Sound Sculpture: Sounds, Shapes, Public Participation, Education

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François Baschet and Bernard Baschet

Abstract—Beginning with a new definition of musical instruments, François Baschet analyzes various ways of making sounds without the help of electronics. He then examines different fields in which sound-producing sculptures and instruments can be used. Bernard Baschet focuses on the applicability of sound sculpture to music education. François Baschet then proposes a plan for the next 20 years.

I. INTRODUCTION
(François Baschet)

When my brother Bernard wrote an article in *Leonardo*, in 1968 [1], we had already been following a working plan for over a decade. This plan can be summarized as follows. In 1955, I noticed that a musical instrument is a combination of at least three of the following four elements:

(a) a vibrating element to create an oscillation;
(b) energy to start and maintain the oscillation;
(c) a device to modulate the scale;
(d) a device to amplify the sound.

For instance, a piano possesses (a) strings to create the sinusoidal oscillation; (b) hammers to strike the wires; (c) a number of wires and hammers to allow modulation; and (d) a sound board for amplification. A flute utilizes (a) the mouth of the flute to make the air vibrate; (b) wind to create and sustain the sound; (c) holes for modulation; and (d) no additional means to amplify the sound.

My brother and I drew up a table with the four columns (a), (b), (c) and (d). In each we reassessed the possible elements:

(a) *vibrating elements*: strings, vibrating rods fixed at one end, vibrating rods fixed at both ends, free vibrating rods, vibrating rods fixed at one point, vibrating rods fixed at several points, plates, etc.
(b) *energizing agents*: bow with resin, bow of moist glass, percussion, etc.
(c) *modulating devices*: multiple tuned strings, multiple tuned rods, modi-

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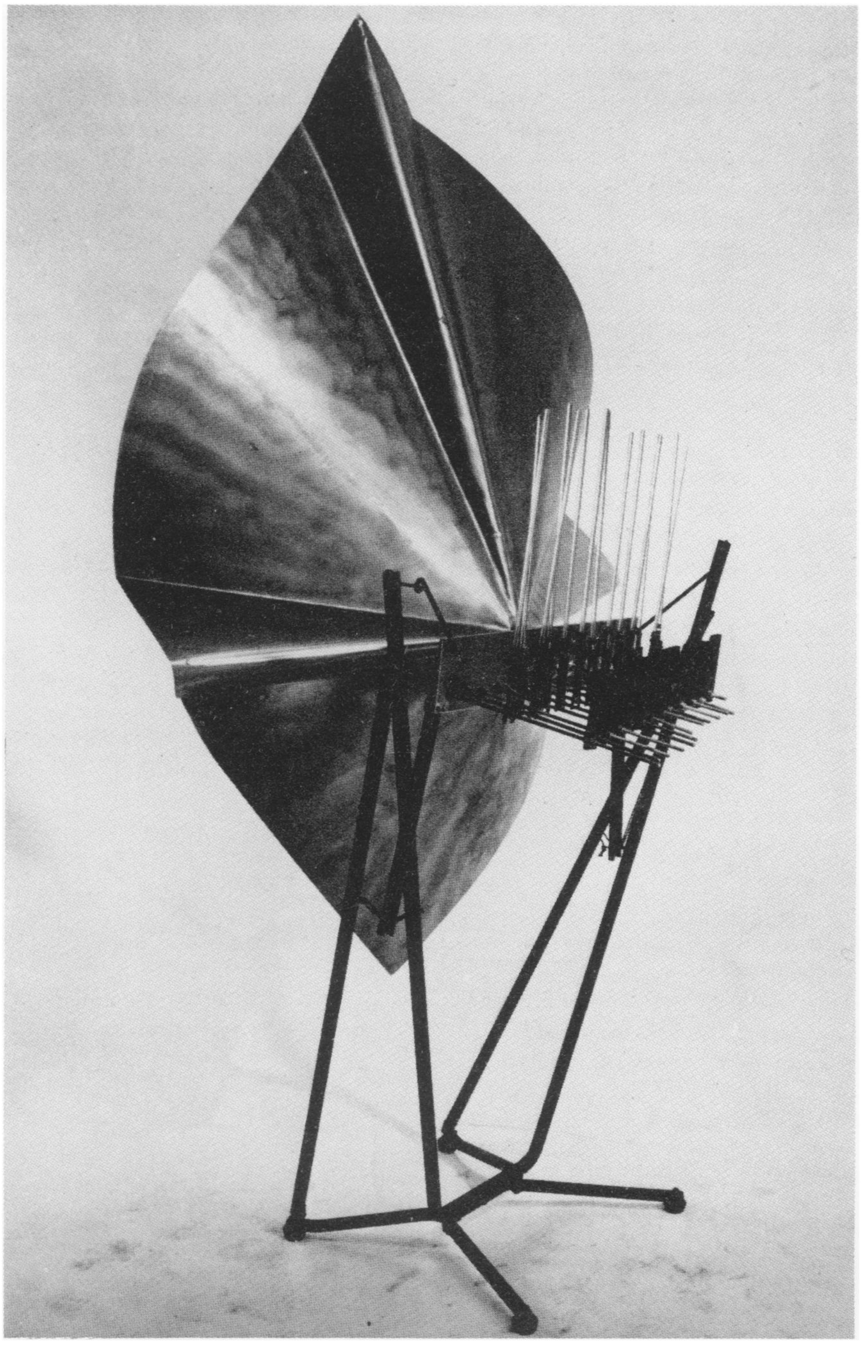

