I wired an information loop of the sounds the performers made with the circuits for the floor lamps that went on or off from those sounds. That was a set piece with no projections. It was interactive electronics. I guess I would have to say that was pretty early for that. It was another piece I did all on my own without collaboration. After 1967, I began to create more interactive pieces, employing direct means for incorporating the individual character of the viewer into the artwork. This direction, like many of the ideas I developed during my time in San Francisco, continues to inspire me.

NOTE

1. Jo Landor was a painter who served as artistic director for the Ann Halprin Dancers' Workshop.

Don Buchla

INTERVIEWED BY DAVID W. BERNSTEIN AND MAGGI PAYNE

Don Buchla, a legendary figure in the history of electronic music, earned a bachelor's degree in physics from the University of California at Berkeley in 1959. He began graduate studies and worked in the university's Lawrence National Laboratory, but he soon got caught up in the whirlwind created by the social, political, and artistic revolutions taking place in the Bay Area during the early 1960s. His scientific knowledge, musical background, and talent in electronics allowed him to become one of today's leading electronic instrument builders. As the discussion below illustrates, Buchla's interests are not limited to sound; they engage the entire range of human perceptions. He specializes in building unique interfaces between humans and machines. As a participant in the 1960s counterculture, Buchla cultivated an antiestablishment "edge" that naturally led him to the San Francisco Tape Music Center and to Morton Subotnick and Ramon Sender, for whom he developed the Buchla 100 series Modular Electronic Music System.

BERNSTEIN: I have read that you composed some music while training to be a physicist. You were working on accelerators? At Berkeley? You had a tape recorder and created some musique concrète pieces. Is that when you first started getting into electronic music?

BUCHLA: Yes, my first work was with tape.

BERNSTEIN: Were you familiar with the repertory, pieces by Stockhausen and other composers?

BUCHLA: Some of them, yes, certainly with Stockhausen.

BERNSTEIN: And then you went to a Tape Music Center concert in the 1960s?

BUCHLA: Yes.

BERNSTEIN: Was that at one of the Sonics concerts? Do you remember? Was it at the San Francisco Conservatory?

BUCHLA: No, it was an early concert at 321 Divisadero. I just had a one-track Wollensack and they had a three-track recorder. So I talked Mort into letting me use their three-track.

BERNSTEIN: Do you still have your pieces?

BUCHLA: Many of them, yes.

BERNSTEIN: And what kind of sounds were you using?

BUCHLA: Found sounds, mostly.

BERNSTEIN: And you worked with tape splicing? You didn't work in real time like Pauline Oliveros?

BUCHLA: Well, I didn't like splicing. But . . .

BERNSTEIN: . . . but you did it?

BUCHLA: . . . to a certain extent, yes. That's all we had.

BERNSTEIN: You didn't really have mixers or anything like that either?

BUCHLA: No.

BERNSTEIN: The spirit behind the Tape Music Center was different from other electronic music studios such as those at Columbia-Princeton, Bell Labs, and all those other places. And I think that you were coming from a direction politically and socially similar to the composers working at the Tape Music Center. Berkeley was a pretty interesting place to be in the early 1960s. It seems to me that you and the others became part of the counterculture. And that's the way you approached electronic music.

BUCHLA: I'd say so, yes.

BERNSTEIN: For one thing, many of you participated in the Trips Festival. Can you tell us about that? I understand that there was a plan to feed Big Brother and the Holding Company through the Buchla that never was realized. But the Buchla was used during that festival. Is this so?

BUCHLA: Yes. I switched bands on and off, toy projectors, and so on and did all the interlude music. I was also in charge of the lighting.

BERNSTEIN: Did you run that through the Buchla as well?

BUCHLA: No, the lighting was done with specialized equipment.

BERNSTEIN: When you say lighting—there were light shows, projections, and all of that?

BUCHLA: Well, we brought in Tony Martin for the projections. We had other lighting, too by various artists of one sort or another.

BERNSTEIN: Did you know about the kinds of electronic sounds that were being played at the Acid Tests?

BUCHLA: I was playing them.

BERNSTEIN: What were you playing?

BUCHLA: My system.

BERNSTEIN: The Buchla?

BUCHLA: Yes.

BERNSTEIN: So the Buchla was there, with Ken Kesey and all the others?

BUCHLA: Oh, yes.

