspeaker, the audio tape onto which the sound was recorded, and so forth.

Let us note that in the cinema, causal listening is constantly manipulated by the audiovisual contract itself, especially through the phenomenon of synchresis. Most of the time we are dealing not with the real initial causes of the sounds, but causes that the film makes us believe in.

SEMANTIC LISTENING

I call semantic listening that which refers to a code or a language to interpret a message: spoken language, of course, as well as Morse and other such codes. This mode of listening, which functions in an extremely complex way, has been the object of linguistic research and has been the most widely studied. One crucial finding is that it is purely differential. A phoneme is listened to not strictly for its acoustical properties but as part of an entire system of oppositions and differences. Thus semantic listening often ignores considerable differences in pronunciation (hence in sound) if they are not pertinent differences in the language in question. Linguistic listening in both French and English, for example, is not sensitive to some widely varying pronunciations of the phoneme *a*.

Obviously one can listen to a single sound sequence employing both the causal and semantic modes at once. We hear at once what someone says and how they say it. In a sense, causal listening to a voice is to listening to it semantically as perception of the handwriting of a written text is to reading it.

REDUCED LISTENING

Pierre Schaeffer gave the name *reduced listening* to the listening mode that focuses on the traits of the sound itself, independent of its cause and of its meaning. Reduced listening takes the sound - verbal, played on an instrument, noises, or whatever - as itself the object to be observed instead of as a vehicle for something else.

A session of reduced listening is quite an instructive experience. Participants quickly realize that in speaking about sounds they shuttle constantly between a sound's actual content, its source, and its meaning. They find out that it is no mean task to speak about sounds in themselves, if the listener is forced to describe them independently of any cause, meaning, or effect. And language we employ as a matter of habit suddenly reveals all its ambiguity: “This is a squeaky sound,” you say, but in what sense? Is “squeaking” an image only, or is it rather a word that refers to a source that squeaks, or to an unpleasant *effect*?

So when faced with this difficulty of paying attention to sounds in themselves, people have certain reactions - "laughing off” the project, or identifying trivial or harebrained causes - which are in fact so many defenses. Others might avoid description by claiming to objectify sound via the aids of spectral analysis or stopwatches, but of course these machines only apprehend physical data, they do not designate what we hear. A third form of retreat involves entrenchment in out-and-out subjective relativism. According to this school of thought, every individual hears something different, and the sound perceived remains forever unknowable. But perception is not a purely individual phenomenon, since it partakes in a particular kind of objectivity, that of shared perceptions. And it is in this objectivity-born-of-inter-subjectivity that reduced listening, as Schaeffer defined it, should be situated.

In reduced listening the descriptive inventory of a sound cannot be compiled in a single hearing. One has to listen many times over, and because of this the sound must be fixed, recorded. For a singer or a musician playing an instrument before you is unable to produce exactly the same sound each time. She or he can only reproduce its general pitch and outline, not the fine details that particularize a sound event and render it unique. Thus reduced listening requires the fixing of sounds, which thereby acquire the status of veritable objects.

Requirements of Reduced Listening

Reduced listening is an enterprise that is new, fruitful, and hardy natural. It disrupts established lazy habits and opens up a world of previously unimagined questions for those who try it. Everybody practices at least rudimentary forms of reduced listening. When we identify the pitch of a tone or figure out an interval between two notes, we are doing reduced listening; for pitch is an inherent characteristic of sound, independent of the sound's cause or the comprehension of its meaning.

What complicates matters is that a sound is not defined solely its pitch; it has many other perceptual characteristics. Many common sounds do not even have a precise or determinate pitch; if they did, reduced listening would consist of nothing but good old traditional solfeggio practice. Can a descriptive system for sounds be formulated, independent of any consideration of their cause? Schaeffer showed this to be possible, but he only managed to stake out the territory, proposing, in his *Traite des objets musicaux,* a system of classification. This system is certainly neither complete nor immune to criticism, but it has the great merit of existing.

Indeed, it is impossible to develop such a system any further unless we create new concepts and criteria. Present everyday language as well as specialized musical terminology are totally inadequate to describe the sonic traits that are revealed when we practice reduced listening on recorded sounds. In this book I am not about to go into great detail on reduced listening and sound description. The reader is encouraged to consult other books on this subject, particularly my own digest of Pierre Schaeffer's work published under the title of *Guide des objets sonores.*

What Is Reduced Listening Good For?