Fig. 1. Sound sculpture, steel, glass and aluminum, 1957. The aluminum foil acts as the sound amplifier in this sound sculpture which sounds like a trombone.

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fication of lengths, modification of tension, modification of weight, etc.

(d) *amplifying devices*: sound boards of different shapes, sound boxes, resonators, etc.

With respect to this last category, amplifying devices, we realized that there was a shortage of conventional means and thus invented or adapted other systems, such as plastic balloons or metal foils (Fig. 1) bent in a suitable manner, to obtain the desired relative amplification of different frequencies (i.e. the desired response curve).

This table, with suitable permutations and combinations of the possible elements, embodies all known musical instruments and an even greater number of instruments that have yet to be made. Without losing one's sense of proportion, one might venture to say that our table is to music as Mendeleev's table of chemical elements is to chemistry.

The first part of our program has been to continue designing and making different sculptures/instruments by combining elements from (a), (b), (c) and (d). The second part has been to extend the use of our work into as many fields as possible including art, music, education and recreation.

Given the scope of our interests, should we call our constructions sculptures or instruments? We decided to make the following distinction. When we work for an art gallery, museum or community center, the shape comes first and we call the work a 'sculpture'. When we work for musicians, the sound comes first; the shape becomes the support or packaging of the sound. Then we call the work a 'structure'.

II. TECHNICAL EVOLUTION OF OUR WORK (François Baschet)

During the past 20 years, we have been working primarily on improving column (d), i.e. our acoustical sound amplifiers. Although we stopped using the plastic balloons when we found acoustical amplifiers with a better output, we have to be grateful to this simple device: it allowed us, from the beginning, to avoid the use of electronic amplifiers. With this simple, inexpensive and versatile tool, we were able to extract the inner sound created inside metal bars.

Children know how to imitate the sound of a bell by using a silver spoon tied to a string: if the spoon is merely hit, one will hear only a faint metallic sound; however, if one holds the other end of the string with one's teeth and stops up one's ears at the same time as the spoon is hit, one will hear—via the string and bone conduction—the magnificent sound of a big bell.

Our plastic balloon replaced the string; in a concert it would have been too difficult to set up a web of strings between our sculptures and the jaws of all the listeners—although this idea is written into our program. We used the plastic balloon to transform the high pressure–small amplitude vibrations in the metal of high impedance into low pressure–large amplitude vibrations in the low impedance atmosphere (Fig. 2). Moreover, it avoided the distortions created by electronic amplifiers, as we believe that electronic music is to music as chemistry is to cooking.

The plastic balloon was the start of our adventure. In 1945, I set off on a tour of the world which lasted seven years. On my way, I was imprudent enough to buy a guitar. We are told the world is large, but that is not true for someone carrying a guitar: railway compartments, hotel rooms, subways—everything seems small. I needed a guitar that was manageable. Since a banjo has a membrane stretched on a frame, why not have a self-supporting membrane—that is to say a balloon. Therefore, when I made my guitar, I replaced the soundbox with a plastic balloon and supported the strings elastically on a frame. At the time, I did not realize that this instrument would be the first of many others, nor did I expect it to generate so many silly jokes.

