Electroacoustic Percussion Boards: Sculptured Musical Instruments for Improvisation

Tom Nunn

Abstract—The author discusses his development and use of a type of musical instrument he calls electroacoustic percussion boards (EPBs). These are essentially sheets of plywood cut into particular shapes, with various hardware devices attached. These devices, which are played in a number of ways, such as by striking, scraping and plucking, give a sculptural appearance to the instruments. Specific instruments are described and some playing techniques discussed. Contact microphones have proved effective with these instruments, as has digital processing as a compositional resource. The aesthetic orientation of the design of EPBs as well as their value as an education tool is explained.

Sound sculpture, sound installations and experimental musical instruments are becoming increasingly established as contemporary art forms. Each year festivals and symposia feature such work throughout the world. A journal published by Bart Hopkin in Nicasio, California, *Experimental Musical Instruments,* which is now in its fourth year, makes it clear what a fascinating area of aesthetic experimentation this is.

I. IMPROVISATION AND FOUND OBJECTS

I became involved in this field in a roundabout way. After several years of composing for traditional instruments, I decided to follow ultimately the direction my music was taking and devote my entire attention to improvisation. My approach to improvisation, however, was that of a composer rather than an accomplished instrumentalist. I wanted to study and experience music at its most basic, primal level, beginning with free improvisation using found objects as instruments. In 1975, working primarily with two other musicians, Jonathan Glasier and Prent Rodgers, I began what was called the ID Project in San Diego, California. For our orchestration, we accumulated a large assortment of objects, most of which were made of metal—brake drums, gas bottles, a Coke sign, pipes, plates, etc. Our first public concerts, which we gave in Balboa Park, always involved passersby. We also gave more formal concerts, as well as workshops for children and adults, and began designing and building, not just collecting, our instruments. Over the next 2 years, we focused our attention increasingly on performance and developed a number of experimental instruments.

II. THE DEVELOPMENT OF PERCUSSION BOARDS

In 1979, after moving to the San Francisco Bay Area, I began making what I called 'Percussion Boards', instruments consisting of a plywood board or plate with various sound-making devices attached. This idea was suggested to me by an instrument that Prent Rodgers had designed and built. *Spring,* as he called it, was a small piece of spruce board to which he attached odds and ends of small sound-making devices —such as a spring, a cork, a rock, a comb—which one could rub, scratch or tap. It utilized a contact microphone, or pickup, and amplification. I thought of it as a 'poor man's miniature synthesizer' because it was capable of producing so many different sounds.

It was not until some years later that I began my own experiments along these lines. Since I did not have an amplification

Fig. 1. The original *Earwarg,* plywood, steel, plastic, rubber, 40 × 58 × 55 in, 1981 [6]. The first amplified, or electroacoustic, percussion board.