“What ultimately is the usefulness of reduced listening” wondered the film and video students whom we obliged to immerse themselves in it for four days straight. Indeed, it would seem that film and television use sounds solely for their figurative, semantic, or evocatory value, in reference to real or suggested causes, or to texts - but only rarely as formal raw materials in themselves.

However, reduced listening has the enormous advantage of opening up our ears and sharpening our power of listening. Film and video makers, scholars, and technicians can get to know their medium better as a result of this experience and gain mastery over it. The emotional, physical, and aesthetic value of a sound is linked not only to the causal explanation we attribute to it but also to its own qualities of timbre and texture, to its own personal vibration. So just as directors and cinematographers - even those who will never make abstract films - have everything to gain by refining their knowledge of visual materials and textures, we can similarly benefit from disciplined attention to the inherent qualities of sounds.

The Acousmatic Dimension and Reduced Listening

Reduced listening and the acousmatic situation share something in common, but in a more ambiguous way than Pierre Schaeffer (who first developed both notions) gave us to understand. Schaeffer emphasized how acousmatic listening, which we shall define further on as a situation wherein one hears the sound without seeing its cause, can modify our listening. Acousmatic sound draws our attention to sound traits normally hidden from us by the simultaneous sight of the causes - hidden because this sight reinforces the perception of certain elements of the sound and obscures others. The acousmatic truly allows sound to reveal itself in all its dimensions.

At the same time, Schaeffer thought the acousmatic situation could encourage reduced listening, in that it provokes one to separate oneself from causes or effects in favor of consciously attending to sonic textures, masses, and velocities. But, on the contrary, the opposite often occurs, at least at first, since the acousmatic situation intensifies causal listening in taking away the aid of sight. Confronted with a sound from a loudspeaker that is presenting itself without a visual calling card, the listener is led all the more intently to ask, "What's that?” (i.e., "What is causing this sound?”) and to be attuned to the minutest clues (often interpreted wrong anyway) that might help to identify the cause. When we listen acousmatically to recorded sounds it takes repeated hearings of a single sound to allow us gradually to stop attending to its cause and to more accurately perceive its own inherent traits.

A seasoned auditor can exercise causal listening and reduced listening in tandem, especially when the two are correlated. Indeed, what leads us to deduce a sound's cause if not the characteristic form it takes? Knowing that this is “the sound of x" allows us to proceed without further interference to explore what the sound is like in and of itself.

ACTIVE AND PASSIVE PERCEPTION

It seemed important, in the context of this book on audio-vision, to draw clear distinctions among the three modes of listening. But we must also remember that these three listening modes overlap and combine in the complex and varied context of the film soundtrack.

The question of listening with the ear is inseparable from that of listening with the mind, just as looking is with seeing. In other words, in order to describe perceptual phenomena, we must take into account that conscious and active perception is only one part of a wider perceptual field in operation. In the cinema to look is to explore, at once spatially and temporally, in a “given-to-see” (field of vision) that has limits contained by the screen. But listening, for its part, explores in a field of audition that is given or even imposed on the ear; this aural field is much less limited or confined, its contours uncertain and changing,

Due to natural factors of which we are all aware - the absence of anything like eyelids for the ears, the omnidirectionality of hearing, and the physical nature of sound - but also owing to a lack of any real aural training in our culture, this “imposed-to-hear" makes it exceedingly difficult for us to select or cut things out. There is always something about sound that overwhelms and surprises us no matter what - especially when we refuse to lend it our conscious attention, and thus sound interferes with our perception, affects it. Surely, our conscious perception can valiantly work at submitting everything to its control, but, in the present cultural state of things, sound more than image has the ability to saturate and short-circuit our perception.

The consequence for film is that sound, much more than the image, can become an insidious means of affective and semantic manipulation. On one hand, sound works on us directly, physiologically (breathing noises in a film can directly affect our own respiration). On the other, sound has an influence on perception: through the phenomenon of added value, it interprets the meaning of the image, and makes us see in the image what we would not otherwise see, or would see differently. And so we see that sound is not at all invested and localized in the same way as the image.