When I arrived in Paris in 1952, I enrolled in classes to study classical sculpture with Emmanuel Auricoste and Hubert Yencesse. But at the same time I was curious to understand how and why my collapsible guitar worked.

I went to public libraries and bought many books on acoustics. I read almost everything that had been published since the seventeenth century: Mersenne, Chladni, Lord Raleigh, Helmholtz and,

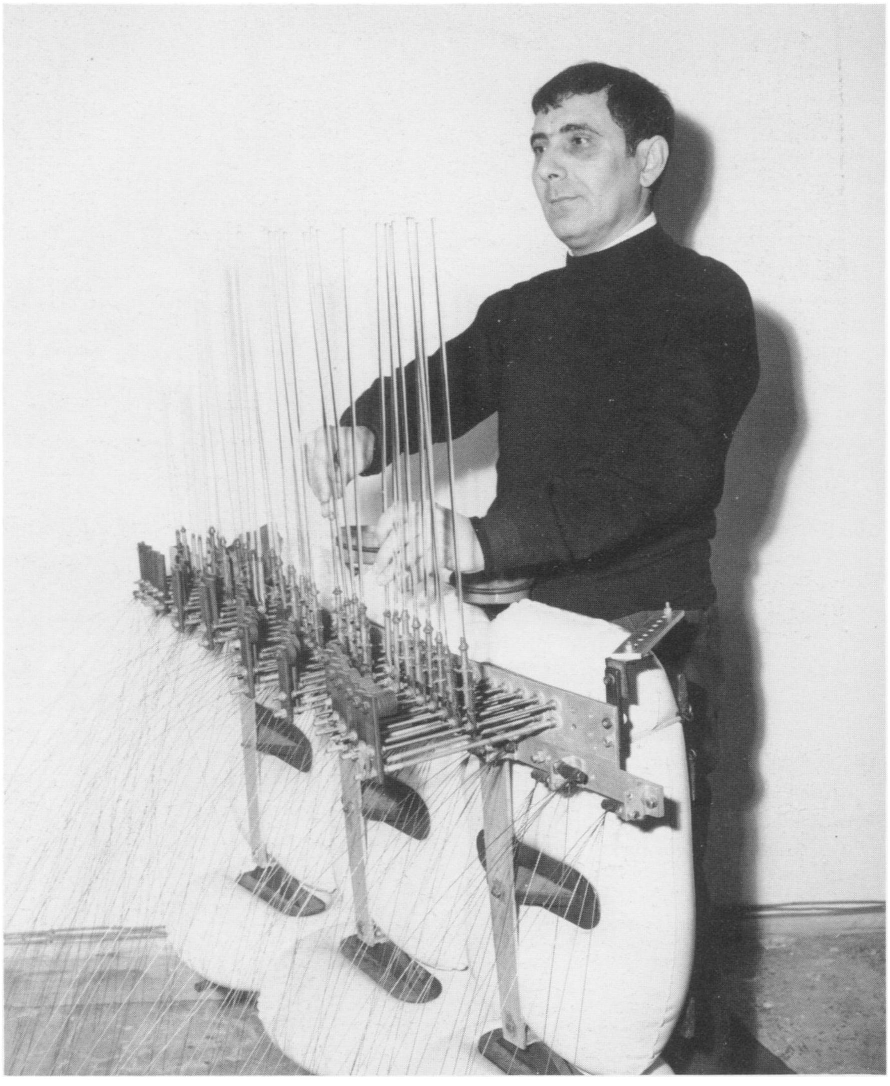

Fig. 2. Sound sculpture, glass rods, steel rods, amplification with plastic balloons, 1958. Pianist Jacques Lasry shown playing 3½-octave sound sculpture. (Photo: Francine Foliot).

above all, Henri Bouasse, who in the 1920s wrote 12 books documenting hundreds of acoustical experiments.

All the while, I continued to work on my sculptures. I wanted to become Auguste Rodin. Some of my friends, already involved in the art world, told me gently that the job had been taken and that I should look for something else. The solution was obvious: I had to combine my manual skills with my knowledge of acoustics. I went to the hardware store and bought all kinds of metal bars, which I combined with the plastic balloon I was using for my guitar.