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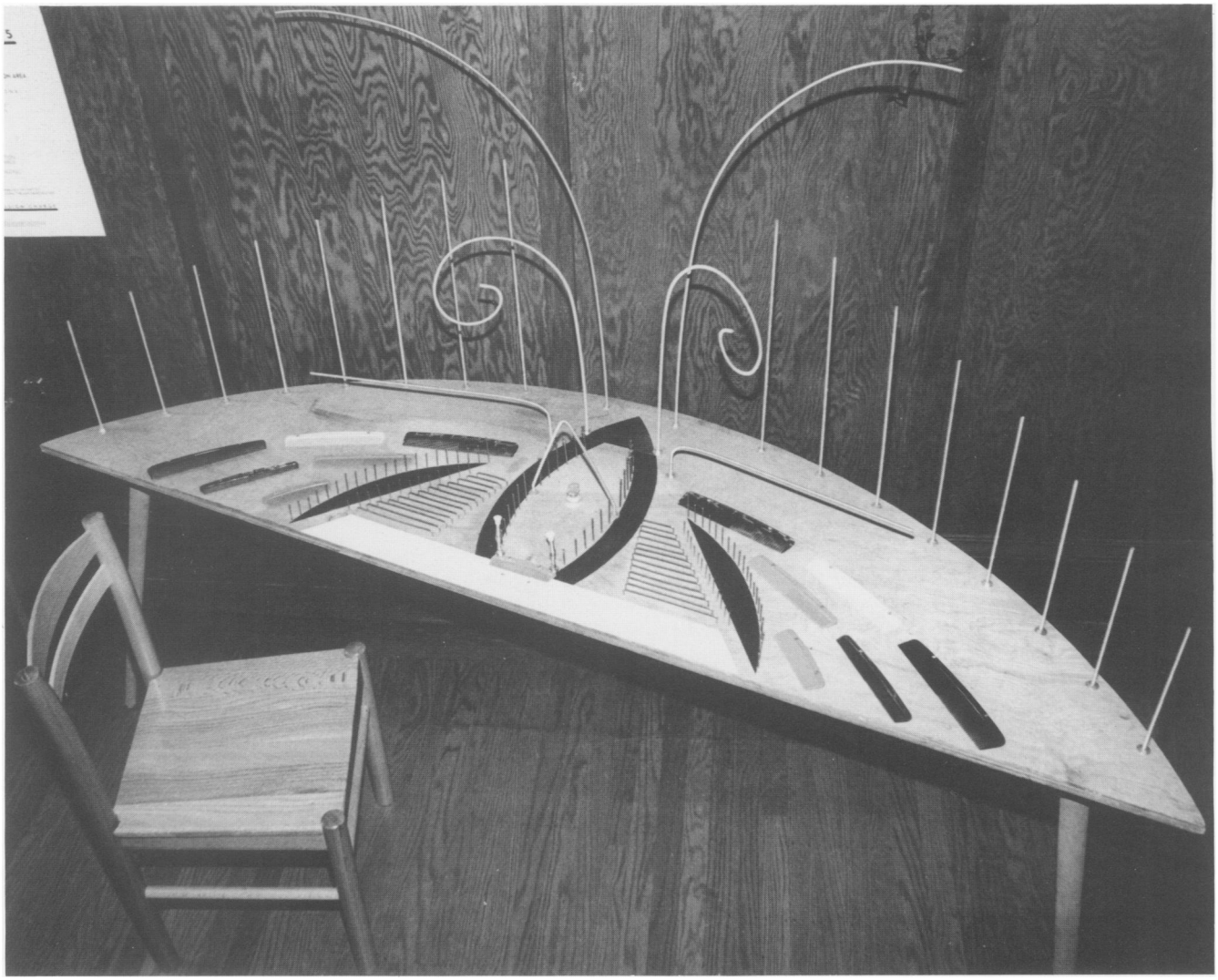

Fig. 2. ***Mothra,*** **plywood, steel, plastic, rubber, 24 × 84 × 62 in, 1985 [6]. (Photo: James R. Russell) Experimental variation of EPB, with more emphasis on visual aspect. Because of its shape, this EPB was not as successful acoustically as the *Earwarg*.**

system at the time, I made a large instrument that could project the sound acoustically. The temptation to let my imagination play with the visual, sculptural possibilities was too strong to resist. This instrument was the *Wavicle Board,* a 7′ × 4′ triangular sheet of ¾″ plywood with various and sundry hardware devices for making sounds: textured surfaces to be scratched; combs to be scraped; horizontal bronze rods and finishing nails to be plucked; strings of music wire to be plucked, bowed or scraped; friction twisters to be twisted; threaded steel rods to be struck or scraped; spring doorstops to be flapped; and anything else I could think of that would transmit sound into the board. The *Wavicle Board* (so named because of its central visual representation of a particle and a wave) was held erect by a specially made stand and had two 2′ × 2′ × 7′ triangular tables which extended out from the base, forming a sort of cockpit within which the player functioned.