Acousmatic Update

By Francis Dhomont

This article is reprinted from CONTACT!, the journal of the Canadian Electroacoustic Community. It was originally written in response to a request to Francis Dhomont to provide an article on acousmatic art which would be relevant to both "beginners " and "experts". The editor is most grateful to Francis Dhomont and to Ian Chuprun of the CEC for giving permission to reproduce this article.

Laying the Foundation

First announced by several precursors in the first decades of this century (Russolo, Cahill, Trautwein, Martenot, Theremin, Cage, Varese, etc), electroacoustic music (not named as such at the time) was born in the sound studios of the RTF [French National Radio] in 1948, in Paris, with musique concrete. Its inventor, Pierre Schaeffer, had the considerable merit of formulating the practical and theoretical notions for a music that required a new way of thinking about composition, and created a new sound world through the use of equally original production techniques. Indeed, in musique concrete, materials are selected from our sound environment, without prejudice.

All sounds, regardless of their origin, are of equal value and can be musically organized. These elements, sound objects (1), originally of an acoustic or electronic nature, are recorded, then processed, edited, mixed (note the analogy to techniques used in cinema) and 'orchestrated' in the studio, through the use of an ever-evolving technology. Finally, - and this is the most important point - the organization of complex "spectromorphologies" (Denis Smalley), far removed from the 'musical note', cannot be fully realized with traditional conceptual tools; a change of such profundity requires new compositional strategies, and very different aesthetic and formal preoccupations than those found in instrumental music composition.

This original compositional method begins with the concrete (pure sound matter) and proceeds towards the abstract (musical structures) - hence the name musique concrete - in reverse of what takes place in instrumental writing, where one starts with concepts (abstract) and ends with a performance (concrete). Consequently, musique concrete pieces asks of its listeners that they unprogram their hearing (accustomed to the matrix of pitch, scales, harmonic relations, instrumental timbres, etc) and develop an attitude of active listening based on new criteria of perception. This music is also called concrete because it is fixed on tape through the recording process ("sono-fixation", M Chion), in the same way that an image is fixed on a canvas or a film. Francois Bayle refers to sound images.

Two years later (1950), electronic music, realized through sound synthesis, emerged from the WDR Studios (West German Radio) in Cologne. Antagonistic at first, the schools of musique concrete and electronic music finally shared their sources and techniques, and were globally identified as electroacoustic music.

Since then, this single term has come to designate an infinite number of sound realizations with little in common, aside from their reliance on electricity; it refers to popular music (electronic instruments, synthesizers, samplers), serious research institutes (CCRMA, GRM, IRCAM, MIT.._), works on tape, instruments and tape, live electronic music, interactive works, etc. "The term Electroacoustic Music has expanded to such a degree that it has become a meaningless catch-all", wrote Michel Chion in 1982. (2) Today, this expression reveals little of what we may expect to hear, and its use is analogous to applying the term acoustic music to define the entire instrumental repertoire. For these reasons, a group of composers, descendants of the school of musique concrete, found it necessary to find a term that clearly designates the genre (3) in which they work, and which calls for a particular reflection, a methodology, a craft, a syntax, and specific tools.

This term is acousmatic (4). It refers to a theoretical and practical compositional approach, to particular listening and realization conditions, and to sound projection strategies. Its origin is attributed to Pythagoras (6th C. BC) who, rumor has it, taught his classes - only verbaily - from behind a partition, in order to force his students to focus all their attention on his message. In 1955, during the early stages of musique concrete, the writer Jerome Peignot used the adjective acousmatic to define a sound which is heard and whose source is hidden. By shrouding "behind" the speaker (a modern Pythagorean partition) any visual elements (such as instrumental performers on stage) that could be linked to perceived sound events, acousmatic art presents sound on its own, devoid of causal identity, thereby generating a flow of images in the psyche of the listener.