PAYNE: I'm so curious as to what came together to spark the idea of a modular voltage-controlled synthesizer? I personally learned in a classical studio with all the knobs; you operated every oscillator and every filter by hand. The voltage-controlled synthesizer was such a major innovation. It really turned the music world on its end. So how did it come to mind that this was what to do?

BUCHLA: I guess I was basically looking for a replacement for tape.

PAYNE: But still, the possibility of using voltage control, was it that the technology was now in place that enabled you to design this system?

BUCHLA: It sort of was.

PAYNE: Were there other applications where voltage control was happening? How did you hook together music, engineering, and physics and put this all together to arrive at this concept?

BUCHLA: I don't know. I just did it.

PAYNE: I am curious about how the development of the voltage-controlled synthesizer came about. What was the design process? I assume Mort may have been primary in working with you.

BUCHLA: Yes.

PAYNE: The idea of having a live performance instrument was unique. That was one of the criteria for the Buchla 100 series. Was it mostly Mort driving it and asking for possibilities and your going back and forth, or . . . ?

BUCHLA: There was a lot of back and forth. We had a lot of discussions.

The Genesis of the Buchla 100 Series Modular Electronic Music System

MORTON SUBOTNICK, RAMON SENDER, AND MAGGI PAYNE

PAYNE: What sparked the idea of building a voltage-controlled synthesizer, especially since the concept of voltage-controlled modules was so innovative?

SUBOTNICK: Ramon and I both had realized the financial implications as well as the portability of the new emerging transistor technologies.

PAYNE: What was the design process for the Buchla in the early stages? Did all the Tape Music Center members meet and collaboratively work out the configuration or was Mort the composer most interested in the development of the synthesizer? What was the nature of the interaction? Lots of back and forth?

SUBOTNICK: A number of meetings with Don, Ramon, and me occurred, during which we spoke of our musical needs. We wanted to be able to control amplitude and frequency, etc. I used the Boulez, *Le marteau sans maître* [1953–55], first page as an example. I would imagine patching the Boulez and see something was missing and we would add another knob.

SENDER: As a pianist, I held out for a real keyboard, but Mort kept pushing for the etched approach and Don also wanted that. Frankly, I think Mort had more to do with the ultimate design.

PAYNE: How long did it take from the first design meetings to come to fruition? I had read that this process had its seed around 1963 and that by 1964 it was well under way?

SUBOTNICK: There were a lot of meetings and talk about what we needed. I started reading the navy book on electronics, and then I realized I didn't know any electricity so I got the navy book about electricity. I got addicted to aspirin in the process because I had such headaches. We read the Helmholtz book first.[1] Ramon and I were talking hours daily about this.

PAYNE: Buchla's interfaces have always been nontraditional (non–keyboard oriented). How did you arrive at the touch-controlled voltage source, with individual A and B control outputs per touch-sensitive area (pad) and the remarkable pressure-sensitive C control output that could be used to control amplitude, frequency, and so forth?

SUBOTNICK: I wanted a neutral keyboard and Ramon wanted a black and white. Don wanted a neutral, so we went that way. The ten-note keyboard [Don made earlier] everybody thought was because we have ten fingers, but it was because we had ten Viking loop decks. The finger pressure was in order to be able to do musique concrète and to control the amplitude on the Viking loop machines.

PAYNE: Could you tell me when the Buchla first arrived at the Tape Music Center?

SUBOTNICK: Well. Let's see. Terry Riley's *In C* was premiered in November 1964, is that right?

1. Hermann von Helmholtz, *On the Sensations of Tone as a Physiological Basis for the Theory of Music,* trans. Alexander J. Ellis (London: Longmans, Green, 1875; reprint, New York: Dover, 1954).

PAYNE: Yes.

SUBOTNICK: I'm 99 percent sure we had the Buchla around that time and demonstrated it. I didn't write it down, so I can't tell you for sure. If it was after that, it had to be right after that. It would have to be January 1965. It couldn't have been much later than that. I was just with Moog, and he remembers it in 1964. He said that it predates anything he did, and that the Moog came out in 1965. He said it was a year before him.

PAYNE: So he would specify how many oscillators he thought would be needed . . . and all the gates and sequencers? Where did all these ideas come from because I don't think there were sequencers at that time?

BUCHLA: No, but when you invent voltage control, you invent ways of generating voltages for control.

PAYNE: Right. So it was just a natural hooking together of ideas after that.

BUCHLA: Yes.

