INTRODUCTION
An Instrumentation of the Sound Environment

THE BROKEN SOUND

Over the centuries, Western culture has relentlessly attempted to classify noise, music, and everyday sounds. Philosophers, authors, scholars, and musicians have worked to abstract and assess sounds on a scale of purity, musicality, and intelligibility. In contemporary opinion, cacophonous, thundering noise is taken to signify the malaise of an anti-human reliance on technology. Ordinary noises and mundane sounds that are not perceived as either annoying or musical are of no interest. Listening to other cultures will, however, reveal that the term "noise" does not automatically involve disturbance, and also that the term "music" does not possess a single universal meaning, nor does it necessarily refer to a common perception of the way sounds are composed.[1] Within hunter-gatherer societies, the primary attention given to ordinary sounds, and their functional as well as symbolic value, is both shared and shaped by the whole community.

So let us not be limited by cultural or stereotyped assumptions. We may discover that sonic marks unconsciously guide our behaviour. Even though they are not included in the linguistic abstraction of scholarly discourse about music, phonology, or acoustic engineering, ordinary sounds nevertheless operate through everyday actions and dialogue, shaping our professional practices as well as our everyday life. As often happens, art already grasps what knowledge does not yet perceive. Contemporary musical practices cheerfully mix all sounds. Inspired by the Futurist movement, *bruitism* has influenced composers since the beginning of the twentieth century.[2] Today, the production of

non-heard unclassifiable synthesized sound signals disturbs traditional academic distinctions. What else can we say about media soundtracks in which music, dialogue, and noises merge in the temporal flow of narrativity, if not that they mimic this "never really silent" stream of sonic experience that we might call the "everyday soundtrack"?[3]

Let us listen to our cities. Is it not the very nature of the urban environment to make us hear, whether we like it or not, this mixing of sounds? Dull murmurs, machine noise, the shifting and familiar acoustic racket created by people – every urban moment has a sound signature, usually composed of many sounds together. Beyond classification, "the city rings" (or as Schopenhauer said, "Die Welt klingt").

This instrumental dimension of urban space requires examination and reflection. Firstly, no sound event, musical or otherwise, can be isolated from the spatial and temporal conditions of its physical signal propagation. Secondly, sound is also shaped subjectively, depending on the auditory capacity, the attitude, and the psychology and culture of the listener. There is no universal approach to listening: every individual, every group, every culture listens in its own way.

The city has sometimes been described as a real musical instrument; the material and spatial characteristics of urban morphology can in fact be compared with similar aspects of acoustic instrumentation.[4] The analogy, which calls for measurement and examination,[5] only considers passive acoustic properties, and therefore does not deserve deeper interest. The metaphor really inspires analysis in relation to performance, the ways to play and conduct sounds, the design and use of effects. What instruments are available to technicians and researchers, administrators and users, designers and inhabitants? What is the sonic *instrumentarium* of urban environments?

ORIGINS OF THE CONCEPT OF THE SONIC EFFECT

An Unobtainable Tool

Like any other environment, the urban sound environment can be subjected to two types of operations: it can be considered as an object of description, or as an object of transformation. The quantitative tools required for this work are numerous and the possibilities of acoustic measurement, including recording techniques and information analysis, are constantly progressing. Different types of built spaces nevertheless do not benefit equally from research and technology. While some listening spaces (such as auditoriums and halls) seem to receive extensive modelization and simulation, other sites do not. In fact, neither

open spaces nor small enclosed ones can yet be measured with sufficient precision. For this practical reason, and also because in inhabited space quantitative valuation cannot take into account the whole human dimension of acoustic phenomena, the use of qualitative tools is necessary.

Two questions must be raised. Are there qualitative tools specifically adapted to the analysis of a sonic environment, and what is their operational value? Can we define qualitative tools that could be used in conjunction with quantitative ones?

At the beginning of the 1980s, a number of different approaches to the description of sonic space were developed in France, inspired by the morpho-typological method of classification frequently used in architecture. But can the visual bias of architectural typo-morphology be adapted to the sound domain? Except for basic measurements – for example, the transmission loss coefficient between outside and inside – measurements and scales dictated by visual architectural typology cannot coincide with sonic space properties.

Another difficulty is the particular physical and perceptive structure of sound phenomena including space, time, and ecological relationships that are specific to each context. Thorough and lasting observations can be undertaken in a single public space.[6] Such attention to time may uncover subtle and interesting information about architecture and people. This work is nevertheless so complex that its overall typology remains cursory. The researcher can only describe, for instance, the seasonal rotation of a place based on four general types of sounds: natural, animal, technical, and human.