In order to avoid any confusion with performance-oriented electroacoustic music, or music using new instruments (Ondes Martenot, electric guitars, synthesizers, real-time digital audio processors, etc), Francois Bayle introduced the term acousmatic music in 1974. This term designates a music of images that is "shot and developed in the studio, and projected in a hall, like a film", and is presented at a subsequent date. (5) Bayle has stated that, "With time, this term - both criticized and adopted, and which at first may strike one as severe - has softened through repeated use within the community of composers, and now serves to demarcate music on a fixed medium (musique de support) - representing a wide aesthetic spectrum - from all other contemporary music." (6)

Today, the act of hearing a sound without seeing the object from which it originates is a daily occurrence. This happens when we listen to an orchestral symphony on our home sound system, when we listen to the radio, or when we communicate by phone, etc. In fact, we are unsuspecting acousmatic artists. But in these examples, it is not the message that is acousmatic but rather the listening conditions for the communication of that message. Mozart, as he wrote the symphonies which we now hear in our living rooms, was not thinking of the CD but rather of live performances by an orchestra. In order to be designated as acousmatic, a composition should be conceived for an acousmatic listening environment, giving priority to the ears. This fundamental distinction is not always clearly understood by neophyte listeners.

An Art of Time Occupying Space

The term Acousmatic Music (or Art) designates works that have been composed for loudspeakers, to be heard in the home - on radio or on CD/tape - or in concert, through the use of equipment (digital or analog) that allows the projection of sound in 3-dimensional space. However, though the concert may provide the ideal presentation for an acousmatic work, it is not a sine qua non criteria for its existence; like books collected for our home libraries, the quality of today's commercial recordings allows us to have at our disposal a wide repertoire of pieces. Moreover, and in contrast to recorded instrumental performances, an acousmatic work on CD is an exact replica of the composer's master. While the CD may serve only as a (good) reduction of an instrumental concert, the acousmatic concert serves as an impressive enlargement of a work composed on a fixed medium. One who has not experienced in the dark the sensation of hearing points of infinite distance, trajectories and waves, sudden whispers, so near, moving sound matter, in relief and in color, cannot imagine the invisible spectacle for the ears. Imagination gives wings to intangible sound. Acousmatic art is the art of mental representations triggered by sound. (7)

Certain Objections

Sometimes, people complain that there is nothing to see at acousmatic concerts. That may be because there's much to hear, often unheard-of sounds. Our focus is limited; if our senses are reacting to a strong stimulus, our attention to other stimuli will diminish. Given the priority of the visual in our present society, at a time when it is no longer certain that music 'is created for the purpose of listening', the public's need for the spectacular does not leave room for the kind of concentration that befits a good audition; 'the eyes block the ears' (is it really coincidence that a blind person's hearing is often very good?). It is for this reason that acousmatic composers, inspired by Pythagoras, limit the amount of stimuli at their concerts. Instead of offering us glimpses of its existence, the act of hearing without seeing (Bayle) allows our mind to concentrate on the music itself.

Another critique that is often leveled at this rebellious sonic art: where are the instruments and the performers? If there are no performers, can we still call this music? As an example, allow me to quote Nil Parent, from an article in a recent issue of Contact! [Fall, 1994]: "Music is an art of performance, that is to say, by definition, an art in the image of time, unstorable." (8) This statement is questionable, and I have often discussed it. What has become of this supposed intangible Credo? Have we ever questioned the inevitability of the fact that music, since the beginning ot time, has only come to us by way of generations of performers? Instead of accepting that it is so 'by definition' (a concept yet to be proven), should we not instead question history itself?

Of course, music originates from oral expression and instrumental gestures. But, soon after its birth, man needed to find ways of reproducing it, of storing it; laborious efforts where made at developing notation. In order to save this ephemeral art form, this volatile phenomenon from extinction, man had no other solution than to turn to performance or, in other words, to a musician's translation of conventional symbols. Today, in fact, we confuse the end with what was once the means: because throughout history, music has had only one way to exist - through performance - it has come to be identified with performance. Though it is obvious that this situation is what has allowed music to become an accomplished art form, the idea that this fact is unchangeable is a limitation imposed by prejudice and force of habit. We must at least admit that an invention that allows us, after several millennium, to capture, store, and reproduce sound phenomena (like what film allows us to do to movement), has truly changed our relation with time. By allowing composers to 'stop sound', by giving them the possibility of getting back sound organizations in their precise original state, in precise detail, and exactly where they left off, recording techniques offer music new areas to investigate, as well as new ways of realization. What will reach the listener is not a music that approximates the intentions of the composer, but rather, exactly what he intended, with all its material characteristics. This music no longer depends on performance, nor does it act as its substitute.

