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FROM QUANTITATIVE TO QUALITATIVE. THE PERTINENCE OF SONOGRAPHIC REPRESENTATION FOR SOUNDSCAPE ANALYSIS

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"*I have never seen a sound*"
Murray Schafer

ABSTRACT
This paper aims at explaining the theoretical contribution and the concrete results of experimenting the sonagram for the soundscape analysis. If this scientific tool of visual representation of sound is widely known by the acoustician, the novelty depends here on the ecological nature of the studied sounds: it is a matter of proving the pertinence of the sonagram for the sonic environment analysis, with the object of creating for the city-planner. After a succinct talk about the sonagram's analysis abilities, therefore a repeat of the potential applications, we will show with an example how the sonagraphic blend is a precious medium in analysis to compare the quantitative data with the qualitative ones. We have recorded a characteristically soundwalk and located the main sound effects (emergence, mask, cutting...) in order to mark out the sonic forms and the transition of acoustic spaces.

1 - CONTENT

Sonagram is a diagram (time/frequency) the goal of which is of using sound graphic analysis output showing the spectrum or frequency content of a sonic phenomenon and its variation in time. The sonagraph is the best device of the acoustician wishing to establish a correlation between the measure of a physical signal and perception [Leipp71, p.87]. Let us start by considering the relevance of its diverse applyings.
1 - In phonetics, the spectrographic representation "time/frequency" first originates from the device called *Visible Speech* (device manufactured in the U.S. in the 40's, marketed under the label SONOGRAPH [Potter 46, cite by Castellengo 99]), conceived to give an interpretable image of the signal of speech, characterized by the complexity and the speed of its variations. This shows that a word is a global form, a "Gestalt" where every elementary movement of the phonatory system corresponds to a "phonatom". Nowadays, the phoneticians mainly use sonagram in its digital form for the study of the prosodic stresses of the language. Transitory attacks, the length of sounds, extinction and intonations can be seen.

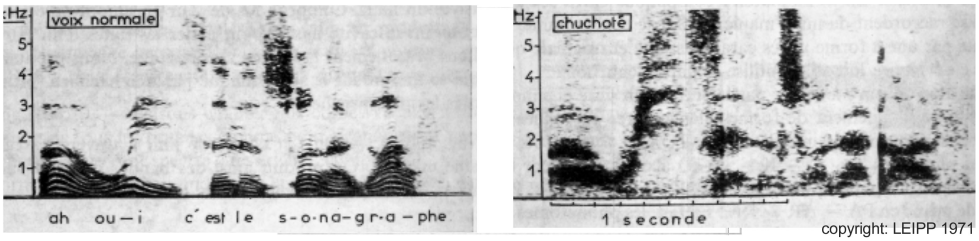

Figure 1: Analog sonagram of a normal voice, then of a whispering voice.

2 - In ethnomusicology, the sonagraphical analysis allows, when guiding the listening, the "hearing" of the melodic ornamentation so as to study it objectively. The sustained graph of the graphic reproduction teaches to forget the notes conscious references of our western music, in order to listen to the glissandi and the exercises in vocalization.

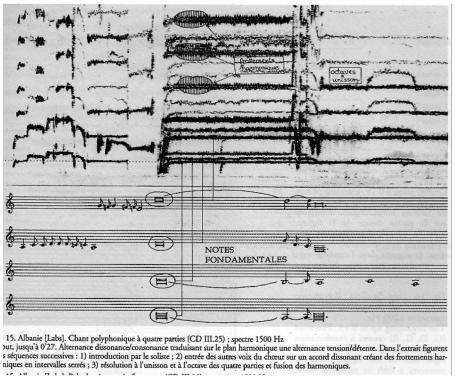

Figure 2: An analog sonagram of extra-European songs and musics.