In the early 1950s, nobody in the art world was ready to consider this kind of contraption an artwork. To make a living, my only solution was to try the music world, which was more open. I became associated with two gifted musicians: Jacques Lasry, a pianist, and Yvonne Lasry, an organist. My brother, Bernard, a former engineer, contributed his knowledge of science.

This long digression is an effort to explain why we nostalgically abandoned our miraculous plastic balloon and replaced it with better fittings. The solutions included:

(1) Cones made out of stiff cardboard or plastic. Because of the hardness of these materials, the cones work more like soundboards than like loudspeaker membranes. We used them for esthetic reasons as well: one can form them into a great variety of shapes and paint them different colors.

(2) Folded metal foils made mostly out of annealed stainless steel. We repolish the foils to give them a mirror finish. If the thickness is 0.8 mm or less, we bend them on the edge of a heavy table. The process has to be carried out with great care, as errors in the bending cannot be erased. If the thickness is over 0.8 mm, we use either the presses found in an industrial shop or a homemade press with a big screw.

(3) Pistons. First we make an aluminum tube with a diameter of 12–36 cm out of 0.5-mm thick aluminum. The length corresponds to one-quarter of the wavelength of the note it is to produce. Then we cut a plywood disc, 5 mm thick, whose diameter is slightly smaller than the diameter of the tube. To make the piston airtight, we stretch a thin rubber membrane over it. Then we suspend the whole thing from the center of the disc. The tube hangs vertically and stretches the rubber by its own weight. If we hang this fitting from a vibrating bar whose frequency corresponds to the length of the tube, we get an interesting amplification.

Fig. 3. Sound sculpture belfry replaces bells in a school near Paris.

As far as the first three elements are concerned—(a) vibrators, (b) energy and (c) modulation—there have been significant improvements but no major breakthroughs. We have improved the quality of the sounds, the precision of the pitch, the flattening of the response curves. We have been less concerned with coming up with new inventions than with developing new uses—new fields—for our discoveries.

III. USES FOR SOUND SCULPTURE (François Baschet)

Museums and Art Galleries

Our works are a synthesis of shapes, sounds and public participation.

Shapes. From an esthetic point of view, we stick to the ancient Greek principle: Art is made to make life more beautiful. Thus we try to build sculptures with clean lines and simple proportions. We believe there is no beauty without coherence, without homogeneity, without unity. We avoid found objects as, we must confess, we cannot give beauty to ugly and careless elements.

We follow the principles of classical sculpture: coherence comes from the unity of materials and elements; beauty comes from simple proportions between the different elements. A good sculpture looks coherent from all directions. The public should be able to view the sculpture from all sides without feeling that there are 'holes' in the design.

Sounds. Our sculptures produce only pleasant, harmonious sounds. Of course, I have found ways of making dreadful shrieking noises, but I would prefer to die with my secrets.

Our search for harmony leads us to putting fine shapes together with pleasant sounds. Unfortunately, both things do not come together automatically: a beautiful violin can produce dreadful sounds, while an ugly piano can produce marvelous ones. There is no connection between the beauty of shapes and the beauty of sounds. Artists must pursue them on two different tracks and assemble them themselves.

Public participation. Philosophically, we think that, in our machine-oriented, automated society, creativity is the only way to avoid mass ossification. Sound sculpture is a tool as much as an art form. The sculptor makes something, and musicians or visitors use it to create their own art. It is a double-trigger operation.

This reminds me of the following story. Eckerman asked Goethe, "What is a *real* thing [eine echte Sache]?" Goethe answered, "A thing is 'real' when it produces something else [wiederproduktive]." In this case, sound sculpture fits with Goethe's definition, as it gives the musician or visitor the pleasure of creating as well. Thus, philosophically, we are happy when the public enjoys our exhibitions. And, as a general rule, it does.

Musically, the result is often a sheer disaster. If one puts a small child in front of a piano, the child will pound on it as heavily as possible: "I make noise, therefore I exist." If one puts an adult in front of a sound sculpture and hands the adult a mallet, the same thing will happen: "I make noise." But I am sure that in both cases the hyperactivity stems from the pleasure of discovering. Next time both child and adult will behave better. It is a matter of education.