A third approach involves the sound phenomena *in situ* analysis, which involves an attempt to harmonize the use of quantitative and qualitative tools. Many models of integration have been proposed or are under development. Many interdisciplinary methods of observation using acoustical measurement, spatial descriptions, and psychological surveys have been designed.[7] However, the descriptive concepts involved generally cannot be used easily and equally by all of the concerned disciplines.

The Sound Object and the Soundscape: Two Enticing Tools

During the 1960s and 1970s, two fundamental interdisciplinary tools for sound analysis were invented: the "sound object" (*l'objet sonore*) and the "soundscape." Both have three functions: description, explanation, and interdisciplinarity. But are they really fulfilling our expectations?

In his famous *Traité des objets musicaux* (1966), Pierre Schaeffer disrupted academic classifications of noise, sound, and music, and created a new musicology. This work presents a general phenomenology of the audible. The key concept is defined not as a musical object but more precisely as a *sound* object that can represent any sound of the environment. The notion is quite complex and its richness cannot easily be demonstrated in a few words.[8] The concept of the sound object can be used in three different ways. From a practical and empirical point of view, it describes the interaction of the physical signal and the perceptive intentionality, without which there would be no perception. From the theoretical point of view, it is a phenomenological quest for the essence of sound. Finally, from the point of view of instrumentation, the sound object is intended to be the elementary unit of a general and multidisciplinary solfège of sounds.

While the precise and complex method proposed by Pierre Schaeffer can sometimes be criticized, the outstanding concept of the sound object has become the basic material manipulated by an increasing number of sound designers. The concept of the sound object can be fruitfully used not only for sound by sound composition but also for every sound analysis.[9] However, even with the ever-increasing possibilities offered by real-time analysis, if the sound sequence is slightly complex or is spread over time, or if conditions of production are taken into consideration *in situ* and not simply simulated, then sound by sound analysis becomes extremely ponderous. In consequence, although the sound object is an essential tool in education or sound design, it can hardly be used as a fundamental concept for the description and analysis of urban sounds.

Another attempt to understand the sound environment in a qualitative way emerged in the 1970s. Its main field of application is the sonic dimension of different ecosystems (rural and urban) that surround humans in their everyday existence. In 1980 in France, the story of the invention of "soundscape" was related and analyzed by architect and sound designer Bernard Delage. Poetic, naïve, and holistic in intention, many urban environmentalists claimed that the sound environment could not be limited to acoustical evaluation (in its strict sense) or to the battle against noise. There was one key concept missing.

At the end of the 1960s R. Murray Schafer introduced the term "soundscape."[10] Through his books and some of his compositions, Schafer constructs a sound environment as one would a musical composition – a masterpiece of nature. In this sense, the term soundscape does not simply refer to a "sound environment"; more specifically, it

refers to what is perceptible as an aesthetic unit in a sound milieu. Shapes that are thus perceived can be analyzed because they seem to be integrated into a composition with very selective criteria. One of these criteria – the selection of *hi-fi* soundscapes – is justified from both an aesthetic and an educational perspective. "We need to clear our ears" wrote Schafer. This didactic approach concerned with quality of listening across civilizations was largely restated under the theme of acoustic communication by Barry Truax in 1984. However, the application of the criteria of clarity and precision discredits a number of everyday urban situations impregnated with blurred and hazy (not to say uproarious) sound environments, which would then belong to the "lo-fi" category. We must therefore question whether, other than for the fields of aesthetic analysis, creation, and conservation, the use of the term soundscape remains useful and pertinent.

We lack the generic concepts to describe and design all perceptible sound forms of the environment, be they noisy *stimuli*, musical sounds, or any other sounds. The concept of the soundscape seems too broad and blurred, while the sound object seems too elementary (in terms of levels of organization), to allow us to work comfortably both at the scale of everyday behaviour and at the scale of architectural and urban spaces. To use a linguistic analogy, the soundscape corresponds to the whole structure of a text, while the sound object corresponds to the first level of composition: words and syntagmas. We are short of descriptive tools to work at an intermediary level, that of sentence grammar or – to leave the linguistic comparison – the level of a code defining possible configurations between the three terms to consider in our observation: acoustical sources, inhabited space, and the linked pair of sound perception and sound action.