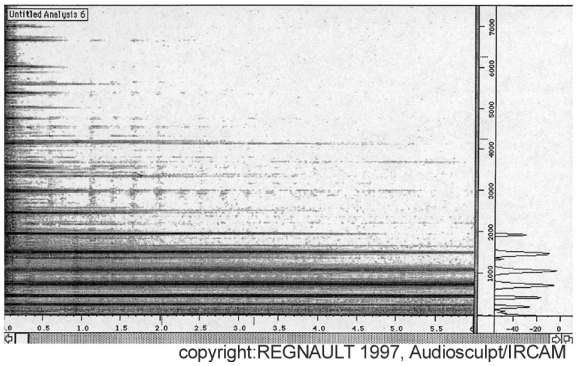

Figure 3: Digital sonagram of a bell; analysis of the sound-creating frequency.

Following the same idea, sonagraphical representation is a powerful tools to analyze of the instrumental rendering of the music played from a score. It allows to compare different renditions of a same works an therefore to study the playing of the musicians [Castellengo, 99].
3 - In musical acoustics, the sonagraphic analyzing software (among them Audiosculpt, graphic software allowing the manipulation of sound (analysis/synthesis), conceived in 1994 at the IRCAM by Gerhard Eckel's team) allow a close osculation of the sonic substance. These software are tools for the musical creation (musical instruments) rich in inventions.
4 - In ornithology [Roché], ethology [Boulard], the researchers equally use these representations in order to take an acoustic photograph of every species. The image's schematisation is a real identity card giving the main characteristics of the song (rhythm, harmonic or non-harmonic lyric).

Figure 4: Diagrammatic and usual sonagram of the song of two standard birds (bluetit, striped petty king).

5 - In electroacoustic music (works mainly composed without any score), the sonagraphic backdrop (conceived with the Acousmograph, software conceived by H. Vinet (INA-GRM, 92) to be used as a tool

for the graphic transcription, healing for the need of the marking of notes of acousmatical works, so as to analyze them; this software enables you to listen to the recorded sound anytime, in synchronism with the corresponding image; the user of such a software disposes of a graphical palette tools, therefore permitting him to invent his owns symbols, in order to annotate the sonagraphic backdrop of the beginning) becomes here a pedagogic medium for all musicology analysis and try of a musical transcription.

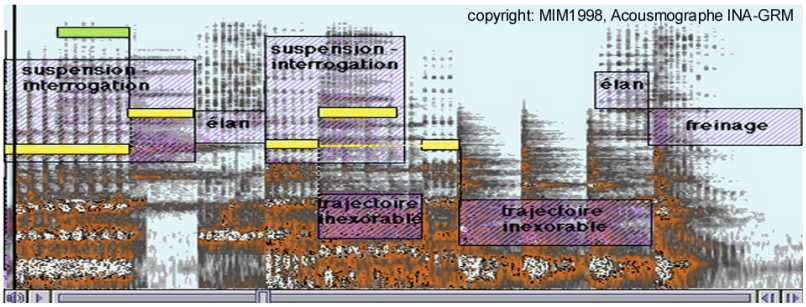

Figure 5: Excerpt of the transcription of a works by G. Reibel, method of annotating so as to mark the Temporal Semiotic Unitises.

But the most interesting analyzes for a neophyte are those about the daily sonic environment. Emile Leipp who has studied the *sonic forms* [Castellengo, 94] of several sounds prop sonic typologies of identifying sounds at first glance. Before identifying the sources, the eye spots the actions that to say, the gesture from which the vibration originates: blowing, rubbing, raking, whistling...