After a time, I decided to try a contact microphone and amplification system, which proved effective. The amplified version was a great advantage, making it possible to reach a balance dynamically with other amplified instruments while allowing a wider range of expression than the unamplified version, now that the subtler micro-sounds could be heard. These instruments I called *Electroacoustic* Percussion Boards (EPBs).

I chose plywood for the body of my instruments because I could get it in large sheets (4′ × 8′) and at a reasonable cost and because it is attractive when stained and finished. Someone suggested to me that a solid wood board of spruce might be more resonant. But I found that resonance is not a problem with plywood. In fact, several instruments that I later made using plywood were so resonant that they were bassy and had to be dampened on the underside (e.g. with lengths of half-round dowel screwed to the underside) in order to get better definition of attack and better balance between upper and lower registers.

I continued exploring the sculptural and ergonomic design of EPBs by making a 2′ × 4′, four-legged table instrument in 1980 which I called the *Tablatura* (later dismantled). It was quite a bit easier to play, being a table at which the player sat, and was somewhat less physically demanding than the *Wavicle Board* had been. I also realized that, since it was amplified, the instrument did not have to be so large, an advantage that was most important before and after the performance!

In 1981, I made the first *Earwarg* (Fig. 1), an instrument I used for performance over the next 5 years, although it underwent changes along the way. Performing with several other musicians in the San Francisco Bay Area—some of whom made their own instruments, and others who used synthesizers and tradi-

tional instruments—I found that EPBs are quite adaptable to different styles of music, adding delicate, folklike percussion, hard drumming, special sound effects or even melodic lines.

In 1985 I experimented with other shapes of boards by making the *Mothra* (Fig. 2) and the *Varion* (Fig. 3). In the fall of 1986, I made two new versions of the *Earwarg* [1]. The new *Earwargs* are a bit larger than the original, have more strings and are slightly different in design (Color Plate B No. 4).

My most recent instrument has much of the richness and variety of the *Earwargs,* but is smaller and thus more portable. I call it the *Bug* (Fig. 4). Using a 2-foot-square piece of plywood left over from making the new *Earwargs,* I discovered what is probably the minimum size for EPBs that still allows the instrument to retain most of the bass response and resonance of the larger instruments. Though the design and devices used are identical to those found on the *Earwargs,* the playing area is smaller; since the devices are more accessible to the player, the *Bug* is less physically demanding to play [2].

A special feature of the EPBs is their large timbral repertoire. Each *Bug,* for example, consists of six sound groups—threaded steel rods, nails, combs, strings, springs and surfaces—any one of which could be considered an instrument in itself. These groups are optimally arranged on the board to accommodate the necessary playing actions including quick changes and multiple voicings (i.e. playing more than one type of device at the same time). The idea is to have a percussion orchestra at the fingertips. An EPB is just that.

Fig. 3. *Varion,* plywood, steel, plastic, rubber, approximately 36 × 60 × 55 in, 1986 [6]. (Photo: James R. Russell) Another experimental EPB, triangle shaped, and quite successful acoustically because of the large, resonant 'belly' area. The first three-legged EPB.

III. PERFORMANCE TECHNIQUES

The techniques one may use to play EPBs are many and varied. I consider a technique as having three elements: the implement (the object held in the hand, or the hand itself), the action (striking, plucking, scraping, etc.) and the device (the thing attached to the board—combs, nails, etc.). The implements I use include combs of various sizes and materials, small metal sticks (knitting needles), wood sticks (shish kebab sticks), small rubber mallets (plastic or metal rods with rubber tubing), small threaded rods, guitar picks, small handmade bows and, of course, fingers and fingernails.

There are over 50 basic techniques: mallets striking threaded rods, sticks scraping combs, fingernails plucking nails, bows bowing threaded rods, sticks striking strings, combs scraping surfaces, etc. And each technique is basic, for the variety within a single technique can be extraordinary. For example, consider the action of sticks scraping combs: where the point of the stick touches the teeth of the comb (from the base to the tip) determines pitch; the pressure of the stick against the comb affects the dynamics, or loudness; how fast the scrape is made along the comb creates another pitch; the angle of the stick as well as its length, diameter and material affects timbre; and so forth. Thus, EPBs can produce a large repertoire of sounds.