Sound Sculptures for Communities

Like Roosevelt and Stalin, who divided the world in two at Yalta, my brother and I defined our zones of activity: Bernard works in France and Belgium; I take care of the rest.

At some point Bernard made a specialty of working with architects and he constructed a series of belfries in new housing programs near Paris. These bell towers are big clocks; they tell the time both visually with moving elements and acoustically with bell sounds. We believe that the sound of a bell is today an archetype deeply buried in the unconscious of humankind. It has a quietening effect and gives a zest of tradition to new communities (Fig. 3).

A major drawback to public sound sculpture is that the noise or music it

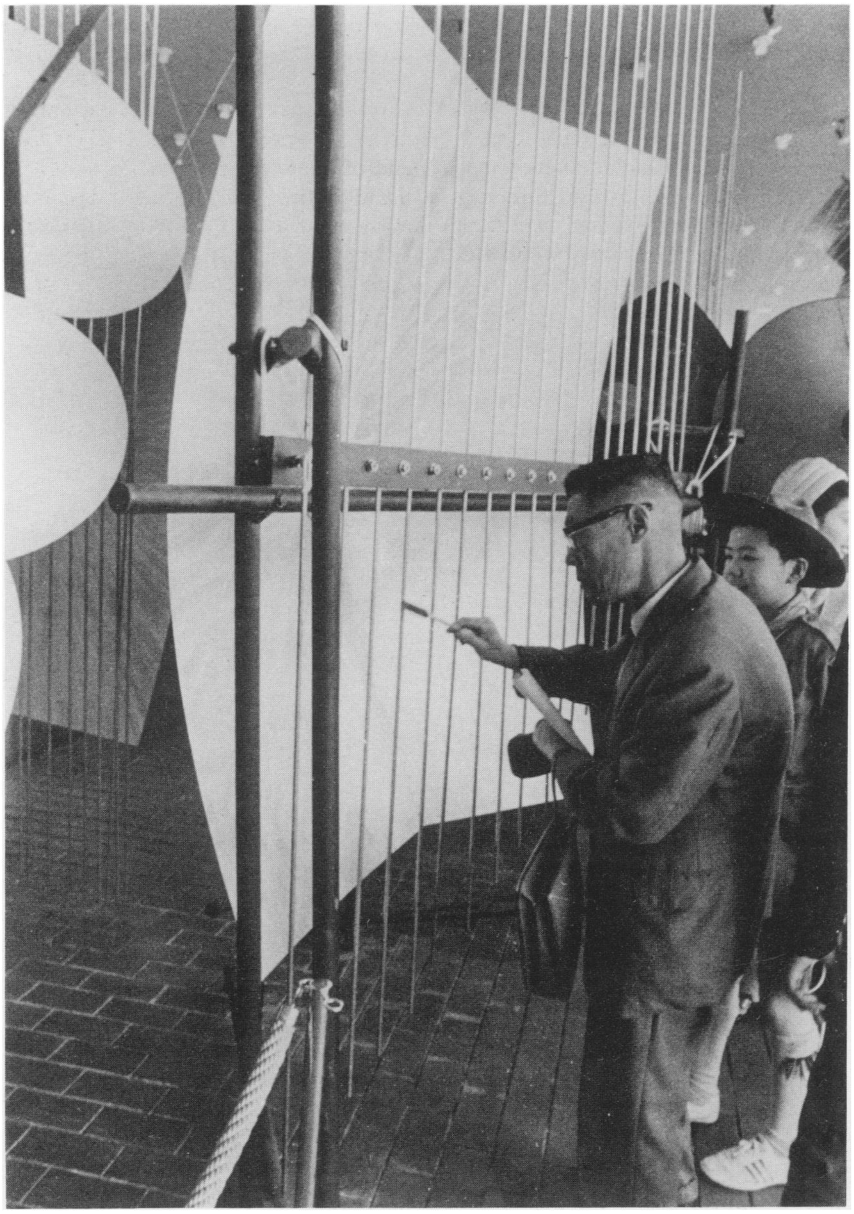

Fig. 4. The world's first and biggest musical playground. Japanese Steel Federation Pavilion, Expo '70, Osaka, Japan.

produces becomes, after a certain amount of time, boring to its neighbors. For this reason, when we place a sound sculpture in a city center, a shopping area or a community gathering place, we usually hook it to a clock. For instance, a meditation fountain installed in a museum in West Berlin [2] consisted of stainless steel tulips that moved at a slow and random pace and plucked low-pitched strings; every 20 minutes, whistles that dipped into the water would imitate a canary bird's vocalization. A kinetic fountain installed in 1973 at the University of Mexico depicted a flock of stainless steel birds in flight; the birds, operated by water jets, would 'sing' on the quarter of an hour with whistles that dipped into the water.