PAYNE: You were searching for an innovative interface between humans and instruments. Your interfaces are unique. It's a really different approach, rather than sticking with keyboards all the time. Even with the very first system, you were already thinking very differently. So I was just wondering, was that something that came up from your side of the equation in trying to develop this system? Was it something that Mort was also interested in? Or, how did that idea . . .

BUCHLA: I was never tempted to build keyboards into synthesizers. To me, that was unnatural.

PAYNE: It puts a mind-set on that system when it's really an instrument of its own.

BUCHLA: Yes. I didn't use keyboards for many years. It wasn't until I could do polyphony that I regarded the keyboard as a potential input.

PAYNE: Interesting. Your device, the touch-control voltage source, was also polyphonic in a way. It had the A, B, and this wonderful pressure-sensitive C control voltage out.

BUCHLA: Yes, that's true. It was tunable, malleable, and not in a twelve-tone array.

PAYNE: Right. There was no system implied other than that you can derive two control voltages plus a third pressure sensitive on each of the twelve, what would you call them, keypads? No, that's not right, touch-sensitive areas perhaps? [Laughs]

BUCHLA: OK. [Laughs]

THE MODULAR ELECTRONIC MUSIC SYSTEM
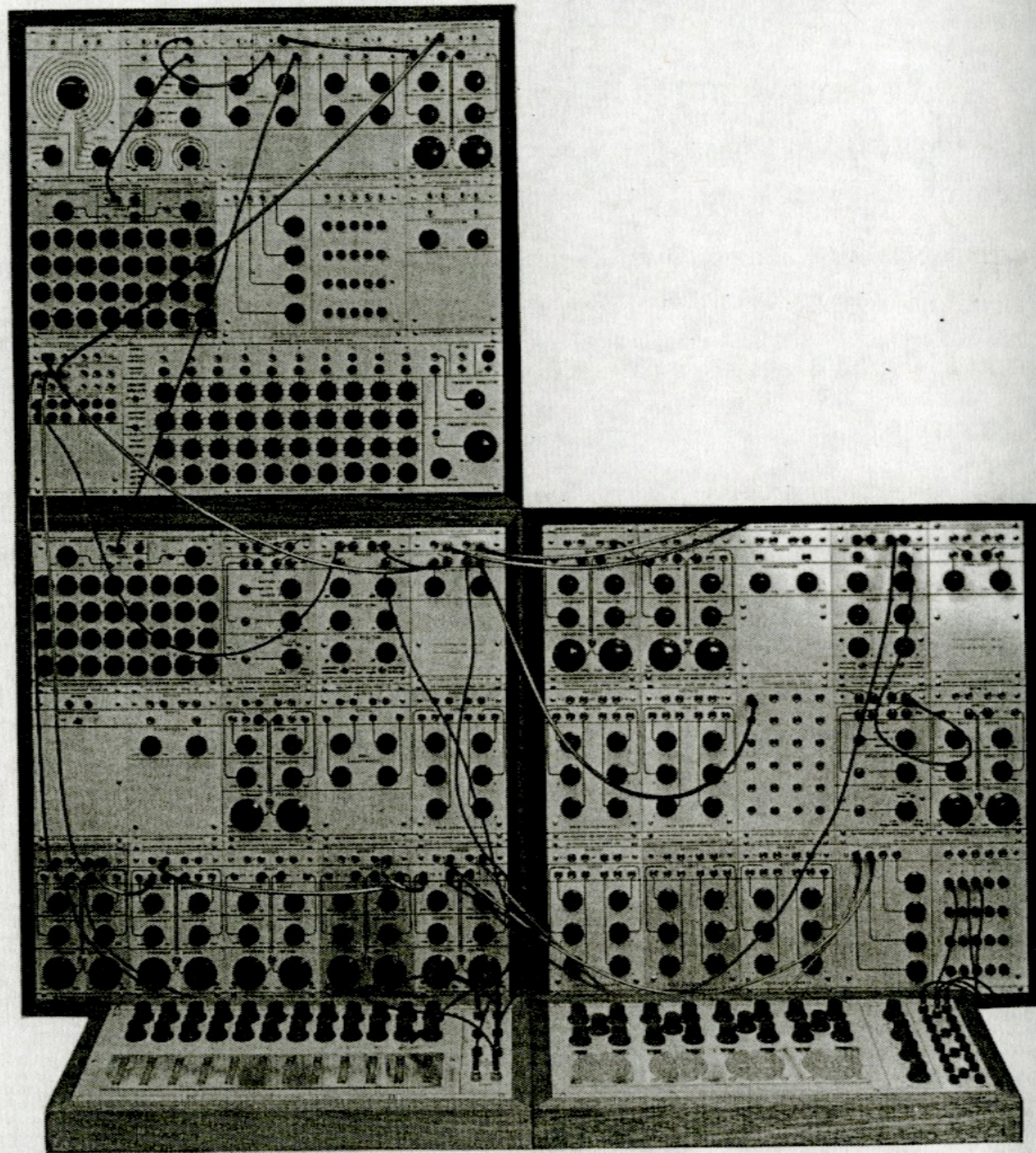
27 **THE BUCHLA MODULAR ELECTRONIC MUSIC SYSTEM, OR "BUCHLA BOX" (PICTURE FROM MANUAL).**