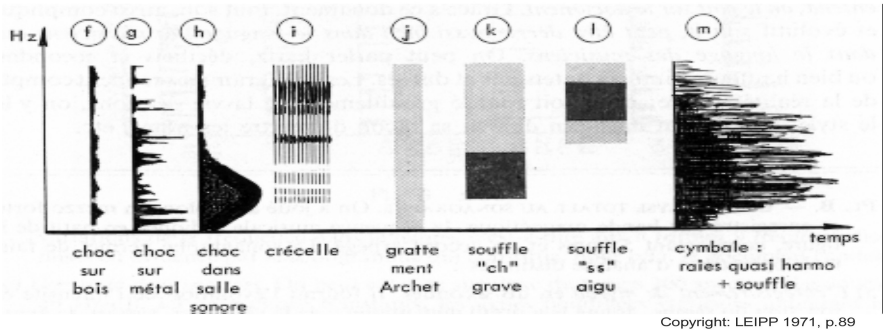

Figure 6: Visual sonic forms of standard sounds.

The exploring study (yo our knowledge, no similar research exists; let's never the less point out C; Arras memorandum who when elaborating sonic ambience classes, has found in the sonagram a track to compare and qualify the "reverberation time" of urban sites [DEA,94, p.52]) that we have done with the view to test the relevance of the sonagram to analyze sonic urban configurations, consists of visualization of sonic snatches, which represent typical sonic situations. The question is to identify and acknowledge during the listening the main quality criterions noticed beforehand (all qualitative study starts by previous analysis consisting in an observation in situ, ethnographic and sociologic; the collected qualitative data lead to recordings of sounds, representing the sonic identify of the studied places; opposed to physic measures, the sound snatches are for us, the best material for all qualitative study of the sonic environment) in situ: richness and diversity of the present sources, rhythmicity, complexity of the sonic mixings, space-time transitions; these last ones are summed up by the intra-fields sound effect paradigm [Augoyard, 95]: repetition effect, metabolism, cutting, irruption, mask...

Prompted by the musical transcription (lnd. fig. 6), we have tested the software Acousmographe which has led us, starting from an analytic listening, and guided by the sonagraphic backdrop, to annotate the perceived sound phenomena. The analysis and the transcription takes place in two times, corresponding to two *ways of listening* (a closely allied concept of the intentionality phenomenologic notion which draws us nearer to the innovating ideas of Schaeffer [1966], forerunner of a new hearing of our environment [Augoyard, 99]).

a - The indexing or causal listening: it sends back to a natural listening, obvious during every first hearing of which you must be able to get rid of so as to switch on a cultural listening. Guided by the

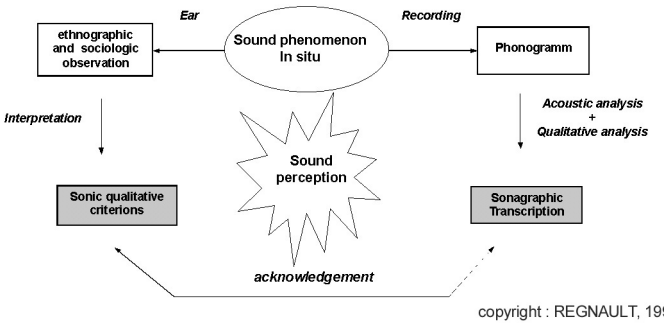

Figure 7: Place of the sonagraphic transcription in the authentication of the qualitative sonic criterions of a sonic snatch analysis.

emergence principles (ratio figure/backdrop), the sonagraphic representation allows the identification of the diversity of the sonic sources; it also allows to name them, to qualify them (typology of emerging or mixed identifying sonic figures). It also permits to located them on the frequency scale, to show their temporal evolution: repetitive sounds, punctual or continuous sounds ...