Another special feature of the EPBs is that they are specifically designed for improvisation. As such, they have built-in elements of non-linearity, randomness, ambiguity and unpredictability. The sequence of pitches in the nails, for example, is purposefully random and non-linear. Thus, when one positions one's hands to pluck the nails, one can play interesting melodic/harmonic patterns with a minimum of movement, simply by plucking two, three or four adjacent nails with each hand. If the nails were arranged linearly as a scale, it would be more difficult, even impossible, to play complicated, disjunct patterns. On the other hand, the vertical threaded rods are tunable and normally are arranged linearly, so that scale-like figures can also be played. Thus, EPBs attempt to integrate rational and irrational elements.

The emphasis here is not so much on control and mastery of the instrument, though that happens in time with practice, but rather on *discovering* the inherent tonal and timbral structures the EPB suggests to the player in real time, through improvisation. In fact, I tend to think of the instrument as playing the player as much as the player is playing the

instrument. There is, to be sure, a musical interaction between the two.

But this is not to say EPBs are only for beginners; they are wonderful to hear at the hands of a classically trained percussionist. Nor is it to say that they are only for improvisation and cannot be composed for. It is to say, however, that they encourage personal, intuitive, hands-on discovery over time and discourage formal, hypothetical or theoretical approaches.

IV. EDUCATIONAL IMPLICATIONS

Precisely because they are experimental by nature—having no literature, no master players, no specific musical expectations—EPBs can be a valuable educational tool. In the spring of 1987, I was invited by my son's fourth-grade teacher to work with the students in designing and building their own instrument. This was a rare opportunity for me to be involved in a collective creative process with children and to see how they would interpret the possibilities offered by this musical/sculptural medium.

I had demonstrated the *Earwarg* to the students to acquaint them with the devices that would be used and with their sounds. During our planning session, we discussed some of the acoustical and practical reasons for placing certain devices in a particular area of the board. For example, the vertical threaded steel rods are placed along the outer perimeter because they are powerful enough acoustically to be near the rigid edge far from the pickup, and because there they do not interfere with the use of other, smaller devices which are located centrally to take advantage of the more resonant areas of the board.

I devoted later sessions first to the design and then to the construction of the instrument. Though I assisted the children to some extent, they were the sole creators of their instrument, and they came up with a beauty (Fig. 5). It was inspiring to see how well these children worked together creatively and, indeed, how naturally creative they were. From this experience, I realized that EPBs are a useful pedagogical tool for teaching not only music but acoustics, sculpture, ergonomic design and construction. Moreover, once the project is completed, the students have a concrete example of their creative efforts in the form of a musical instrument to use to explore their own sound fantasies!