Outdoors, the situation is different, as long as the site is far from buildings and nervous neighbors. For instance, we made musical windmills for the city parks of Cologne, West Germany.

We are working currently on the design of musical playgrounds for children of all ages (Fig. 4). Because of the syndrome "I pound, therefore I exist", we have to add walls as sound barriers. But, turning a minus into a plus, we can use these surfaces as inexpensive supports on which to display static artworks.

For Hemisfair '68 in San Antonio, Texas, we made a kinetic and musical fountain that stressed public participation. By playing with 56 water valves that operated 28 musical watermills, the public could regulate the movement and the sounds of the fountain (Fig. 5).

That same year at the 1968 Olympics in Mexico, 240 children from 120 countries assembled twenty 12-feet-high musical sculptures; the sculptures were made from kits—large lego-type tinker toys. Everybody had a lot of fun.

Sound Sculptures for Musicians

Since that first day in the early 1950s, we have always been asked: Why do you invent acoustical musical instruments if the future belongs to electronics, which can produce any kind of sophisticated sound?

My answer is the following: When my grandfather saw the first photograph, he said to himself, "This is the death of painting"; when he saw the developments of organic chemistry, he said, "This is the end of haute cuisine." When my father heard the first telephone, he said, "Throw away your pencils, nobody will write anymore"; when he heard the first gramophone, he said, "This is the death of concerts." The first radio should have sounded the death knell of newspapers. Movies should have meant the end for theaters. Television should have closed down Broadway.

No such thing happened, the reason being that technology and art follow different paths. In the art field, luckily, 'anything goes'. We need every means of communication, of expression.

IV. SOUND SCULPTURES FOR EDUCATION: MUSIC THERAPY (Bernard Baschet)

In 1964, François and I became aware of the reactions groups of children visiting our exhibitions would have as they rushed to play with our large sound-producing toys.

In 1973, our music teaching sessions were initiated in schools. Our first step was to observe the cases of children considered 'unadapted' to school. In 1974, the first music teaching sessions for groups of mentally and physically handicapped children were organized. As a result of our observations, we studied specific pedagogical materials.

From 1975 until 1978, we worked in New York on a program called "Learning to Read through the Arts", set up by the

Fig. 5. In this sound sculpture, the public can play with 56 water valves which operate 28 musical watermills. Hemisfair '68, San Antonio, Texas.

Guggenheim Museum for the children of Harlem who did not have access to regular schooling. On the basis of this experience, in 1977 we developed a dozen 'sound structures' to be used in schools or while working with troubled children. Little by little, these structures have been adopted.

Since our main concern has been to allow the child to participate actively in the process of learning, it was essential to design instruments that could be handled without special training. This was made possible by concentrating on the structure of the sound itself. The following comparison should help clarify this point. In the past, during art classes, kindergarten children were given an object and told to copy it; only when the drawing had been completed were they allowed to color it in. Under the influence of modern pedagogy and contemporary art, in particular abstract art, children today are more likely to be given colored pencils with which they are free to 'project' the colours on the paper at will. While learning gradually to structure their images, the children structure themselves.

Influenced by electro-acoustic music and contemporary music, we thought of creating 'sound colors' that could be used freely. Previously, nothing of this kind had been tried in music education. Children usually started with scales—an intellectual concept, comparable to rigorous drawing.

A 'regular' instrument produces a sound with a well-determined fundamental frequency, therefore a predominant height. Classically, three musical sounds following one another introduce a melody. Our task consisted of looking for sounds that did not have this characteristic; acoustically speaking, this is difficult. We chose sounds with a weak slope of attack, meaning non-aggressive sounds. We used sounds that were pleasant to hear, close to classical, electro-acoustic or non-Western sounds.