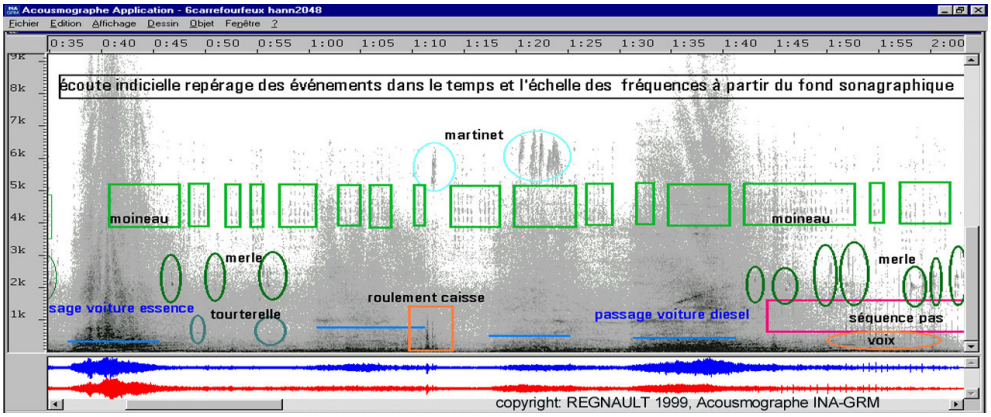

Figure 8: Annotating of the sonic events.

b - "L'écoute réduite" (listening initiated by Schaeffer, 1966, bringing in the phenomenological "réduction") is a skilled listening attitude [Schaeffer,66] which consists in listening to the sound for itself, out of its producing background. It is here question of making out sonagraphic backdrop of the sonic figures essentially corresponding to the said time-space effects. This notably asks the question about the observation scale of the urban sounds.

2 - CONCLUSIONS

Applied to the fields here inventoried as for the sonic environment, the sonagraphic analysis has a double function: it is at the same time a scientific research medium for analytic listening −correlating the quantitative data (frequency, dynamic) with the known or new qualitative data − and a medium for a didactic communication. A ideal representation of our sonic perception does not exist. The marking out of the compounding indicators the sonic material of our environment is for each individual of a complex personal apprenticeship, which is elaborated by step during the listening. Within the subject, the sonagram associated to the visu-listening (a term that we prefer to audio-vision since here the diagram guides the listening and not the opposite, as it is frequent at the cinema) is a good pedagogic medium because it allows to make the learner and the teacher get on about what they hear in correlating the abstract (in the sense that they are defined by the abstract signs: the words) qualitative criterions when listening concretely to a sound material. That's why the digital media (like multimedia CD or Geographical Information System, GIS) are according to us tools of the future for the management of the sonic environment. On top of it, the sonagraphic visualization allows to bring forward the environmental listening of the quantitative (physic measure of the signal) to the qualitative criterions (the sonic perception). It gives access to acoustic pieces of information which not only ask questions to the physician

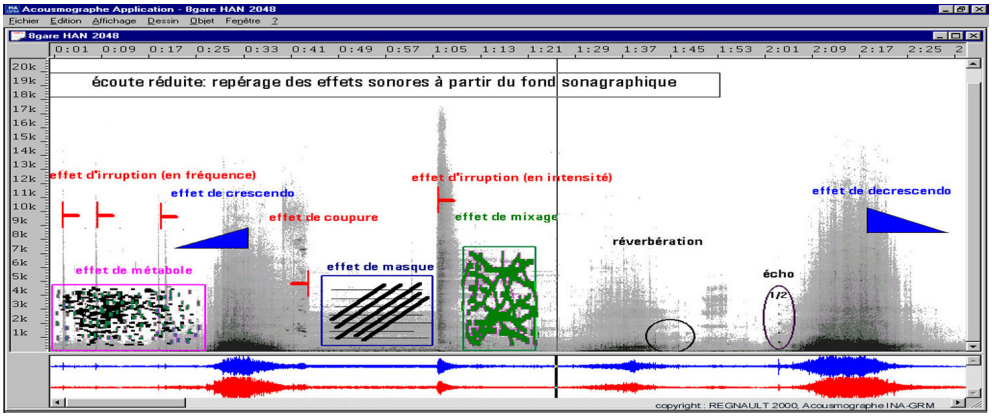

Figure 9: Marking out of the sound effects.

but also the psycho-acoustician. But the matter of the visu-aural identification systematic and possible automatic of graphic unitizes corresponding to the noticeable sound effects remains to be acknowledged in other experimental fields.

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