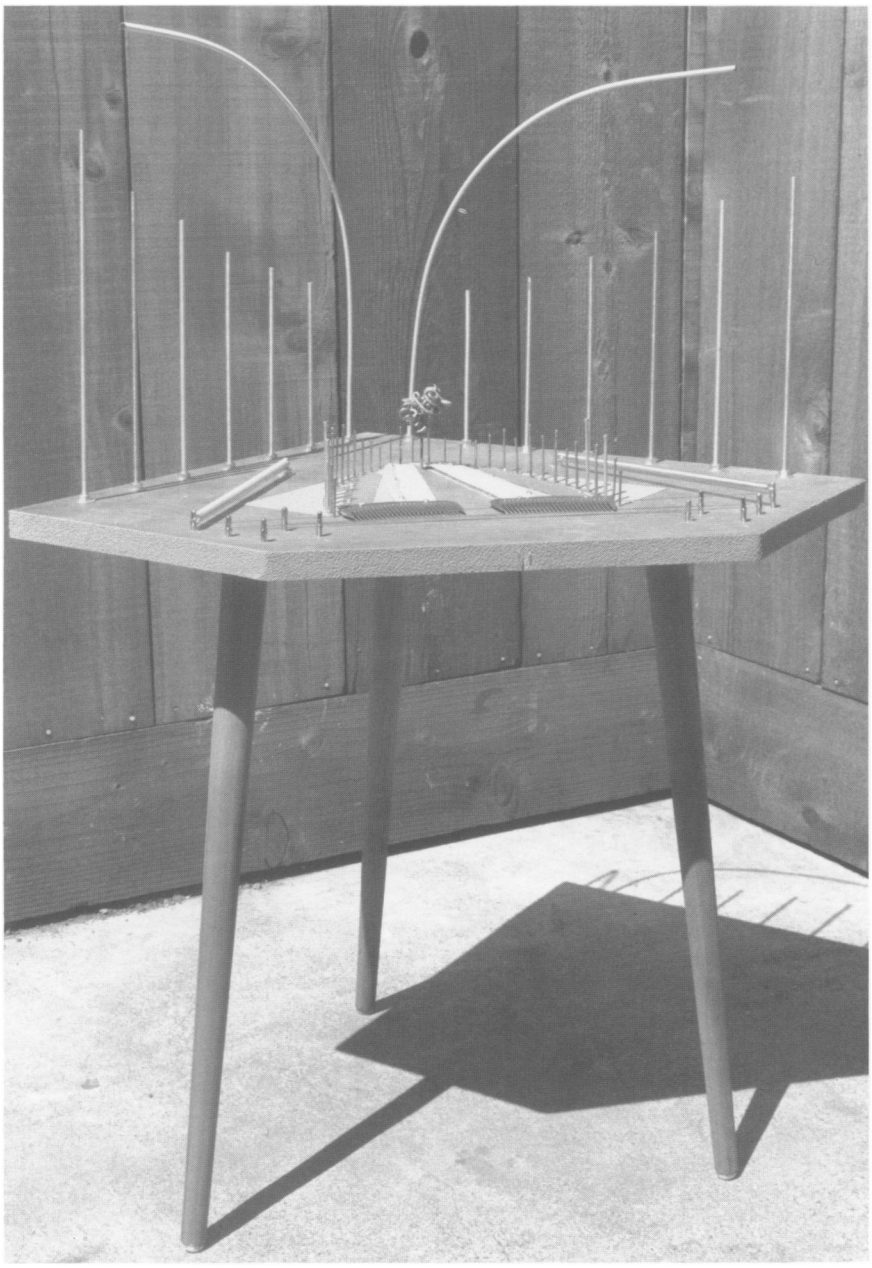

Fig. 4. *Bug,* plywood, steel, plastic, rubber, 25 × 34 × 49 in, 1987 [6]. (Photo: James R. Russell) Small, portable EPB, which retains most of the acoustic characteristics of the larger *Earwargs;* also less physically demanding to play, having a smaller playing area.

V. ELECTRONIC AMPLIFICATION AND MODIFICATION

There is a technical aspect of these instruments that deserves more attention, and that is the pickup, or contact microphone. This is the vital link between the real micro-acoustic sound and what is heard through the speaker. If the pickup is inadequate, the instrument will be inadequate. Of course, poor sound transduction, resulting in a limited frequency response, can be compensated for somewhat through equalization; however, the ideal is a pure, unadulterated transduction of sound [3]. The location of the pickup on the board, particularly in a small instrument such as the *Bug,* has a noticeable effect on the sound. Locating it in the center favors the lower frequencies, while locating it toward an edge brings out the higher frequencies; thus, the basic sound of the instrument can be adjusted.