In passing, I would like to reply to Nil Parent, in regards to the supposed 'devastating progress through accumulation' that he makes reference to in his article, which, though not lacking in quality, ties nevertheless too many problems to a single cause. While he calls for the "urgent revaluation of the performer (9) that the return to 'directness' implies" (10), I would like to remind him that recording must not be such a terrible medium, if Glenn Gould, not what one would call your 'average' performer, chose it over live performance.

Perspectives

Since music, considered for many years an art of performance, can now also be presented in the form of a fixed medium, like cinema, why should we not investigate this new creative space? Let's stop comparing it to a 'performing' art. It is not the sheer physical presence of performers that guarantees the authenticity of a work, but rather what is transmitted in the act of hearing; in that sense, live music is no more or less alive than music on a fixed medium; both can take on meaning if their message reaches us. In fact, though McLuhan may disagree, the message is not the medium, but rather the message.

We will soon celebrate the fiftieth anniversary of musique concrete. The evolution of this art is measured by the abundance of the repertoire that is now available. But theories concerning this art change quickly and we are only now beginning to explore its resources. Here and there one can find conferences, concert series and festivals dedicated to this art, particularly in Europe; more and more articles and books are appearing and helping to shape new approaches to composition. This is undoubtedly a new artistic path for the upcoming century; it can no longer not be taken into consideration.

Notes

1) It is important to make the distinction between sound object (perceived sound) and material object (resonating body).

2) Chion, M., 1982, La musique electroacoustique, PUF, Paris, P.9

3) As many others have done in other genres; serial, minimalist, spectral, rock, country, etc.

4) Michel Chion would rather keep the term musique concrete, since it is well entrenched. The main objection that he has faced is that it refers to a historical period. Although musique concrete is still alive in its contemporary form, it is likely that a renewal of terminology may trigger a similar renewal of its theory. .

5) Sometimes referred to as cinema for the ears (this analogy should not be taken literally).

6) Bayie, F., 1993, Musique acousmatique, propositions... positions, Buchet/Chastel-INA-GRM ed., Paris, P. 18

7) For more information, please refer to Bayie,Äôs previously cited work, as well as the following: Chion, M., L,Äôart des sons fixes ou la musique concretement (1991), Fontaine France, Editions Metamkine/Nota-Bene/Sono-Concept; and, Vande Gorne, A., Vous avez dit acousmatique? (1991), Ohain, Belgium, Editions Musiques et Recherches.

8) Parent, N., 1994, Contact! 8.1: Play. The Decline of a Musical Culture, CEC, Montreal, P. 50.

9) Is there really such a need for revaluation of the performer in our media-star epoch?

10) ibid

Sound & Basic Acoustics 1: What is a Waveform?

Imagine a player in San Francisco... You might, at home one evening in 1994, listen to music that was recorded in San Francisco in 1952. You might then wonder: how did the sound travel so far through space and time?

Basic definitions. Sound is pressure variation in a compressible medium which produces the sensation of hearing. Sound travels through space as longitudinal waves of alternating condensations (points of greater-than-ambient pressure) and rarefactions (points of less-than-ambient pressure). A waveform is a graph of these pressure variations. Some basic laboratory-produced waveforms, such as the sine, sawtooth, rectangular, square, and triangle waves, are visually recognizable. The more complex waveforms of the real world, however, are not visually recognizable and have no labels.

Frequency and amplitude. Waveforms are most importantly described in terms of frequency and amplitude. Frequency is the rate of recurrence of a cycle per unit time, measured in Hertz (abbreviated Hz). 1 Hz equals 1 cycle per second (cps). 1 kHz equals 1000 cps. Amplitude is extent of variation above and below a zero reference line, measured in any of three ways: (1) as *amplitude*, which is the average variation above and below zero, (2) as *peak-to-peak amplitude*, which is the distance from positive to negative peak, and (3) as *instantaneous amplitude*, which is the position of the waveform curve at a particular instant in time.

Analog vs. digital. The analog representation of a waveform is a continuous curve. The digital representation of a waveform is a table of numbers, where each number represents a *sample*, which is a measurement of instantaneous amplitude at any point in time. If a *sampling rate* is not fast enough to accurately represent the sampled waveform, *alias distortion* results. If the amplitude measurement for each sample is not fine enough, *quantization noise* results.