The musical handling of the instrument is meant to be simple, unprecise and, therefore, accessible even to kindergarten children. With our instruments, anyone can produce sounds and assemble them without any reference to notes or scales, without previous intellectualization, without instrumental technique. The children are given a selection of sounds; they then choose the ones that suit them best and modulate them (Fig. 6).

Most of our instruments have been designed to be played by a child with an adult, therefore establishing a non-verbal dialogue (Fig. 7). In these circumstances, a sound-producing object becomes a relational object. Both 'musicotherapy' and 'sonotherapy' are accurate terms. At what point does music start? But this is a topic for another article.

V. PROGRAM FOR THE FUTURE
(François Baschet)

What you have been reading up to now is a short summary of our activities during the last 20 years. Our plan for the next 20 years is to try to set up a "Center for Acoustical Studies".

The working program of the Center would have four parts: (1) a bank of new instruments, (2) a teaching department, (3) a research department and (4) a marketing department.

Fig. 6. Children playing with Baschet sound sculptures (steel, aluminum). Akademie der Künste, West Berlin, 1972.

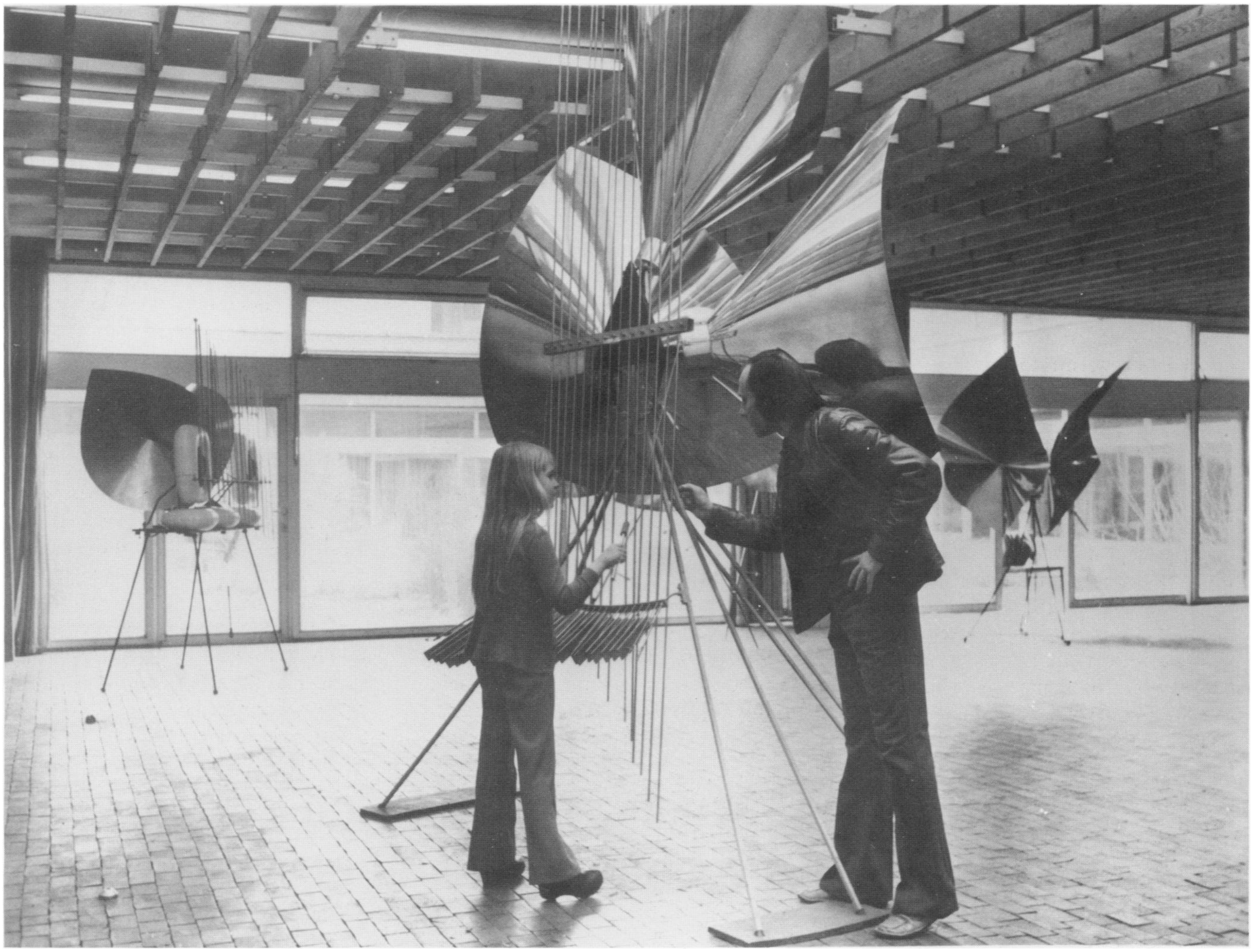

Fig. 7. Child and adult playing with Baschet sound sculpture (steel, aluminum). Akademie der Künste, West Berlin, 1972.

New Instruments Bank

A 'bank' of new musical instruments would be established based on new patents I would like to take out. This bank would create:

(1) Instruments for conventional orchestras: improved designs for percussion instruments (the materials currently used are poor) and for classical keyboard instruments (today's piano is a musical wheelbarrow); many others can be improved as well.

(2) Custom-made instruments: the Center would produce instruments or sound sculptures for dancers, musicians, actors. For example, we have made instruments for a ballet in which the dancers doubled as musicians using hand-carried lightweight musical instruments [3]. On another occasion, we designed a musical stage setting for the U.S. National Theater of the Deaf [4]. Along the same line, I would like to develop instruments for deaf children based on bone conduction [5].

(3) Sound sculpture for industry: at the Paris World's Fair in 1937, Alexander Calder made a kinetic fountain to promote the Spanish quicksilver industry [6]. Years ago, for a grain company, I designed a musical fountain that used corn. At many of our openings, one of our fountains pours white wine, which always creates a big success. We also made a musical sculpture with crystal bowls for the Baccarat bicentennial. Ideally, this industrial market would help provide financial backing for the Center.