Another technical matter, which is a dynamic component of my music, is the utilization of analog and digital effects. Since EPBs are amplified, their sound can be modified through devices such as effects boxes or programmable digital delay. In recent solo performances, I have utilized the 16 memory banks of a digital processor [4] to form a compositional framework consisting of a sequence of orchestrations[5]. Each memory bank is programmed to modify the sound in a

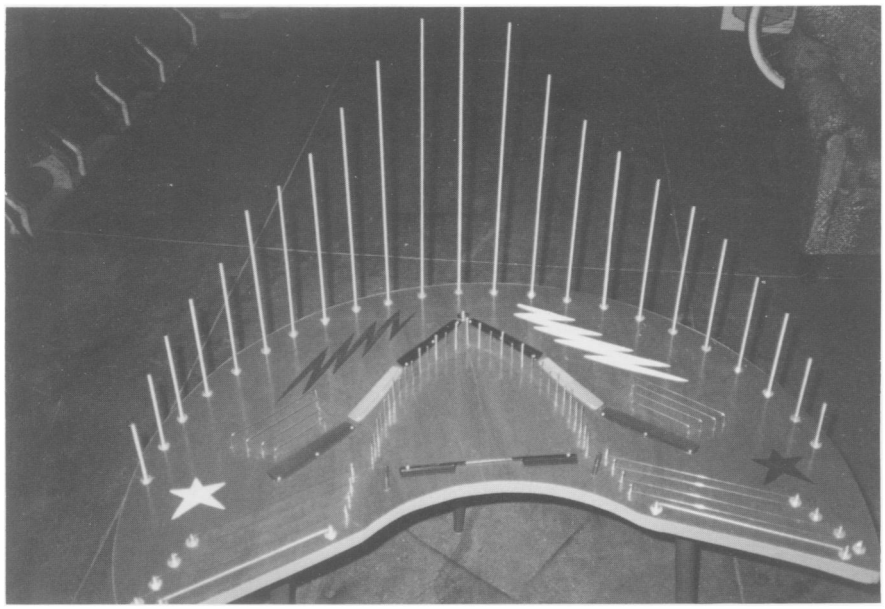

Fig. 5. ***Heavy Metal,*** **plywood, steel, plastic, rubber, approximately 32 × 52 × 55 in, 1987 [6]. EPB designed and built by fourth-graders at Live Oak School, San Francisco. The students collectively designed this instrument by suggesting several different shapes, then voting to determine which shape to use.**

particular way; for example, to enhance the resonance, to repeat rhythmically whatever is played, to glide or bend pitches, or to change the sound radically with rapid glissandi. In these performances, I use a particular implement with each memory bank, thus further specifying the orchestration of the composed framework. Within this framework, I improvise in a style reflecting both the particular kind of instrument I am playing and my own performance idiosyncracies. The result is a real-time composition of electronic/percussion music.

Today, there are many relatively inexpensive electronic special effects devices on the market designed for guitars and keyboards. There are also more expensive devices such as computers and samplers which multiply the possibilities manyfold. EPBs make the most of this new technology, and in turn it makes the most of EPBs. With ongoing technological advancements, the cost of such equipment is decreasing each year, making electronic music more accessible and appealing to everyone.

VI. EPBs AS SOUND SCULPTURE

Finally, EPBs could be considered sound sculptures, because they have aesthetic visual interest. However, I think more specifically of a sound sculpture as being visually oriented and requiring less of the player than does a musical instrument. As such, sound sculptures can bring the experience of making music into the lives of ordinary people by making it attractive and easy for them to create extraordinarily interesting sounds. In the near future, I plan to explore more of the sculptural possibilities suggested by the EPBs and other instruments that I have made in the hopes of enticing 'viewers' to become 'sounders'. In this vein, regarding performance, I am fascinated by the possibilities of dancers creating their own music using on-stage sound sculptures which they would play as an integral part of the dance. This is an area ripe for exploration.

Suffice it to say, there is a great deal more to be discovered and developed in this rich medium of sound/shape. Many artists and musicians today are exploring that potential in their own way, particularly in California. It is certainly a growing trend in art to listen/watch for.