PAYNE: I think that's a major innovation. And you certainly continued that with all the other interfaces. You mentioned that you went to a concert at the San Francisco Tape Music Center. Did you already know Pauline or Ramon or Mort? What got you interested in going to that concert? Or were you just interested in new music at the time?

BUCHLA: Oh, I went to a lot of concerts.

PAYNE: But how did you get involved in the Tape Music Center so deeply?

BUCHLA: I asked Mort what type of resources they had. And he said to come on up and look at the studio. So I saw the three-track there and that did it.

PAYNE: Do you remember who their technical person was at the time? Was Bill Maginnis already there?

BUCHLA: It was pretty much . . .

BERNSTEIN: Michael Callahan?

BUCHLA: No, I didn't know Callahan. But Maginnis was already there, if not then, shortly thereafter.

PAYNE: It appears that he was probably the first person to actually produce a piece on the Buchla.

BERNSTEIN: We have recordings of his piece called *Flight*. The first Buchla was completed in late 1964. Is that right?

BUCHLA: I don't know the dates. That sounds right.

BERNSTEIN: During the time before that, had you invented anything else? Were you working on any other kinds of electronic music instruments?

BUCHLA: No. I started on the modular system in 1963.

BERNSTEIN: So that's before, isn't that before you started working with Mort?

BUCHLA: No, that's when I started.

BERNSTEIN: Oh, in 1963, that early?

PAYNE: That's the date I have.

BERNSTEIN: So it probably took it about a year to bring it all together.

BUCHLA: Well, it didn't occur all at once. It was a modular system. One module developed into the next.

BERNSTEIN: Did you start off with the idea that you wanted to make it portable? I know that you weren't interested in its commercialization, but you wanted to be able to disseminate it, to be able to allow other people use it.

BUCHLA: Yes.

BERNSTEIN: I've read the original brochure. It's visionary because it says these instruments are going to be available to all sorts of musicians, from rock to classical.

BUCHLA: One instrument that I brought in hadn't previously been used musically, it was called an ORB and was for optical ranging for the blind. Cage was particularly fascinated by it.

PAYNE: What is it? Can you describe it?

BUCHLA: Yes, I remember it quite well. It employed one of the first LEDs made by RCA. They gave me a bunch of them, they were $450 each, so . . .

PAYNE: . . . for an LED?

BUCHLA: Yes, [laughs] and they probably consumed a lot of power.

PAYNE: They were very inefficient. Right?

BUCHLA: Yes, but I managed to make a beam out of it, and the device could be carried by a blind person, and it would translate distance into pitch.[1]

PAYNE: Oh, that's so interesting.

BUCHLA: I taught at the blind school for some time, so . . .

PAYNE: The one at UC Berkeley?

BUCHLA: Yes, it didn't used to be so associated with the university. It was private. I found that congenitally blind people had enormous ranges for learning, enormous centers for basically doing pitch discrimination and acoustic analysis of their environment. So I built this gadget, and John [Cage] liked it simply because he put his hand in it, moved it around, and it made all kinds of funny squeals.

PAYNE: I forget the name of the devices that I believe Alvin Lucier used, the clickers, right? This was a kind of echo-location device where you'd hear the echoes bounce off the walls and other surfaces. He did a really wonderful piece called *Vespers* [1968]. [Your device] is even more sophisticated, and it has a continuous tone, I presume . . .

BUCHLA: Yes.

PAYNE: . . . that would change in frequency, that would give you feedback at all times and not be so complicated by bouncing the signal off so many walls.

BUCHLA: Yes.

PAYNE: Because you could aim it.