In a digital device, each number in the table of numbers is stored and processed in binary format. In the binary number system, each column, from right to left, has the value of an increasing power of 2, and each column may contain any of two figures, 0 or 1. (For comparison, in the decimal number system, each column, from right to left, has the value of an increasing power of 10, and each column may contain any of ten figures, from O to 9.) Each item of binary information, i.e. each column in a binary number, is a bit, and a group of bits is called a word or a byte, depending upon the context.

How can a waveform's amplitude be processed? By analog operations, *amplification* and *attenuation* are performed in amplifiers and attenuators, where the ratio of output to input amplitude is called gain. By digital operations, it`s called *scaling* and it`s performed by simple multiplication (which is also a very simple example of *digital signal processing*).

How are waveforms stored? As CDS, DATS, computer files, and in a wide variety of other mediums and applications that are currently appearing on the market.

Sound & Basic Acoustics 2: Combining Waveforms

Two or more sounds together. Different waveforms, for example from the different instruments in an orchestra, when travelling together in the same space, combine by interference, i.e. the simple addition of waveforms as both congruent (*constructive* interference) and anti-congruent (*destructive* interference) shapes, to produce a *composite waveform*. The composite waveform produced by an orchestra, for example, is the sum of the individual waveforms of all of the instruments. It's the composite waveform that's stored in a recording.

Interference can be simulated in electronic devices. In analog operations, the output from a mixer is the sum of the individual waveforms of all of its inputs. Interference is an additive process. So is mixing. One could think of interference as mixing in the air. In digital operations, it's simple addition (another example of digital signal processing).

Sounds mix with themselves at various delays. Waveforms also add with time-delayed reflections of themselves. In concert halls and other enclosed spaces, sound waves reflect from hard surfaces and add together at various delays, producing either *phase differences*, r*everberation* or *echo*, depending upon the length of the delay. If the time difference between a waveform and its reflection is less than a cycle, there is said to be a phase difference between the waveform and its reflection. Reverberation is a delay longer than a cycle but less than the total sound. Echo is a delay which is longer than the total sound. How can these delay-effects be simulated with analog and digital operations?

Sound & Basic Acoustics 3: What is a Spectrum?

Basic definitions. A *spectrum* is a collection of partials, or overtones, which add together at various frequencies and amplitudes to comprise a total waveform. The term waveform, in this context, might be said to refer to the finished dish, while the term spectrum refers to the recipe. Further, the dual nature of sound as waveform and spectrum is reflected in the biological construction of the ear. Our ears are both waveform sensors and spectrum analyzers. And to go further in explaining the duality of waveform / spectrum, waveform changes are considered to occur in the *time domain*, while spectrum changes are considered to occur in the *frequency domain*.

Spectra can be categorized as discrete and continuous and as *harmonic*, *inharmonic* and *noise*. The following chart presents an overview 'of spectrum types:

Discrete spectrum	Harmonic spectrum (fundamental and harmonics) Inharmonic spectrum (partials)
Continuous spectrum	Noise

Harmonic spectrum. An *harmonic spectrum* contains only partials whose frequencies are integer multiples of the frequency of the lowest partial. In the particular case of harmonic spectrum, the lowest partial is called the *fundamental* and the other partials are called *harmonics*. In the spectra of the basic electronic waveforms, which are harmonic, the partials are in fixed amplitude and frequency relationships; in the spectrum of a sawtooth waveform, for example, each harmonic's amplitude in relation to the amplitude of the fundamental is the inverse of its position in the frequency series (the second harmonic is twice the frequency of the fundamental and one-half its amplitude, the third harmonic is three times the frequency of the fundamental and one-third its amplitude, etc.).

Changes in spectra. The spectrums of acoustically produced sounds change in time. Each partial's amplitude (as well as, to some extent, its frequency and phase) changes independently. Changing spectra made up of discrete partials, whether harmonically or inharmonically related, can be quite complex. Changes in a waveform or a partial are graphed as an *envelope*. An envelope is a graphic representation of the way an attribute of a waveform changes in time.

Inharmonic spectrum. An inharmonic spectrum contains partials whose frequencies are not integer multiples of the frequency of the lowest partial.