NOTES

1. One version of the *Earwarg* was displayed in San Francisco at the California Crafts Museum in Ghirardelli Square in 1987. It was part of the exhibit "Making Music", which featured experimental/handmade musical instruments.
2. I now make multiples of the *Bug* for sale to the public, as it is a relatively lightweight, portable and inexpensive instrument.
3. Barcus Berry in the U.S. and the Shadow company in Germany make relatively inexpensive contact microphones (U.S. $50–150) which work well on EPBs. An excellent, though expensive, contact microphone is the FRAP (Flat Response Audio Pickup), which I currently use.
4. I use a Yamaha D1500 digital processor.
5. Four solo performances of "Currents" with the University of California, Berkeley, Dance Department (David Wood, choreographer) are improvisations that utilize a series of eight specific orchestrations to accompany a completely choreographed 16-minute dance performance. "Chromazones", a solo concert presented at New Langton Arts (San Francisco) on 5 March 1988, is based on two superimposed series: a series of specific implements heard once and a series of programmed digital effects heard twice.
6. Dimensions listed in the figure captions indicate length, width and height. Height is measured from the ground to the top of the highest vertical threaded rod. All of these instruments are tables, with the playing surface 29″ from the ground.

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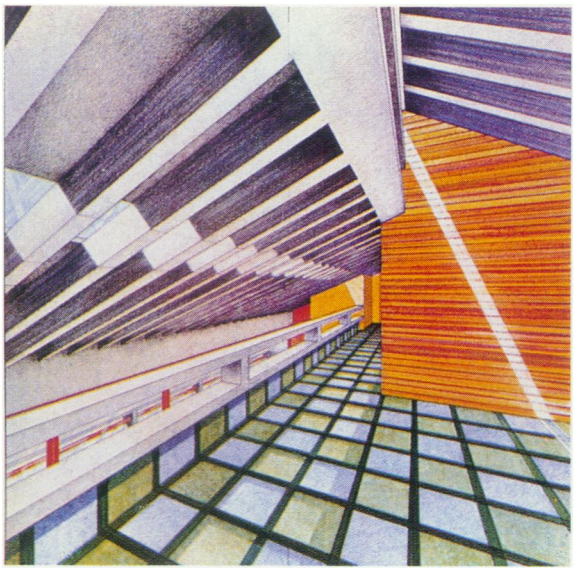
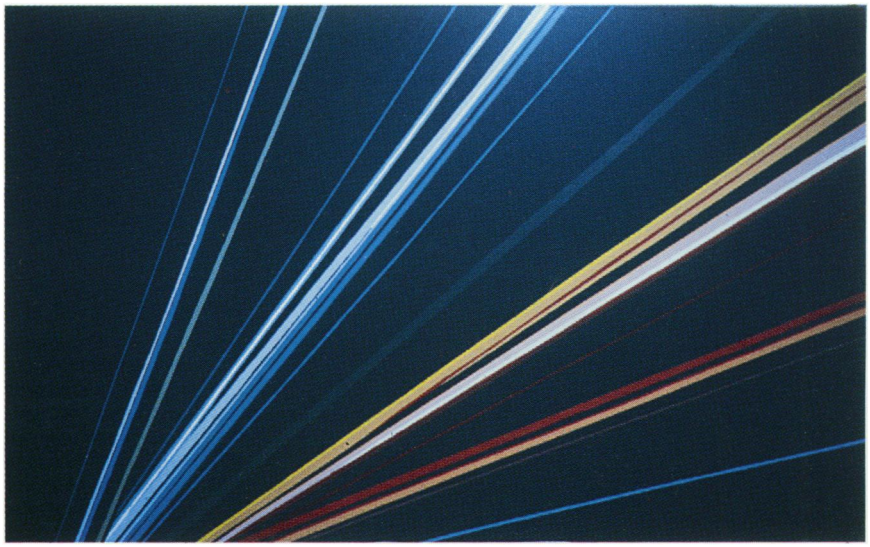
DISCOGRAPHY

Chris Brown, David Poyourow and Tom Nunn, *Earwig,* audio cassette tape, 1980.