Three Fields for a New Notion

Since the beginning of the 1980s, researchers at the Centre de recherche sur l'espace sonore et l'environnement urbain (CRESSON)[11] have wondered about this deficiency in tools to fulfill three criteria: interdisciplinarity; suitability to the scale of the urban situations to be observed; and capacity to integrate dimensions beyond aesthetic design. The notion that has finally been adopted and placed at the heart of our process is that of the "sonic effect," which is becoming more and more necessary in the three fields in which it is particularly effective: social sciences, urban studies, and applied acoustics.

The sonic effect was first used in the social sciences. Our work on perceptions and everyday sound behaviours[12] indicated four impor-

tant psycho-sociological processes: sound marking of inhabited or frequented space; sound encoding of interpersonal relations; symbolic meaning and value linked to everyday sound perceptions and actions; and interaction between heard sounds and produced sounds. These four processes are common not only to everyday, non-specialized sound experiences but also to those that take place in a space filled with disturbing noise or music. We were thus dealing with phenomena that could not be described either as basic reactions to a *stimulus* or as simple subjective impressions, but that in fact seemed like aesthetic operations including active shaping with particular local configurations of the physical sound element. The information collected through various surveys was analyzed as *effects* relative to a context and a local organization. Surveyed inhabitants spoke directly of effects such as cut out, niche, masking, and reverberation (often called echo).

From this psycho-sociological point of view, the environment can be considered as a reservoir of sound possibilities, an *instrumentarium* used to give substance and shape to human relations and the everyday management of urban space. There is an effect to any sonic operation. The physical signal is under a perceptive distortion, a selection of information and an attribution of significance that depends on the abilities, psychology, culture, and social background of the listener.

The second field of application of the sonic effect is constituted by urban planning and the forms of this sound *instrumentarium*, the city. Architectural and urban knowledge are considered necessary in our process since constructed space itself shapes many sonic effects. Our psycho-sociological surveys called for direct observations and statements to confirm or contextualize the information given by inhabitants. Could we observe a sonic effect directly? Could we measure it and analyze its spatial context?

Some effects, such as those related to memory (remanence, phonomnesis) and semantic effects (imitation), are totally independent from conditions of production, but most of the major effects depend directly on spatial context. Without a particular organization and morphology of a space, there can be no reverberation, resonance, cut out, ubiquity, or natural filtration. Applied acoustics shows how space, volume, shape, and materials all determine the propagation of sounds. But urban zoning, the layout of road systems, traffic maps, and the distribution of socioeconomic activities can also offer other efficient possibilities for sound information or interpretation to citizens. It is the combination of passive acoustic capacities and particular sound sources or actions that produces some effects – such as resonance, cut out, and ubiquity – as characteristics of urban space.[13]

The third field – applied acoustics – cannot be limited to the description of sound signals, as if the initial physical state of the sound phenomena remained the only reference, outside of which any distortion related to space considered a simple accident. Sound is a propagation and is therefore directly connected to circumstances. It is linked to the characteristics of the constructed environment and the physical conditions of hearing and listening (including filtration, anamorphosis, and listener's location).[14] Also, measurements, projects, and constructions in built space inevitably produce quantifiable characteristics. Inversely, knowledge and experience of architectural and urban configurations allows us to predict certain acoustic behaviours. Space and sound are integrally linked. Moreover, modern physics provides an opening for circumstantial and modal phenomena; some effects, including the Doppler effect, masking, the cocktail effect, and the Lombard effect, have been defined and described in acoustics for a long time.

To sum up, the sonic effect, sometimes measurable and generally linked to the physical characteristics of a specific context, was not reducible either objectively or subjectively. The concept of the sonic effect seemed to describe this interaction between the physical sound environment, the sound milieu of a socio-cultural community, and the "internal soundscape" of every individual.[15] What is the nature of this operative concept?

DEFINITION OF THE SONIC EFFECT

The Sonic Effect: A Paradigm

The sonic effect should not be understood as a full "concept" in its strict sense. The example of the "soundscape," prematurely presented in the 1980s as a miraculous, qualitative, and hedonistic concept by urban planners, architects, and landscape designers, is an important warning. This eagerness to approach sound like any other object and to use a key word, which in fact masks a deficiency in our knowledge about sound, is largely responsible for the loss of focus and unlikely relevance of a term endowed with a particular and precise meaning.

The effect may not be a concept. The survey of objects it refers to remains open. The notion is only partly understood; the sonic effect is paradigmatic. Halfway between the universal and the singular, simultaneously model and guide, it allows a general discourse about sounds, but cannot dispense with examples. Rather than defining things in a closed way, it opens the field to a new class of phenomena by giving some indication of their nature and their status. Finally, it characterizes the modal or instrumental dimensions of sound. Because of these