Noise. If changes in a waveform occur from cycle to cycle, or at time intervals of less than a cycle, a spectrum becomes continuous. Rather than contain discrete partials, a continuous spectrum, which produces what we call *noise*, tends to be a continuum of sound energy with partials at infinitesimal amplitudes at frequencies infinitely close to one another.

Noise is characterized by the distribution of energy within a bandwidth. *White noise*, for example, is equal sound energy per unit bandwidth. *Pink noise* is equal sound energy per octave bandwidth. A bandwidth is a specified range of frequencies, located around a center frequency. For example, one might speak of narrow-band noise with a bandwidth of 2 kHz and a center frequency of 1 kHz, or one might speak of wide-band noise with a bandwidth of 20 kHz.

Sound and Basic Acoustics 4: Psychoacoustics: The Perception of Sound

Perception of frequency and amplitude. A waveform must have a frequency within the range of roughly 20 Hz-20 kHz to be heard by humans. Within that range, our perception of frequency is related to what we call pitch, which is our sense of how "high" or "low" a tone seems to be.

Amplitude is related to what we call loudness, in that if two waveforms are identical in all respects except amplitude, the waveform with the larger amplitude will be heard as louder. But frequency and amplitude are themselves related. The ear is most sensitive within the range of approximately 1 kHz-3 kHz and declines in sensitivity progressively in each direction. A waveform at 100 Hz, for example, must have a significantly larger amplitude than an identical waveform at 1 kHz to be heard as equally loud.

Perception of multiple sounds and time delays. How do we hear the flute in an orchestra? How do we hear our names whispered in a crowd? How do we taste the garlic in a tomato sauce? Analysis is learned.

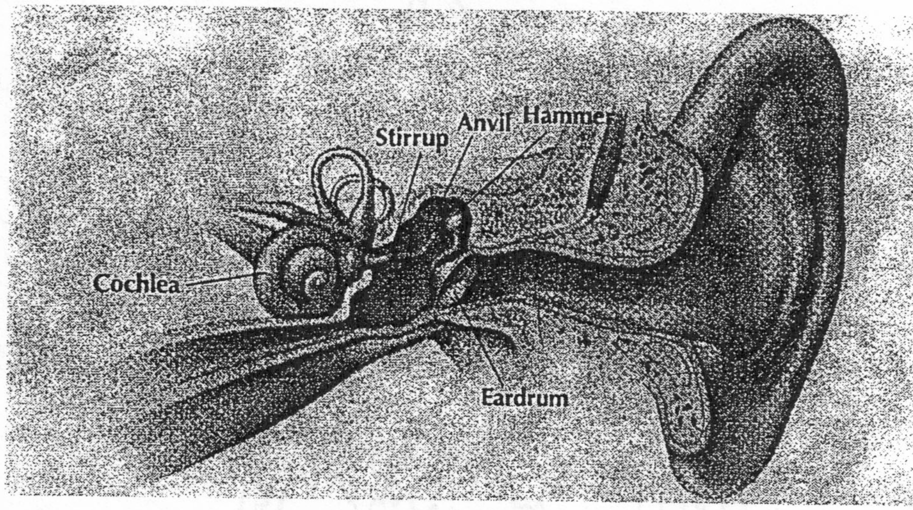
Perception of other waveform activities. How do we sense the direction of a sound? If our ears are equidistant from a sound source, we can't tell its direction. If they're not, we calculate the relative time delay from ear to ear. How do we follow the movement of a sound in space? Partly through the Doppler shift effect and partly from sensing the direction of a sound source.

Pitch and loudness as related to spectra. Periodicity is heard as pitch. The harmonic spectrum gives us a clear sense of pitch: Because the frequencies of all of its component harmonics are integer multiples of the frequency of a fundamental, all of the harmonics simultaneously cross zero at the frequency of the fundamental, emphasizing the frequency of the fundamental. Inharmonic spectra give only a vague sense of pitch because there is no fundamental. As changes in waveforms become increasingly random and the bandwidths of spectra become increasingly wide, the sounds they produce become increasingly nonpitched.