Teaching Department

Having neither pupil nor follower, I would like to transmit my knowledge to others. Under the auspices of the Center, I would recruit pupils with whom I could build these sculptures. Through firsthand experience, they would learn this new technology.

Research Department

A book would be published summing up all the experiments of the Center. It would prevent future sound sculptors from remaking our past errors. Every new technology needs a textbook. We would publish charts that related the correspondences between frequencies, dimensions and shapes. We would also make available analyses of different metal alloys or plastic. Potential sponsors might be aluminum, steel or plastics manufacturers. We would publish the so-called Mendeleev table of musical instruments.

Marketing Department

First, it would serve as an outlet of ideas. Sound sculpture, new instruments, are 'in' today. The Japanese have a glass orchestra; sound projects are starting everywhere. The Center might work together with *Experimental Musical Instruments* [7] to organize an international club open to everyone interested in this field.

Second, it would serve as an outlet for products—the commercial end. The research department would produce musical instruments, musical toy sound sculptures; these would be easy to market and thus would help finance the Center. I have in mind a lego–type tinker toy, sold in kits, that would allow one to construct about 30 possible instruments, using multi-purpose elements.

I do not know if my project for this Center will ever see the light, but now, at the age of 66, I know I have already completed the first third of my program. The second third is the Center. The last third is the re-designing of all the pieces of furniture of a house.

With what has already been done, I feel privileged. Many others have not achieved as much. Moreover, avant-garde artists must bear in mind Cocteau's recommendation: "Be a happy man and a posthumous artist."

REFERENCES AND NOTES

1. Bernard Baschet, "Structures sonores", *Leonardo* **1**, No. 4, 393–403 (October 1968).
2. This sound sculpture was installed at the Nationalgalerie in West Berlin. The Nationalgalerie serves as a museum of modern art.
3. The ballet was choreographed by Francine Coursange, and the music was composed by François Mache.
4. The stage director was David Hays.
5. I stated this wish years ago at the New York School for the Deaf (Hannah Manshel, director).
6. This fountain can be seen today at the Foundation Joan Miró in Barcelona.
7. *Experimental Musical Instruments*, P.O. Box 423, Point Reyes Station, CA 94956, U.S.A.