relation to the general organization.

It remains then to look further into this research until the result of the performances. The industrialist who takes part in the project will then be able to consider the realization of prototypes. Besides he has taken part in the design, since the beginning, in order to check the validity of existing materials, the technical possibilities, whether some safety constraints should be taken into account (for the walls and other architectural elements).

After the final definition of the site and architectural regulations, we will consider the prototypes, undoubtedly in laboratory, with the assistance of a design consultancy. After measurement and checking, the assembly will be done on site. The industrialist does not exclude to imagine new products or systems to answer the elements of research.

Right now, some the systems and products can be considered, for example the PLAtec system, which makes it possible to create forms out of plasterboards. Cupolas were made. There are also particular acoustic partitions, which satisfy specific acoustic performances.

Architectural sound prototypes

Grégoire Chelkoff, Architect, Grenoble School of architecture, CRESSON

We answered the call for research proposals with the idea to try out and seek architectural prototypes sound in what exists around us, in what one could learn from preceding research, and at the same time to create something nearer to the prototype which is being tested within the *Grands ateliers de l'Isle-d'Abeau*, near Lyons, with which our school of architecture works a great deal.

There are several issues in the research assumptions. It seems to me that one too often talks about

sound quality in passive terms, in terms of listening, reception. Our idea was above all to try to think architecture of sounds, to see whether there are possibilities of sound affordances, i.e. possibilities of action for users, enabling their to adapt their sound environment according to their concern of the moment. This is why I had called this presentation "listening while moving" - listening and the action of moving around a wall thought of in relation to the

potential sound action.

One talked about the stress related to sounds : but, sometimes, it is also about a stress related to incapacity to act and modify the sound environment. Architecture has perhaps something to say, not by thinking in an only defensive way, but by proposing. And more precisely, in the example I will take, to propose the maximum of opportunities in the minimum of space.

We are here in architecture without standards. We are in experimenting conditions, in front of a building which itself is dedicated to the experiment. We wanted to work on micro-architecture which would answer to micro-mobilities : we all are, when we await something, for example means of

transport, in a state of movement: movements which make it possible to deviate, to perhaps adapt its position in function – – sound environment.

Our laboratory, linked to the Grenoble school of architecture, is a multidisciplinary team, which much worked and published on the sound effects. But beyond that, the object about which I talk to you seek to go further with "sound kinesthesis": elements of space made sensitive by sound and movement.

Research was undertaken by a very composite multidisciplinary team :
Philippe Liveneau, architect, myself, research leader, Jean-Luc Bardyn for all that relates to acoustic thought, electro-acoustics, equipment, the sound tracks, and Rachel Thomas, sociologist. A team of architecture students, Juliette Rault, Xiao Shan Guo, Julien Plessis, Lydie Menet, Gaëlle Perrin and Romuald Morel, helped us for the assembly.

Three principles guided us:

- thinking of sound ergonomics, something which satisfy the kinesthetic approach: how do the built forms offer possibilities of action?
- a scale of work close to the body: we had in particular noticed in preceding research the proximity of the built elements and the importance what happens when one is near the things or moves away from them;
- the desire to build an experimental approach on several plans, not only by the fact of getting in a place to try out something.

In methodological terms, that means : can one experiment the sound other than by systems of virtual simulation? By a study *in situ*? The *Grands ateliers de l'Isle-d'Abeau* were the occasion of going towards this methodological aspect, with the help of an innovation effort in the method of survey and

the method of setting the device in motion.

We were not starting from scratch, since, in the previous years, we had worked on natural size models from ten to twelve meter long while seeking to create sound situations.

The assembly was made up of rough wood elements. One sees what we called inclusion : we looked for something which can include us without locking us up : when one works on the sound, one always

faces a paradox between open space and the will to create differences on the noise level.

In this research on archetypes, in real situations which were clearly located and tried out a prototype, we started from three essential categories:

- articulation, i.e.: how does a movement between two different spaces transform the lived sound? What occurs when one moves between two spaces? How to locate several shapes of sound and space articulation? For example a slow decrease, but also an alternated passage, which make alternate the sound of a step according to the device which makes it resound, etc. These are real situations;
- the limit situation: one was interested rather in micro-mobilities, when we are in a situation of limit, for example in front of a counter, when one needs to talk to somebody, or at the limit of a parapet dominating a town: the movements of the body are rather small, and make the sound environment change quickly;
- inclusion, that it interested us to locate : idea that, in a sound place, when people are not entirely cut from what surrounds them, they are included in an environment. It is not the movement which creates inclusion, it is indeed perception, may be projection, of a relation between two places, mental projection without movement.

There are thus three degrees of movement: a significant movement, a tiny movement, and a null movement.