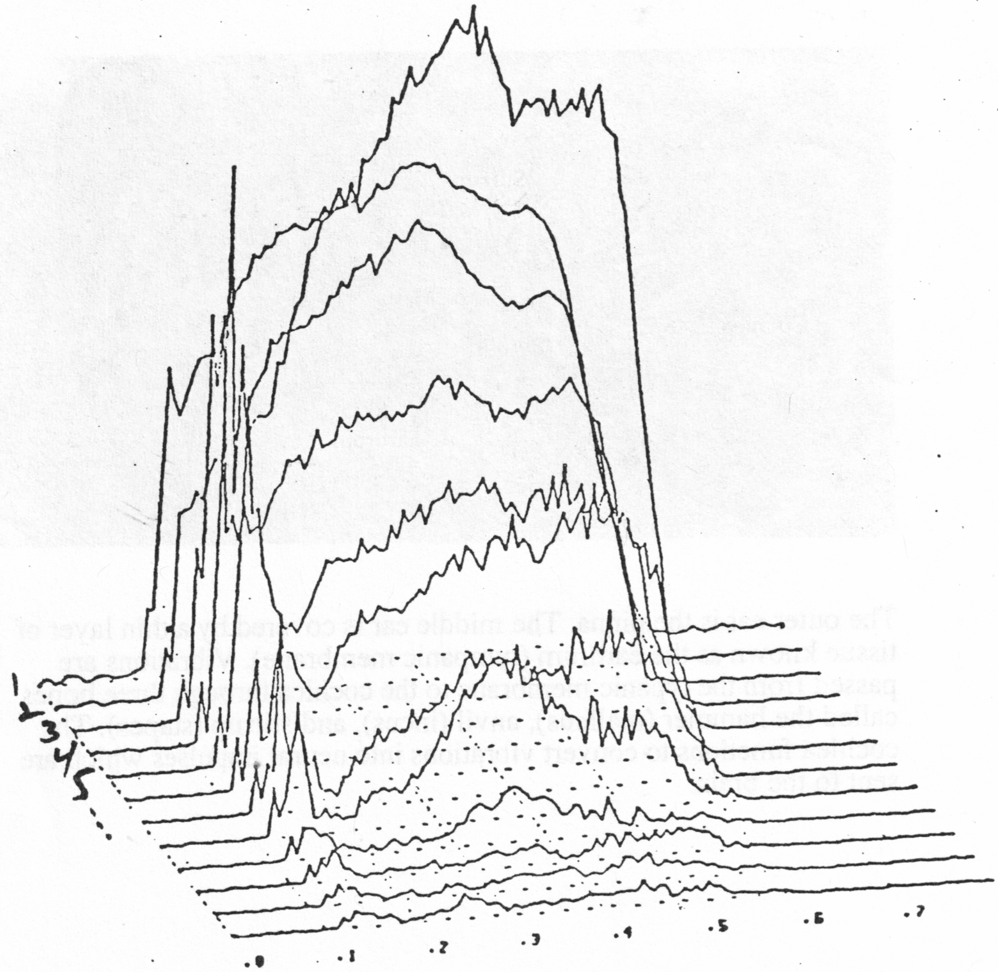
Random and wide-bandwidth sounds may seem louder than pitched sounds because our perception of loudness is related to spectrum density and bandwidth. Given two waveforms of equal amplitude, the spectrum with the greater number of partials and/ or the spectrum with the more widely distributed partials will seem louder.

Timbre. Our perception of timbre, i.e. tone quality, is related to the nature of a spectrum. It is the frequency and amplitude relationships between partials which leads us to perceive timbre in such general terms as "mellow," "bright," "nasal," etc.

But we also perceive timbre by the attack transients of a sound, i.e. nonperiodic changes which occur within the first few centiseconds of a sound. Attack transients are important because they give us information about how a sound has been produced. We recognize a trumpet sound, for example, partly because of a brief noise as the player's lips are forced to vibrate and partly because of a slight glissando as the player finds the pitch. We recognize a string sound partly because of the noise associated with placing a bow on a string.



The outer ear is the pinna. The middle ear is covered by a thin layer of tissue known as the eardrum (tympanic membrane). Vibrations are passed from the typanic membrane to the cochlea through three bones called the hammer (malleus), anvil (incus), and stirrup (stapes). The cochlea functions to convert vibrations into neural impulses which are sent to the brain.



Spectrum of a Trumpet playing D^4