Eric Marin, *Earwig,* film featuring Chris Brown and Tom Nunn, 1980.

Tom Nunn, *From the Pages of Experimental Musical Instruments—Improvisation on Crustacean and Varion*, audio cassette tape, 1986; *Making Music—Contemporary Musical Instruments and Sounds Crafted in California,* improvisation on *Earwarg II,* audio cassette tape accompanying exhibition catalog, California Crafts Museum, 1987; Improvisations on *Varion* and *Fleur d'Esprit,* audio cassette tape accompanying *Mechanical Disturbances, Especially in Air,* Vol. 37 of *Musicworks,* 1987; *The Bug,* 10-minute demonstration audio cassette tape (San Francisco, CA: Tom Nunn, 1988).

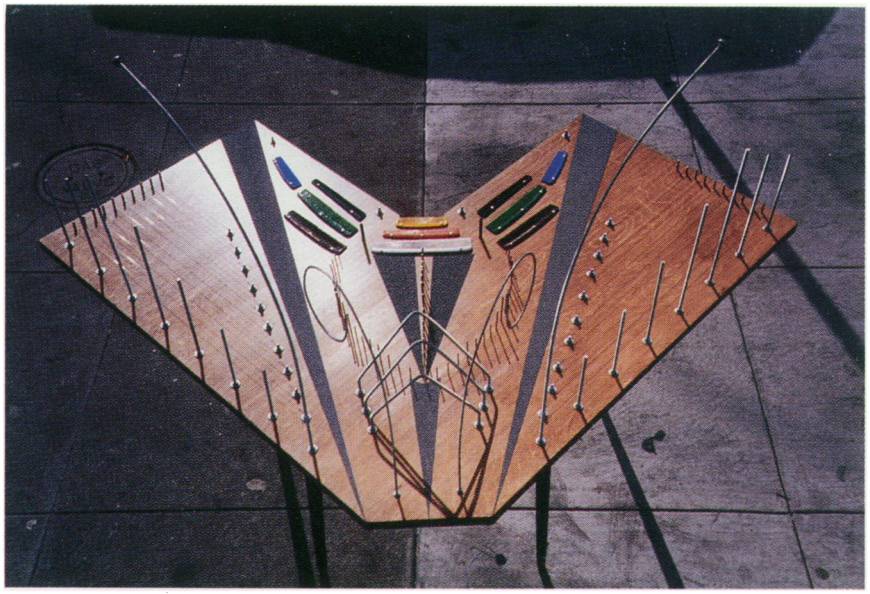




No. 1. Top left. Tomás G. Salgado, interior design by means of Modular Perspective, Prismacolor, 50 × 50 cm. This perspective drawing shows an interior of a house by means of the author's Modular Scale given in a 90° angle aperture of visual field. A smaller angle will reduce the picture scene. Control of the aperture of the visual field for a given observer station is one of the advantages of the Modular Network method.

No. 2. Top right. Evelyn Rosenberg, *Forest Floor*, brass and copper on stainless steel, 3 × 4 ft, 1987. Animals, because of their diversity of shape and range of color and size, fulfill many of the artist's design needs. The author has often used more conventionally unattractive animals, some of which appear in this bas-relief metal sculpture formed by detonography.

No. 3. Center. Bettina Brendel, *Metal-Vapor Lasers,* acrylic on canvas, 50 × 80 in, 1985. (Collection Pepperdine College, Malibu, CA, U.S.A.) The painting depicts laser light that has been produced by a metal-vapor system, passed through a diffraction grating and dispersed at various angles in the colors of the spectrum.



No. 4. Bottom. Tom Nunn, *Earwarg II,* plywood, steel, plastic, rubber, 48 × 67 × 55 in, 1987. (Photo: James R. Russell) Refinement of the original *Earwarg,* with larger size and denser (14-ply) birch plywood body. This electroacoustic percussion board (EPB) and its twin, *Earwarg III,* might be considered the concert grand pianos of EPBs.