To come to the experiments themselves : fifty archetypes were listed. We have sound recordings, space locations, and descriptions of what is played. The experimental part of research extended to the assembly of this object which resembles many things. One made of them, at the end, a bus shelter, but our intention was to work on a "wall", a wall equipped with faculties, various potentialities, as one could as well regard as the entry of a building, an object located in a large hall or an underground space with acoustics difficult to live when one moves there. One more particularly worked on the assumption of some sound street furniture, to accompany waiting and to create a maximum of possibilities of waiting in a restricted space. Manufacturing costs were some wood panels, battens, and five days of construction with the students. The object remained one month outside, without burning nor decaying under the rain.

We established it along the building, which created a separating wall, the quay in front of the building simulating a pavement. We imagined the arrival in front of this object : the passer by must choose, pass on the right or pass on the left. On the left, it is rather about a slide which protects from the sounds, about which I will talk later, since we simulated another sound environment that the existing one. It is thus necessary to choose: to pass on the side of shade or the side of light and sound. Shade side where one has ten decibels less than the diffused sound, light side where one has a very

strong sound. There is already there the interaction between the various senses : sound is not isolated from the other senses, it is a significant question that we approach in terms of environment. It is well to isolate hearing, it is well also sometimes to connect it to other sensory dimensions.

To manufacture this object, we adopted a series of work operators, proper architectural forms. These operators are here three, supposing that they could return to sound possibilities : imprint, fold and splitting.

The imprint will be something which determines a hollow in a wall, in a mass. The degree and the variability of the depth can be interesting : something changes according to whether one places oneself at the bottom or on edge. The folds were to make it possible to prolong some parts of the walls to make reflectors, shelters, and armrests, to offer places where to talk. Splitting allowed to make the walls slip without opening too much, while opening to light, sometimes to movement; it made it possible to keep visual and sound points of contact.

As for the sound assembly, it was necessary to put the device in context: three loudspeakers were placed some ten, twelve meters away and diffused a sound environment of transport, bus, trains...

Then the survey protocol was set up. We asked seventeen people to leave the same point, approximately ten meters from the prow of the object, which they had four minutes to explore. Then, to put the sound dimension in action, we called them on their mobile telephone to ask them to read a text, during the diffusion of the recorded sound. Thus, in four minutes people learn the device, understand how it goes, where to sit down, where to pass, where not to pass. When one asks them to read the text, the sound causes adaptations. That learned to us many things, the more so as among the seventeen were four blind people.

One can follow an example on the photographs: the person answers the telephone, initially sitting, then starts to read the text and moves, to settle directly in the small one meter sixty wide room, which shelters sufficiently, although it is split on the other side. We could make note of very different positions.

Another person will pass behind the device, and will put him/herself against a wall, undoubtedly for better hearing. Another will fix him/herself between two posts and place him/her head between two walls. One looks through a slit, one shelters oneself in an inclusion where the sound is differentiated... It is this adaptability which the seventeen people taking part in the experimentation showed us.

These are the micro-mobilities, even a little forced, which interested us : it is seen there that we are not passive, that, if something occurs, we seek to adapt ourselves.

We tested the device by recording a pink noise, the pink noise which all acoustics experts know, around the device. While moving, the technical operator tests the various depths: the pink noise varies somewhat, and that gives us indications on the elements of change related to micro-mobilities of the passers by. One hears then the transformations, the attenuations, amplifications, which reveal us the sound or acoustic dimension of the architecture.

The various positions adopted by the passers by reveal us the active dimension of the ear which one too often forgets, and who crosses very well the space dimension of architecture.

This experiment required much investment from us, much work, and it is difficult "to show" the results. But we are satisfied with the categories which we could release, and continue work by deepening its inter-sensoriality. The operators whom we had retained seemed to us effective, we will develop research in this direction. The experimentation showed us the interest to associate architectural research and acoustic research and with evaluation by the use, it showed us new possibilities.

We hope to be able to test with other materials, to revalue some methods and general principles.

POINT OF VIEW OF THE INTERNATIONAL EXPERTS

Henrik Karlsson

With regard to the sound environments in hospitals, I would have a question to raise. I did not hear talking about ventilation, air-conditioning. I spent a few nights in an hospital, and I could not sleep because of the air-conditioning. Did you ask the personnel to apprehend their experiment, their perception of a good sound environment? And patients, insofar as they can talk and remember? I have the feeling that there is a conflict, and that it is the personnel who tends to take the top and to decide according to what is good for them. This is why one leaves the doors open in hospitals. But if the patient wants to rest, I think that the doors must be kept closed. The opinion of the patients and that of the personnel are not the same ones: how to advance between these two visions?

Another question addressed to Grégoire Chelkoff: how to transfer this experimentation on usual practice?

Jian Kang

I am impressed by the remarkable quality of this interdisciplinary work. It seems to me that in the United Kingdom, we are late. Few people research on the Soundscape. The two projects enabled us to consider a sequence of spaces, a set of spaces, rather than a single space. It is new, and significant compared to the former considerations where one was interested in a theatre, in a