BUCHLA: Well, they're different functions of that sort of thing. Eventually, we combined it with ultrasound, in which we could discern the nature of surfaces as opposed to the discrete terrain-avoidance problems.

PAYNE: Sort of mapping the surface? The texture?

BUCHLA: No, we didn't try to map it.

PAYNE: But it was refined enough that you . . .

BUCHLA: Well, you don't have to refine it very much. People didn't understand what the blind brain was all about. They still don't. But they can learn far better discrimination than we can.

BERNSTEIN: Did you have contact with David Tudor?

BUCHLA: He was my first customer for the modules.

BERNSTEIN: What year was that? Do you remember? Just around when it was first invented?

BUCHLA: Must have been in 1964.

BERNSTEIN: Do you know what he used it for? Which pieces?

BUCHLA: No, I don't. I have no idea. I know what he got.

PAYNE: Which is?

BUCHLA: One was a series of circular pads [which Tudor apparently used to change the spatial location of sounds]. I think there's one—maybe Mills has one—I guess not. People are trying to trace these things down. They're in pictures.

PAYNE: It's too bad that we don't have one.

BUCHLA: There's one that exists that we know of. There were five channels, four on the periphery and then one in the center of this controller. And there were four such pads, so one could take a sound, and take your hands like this, and manipulate them. And then that hooked up to a pretty amazing voltage-controlled mixer, a matrix mixer.

PAYNE: I think we have a voltage-controlled matrix mixer.

BUCHLA: You do?

PAYNE: Yes, but I'm not sure it's working.

BUCHLA: So it has five signal outputs and five control voltage inputs for each pad—so it has twenty inputs. And . . .

PAYNE: . . . and they're controllable. Each one of them, right?

BUCHLA: Mmm-hmm.

PAYNE: For amplitude?

BUCHLA: Yes. Well, I just imagined this one application, but later on we added other modules, and a lot of other things went with it that were automated. But my

own studio had the four channels plus one overhead, so, it was a four point one. [Laughs]

BERNSTEIN: So leading up to the "[Buchla] Box," you were working with all these modules, and there were a lot of different tributaries in the development.

BUCHLA: Yes. My modules have been cataloged, most of them. They still find one once in a while that wasn't in the catalog, but there is a rather large number. I was amazed at how many modules I've done over the years.

BERNSTEIN: After the Tape Music Center, where did you work? You had a studio at the Alameda Naval Base? Is that where it was?

BUCHLA: No, it wasn't in Alameda. It was in Oakland at the big shipyard, the Kaiser— or the ex-Kaiser shipyard.

BERNSTEIN: And you were making music there and building more modules?

BUCHLA: Lots of music and some modules. That's where I developed the [Buchla] 200.

BERNSTEIN: And I think Ramon Sender came out there.

BUCHLA: Yes.

PAYNE: He did several recordings?

BUCHLA: Yes, he was a frequent visitor, along with all kinds of people.

PAYNE: Do you remember anyone specifically?

BUCHLA: I remember I had a quad mix down situation before it was common in the studios, and one of the funniest scenes was Wally Heider driving up in his portable recording studio and passing cables through my windows to get to my basement studio.

PAYNE: Yes, Heider was a major recording engineer. He was also a very generous person.

BUCHLA: And I did a lot of recording with the Hell's Angels.

BERNSTEIN: What did they want?

BUCHLA: They were a little bit associated with Kesey's bus and were involved in drug distribution. [Laughs] It all seemed fine to me. I got some interesting tapes from that source.

PAYNE: They were musicians as well?

BUCHLA: No, you don't have to be a musician to make a tape.

PAYNE: Were they using your synthesizers?

BUCHLA: No. Well, Ken did, but that was just in the bus. But the Hell's Angels were just a funny scene.

BERNSTEIN: So Kesey was interested in electronic music and got into making tapes.

BUCHLA: I'm not so sure that he was interested in electronic music.

BERNSTEIN: I mean sounds for the Acid Tests.

BUCHLA: I don't know the background there. I just showed up at the places with my instruments, took some acid, played some music.

BERNSTEIN: And they had lights going on, too.

BUCHLA: Sometimes, yes. There was quite a variety there.

BERNSTEIN: I've read that you were working with randomness in some of the machines that you built?

BUCHLA: Yes.

BERNSTEIN: When did that start?

BUCHLA: Oh, from the beginning.

BERNSTEIN: Did Cage influence that?

BUCHLA: Yes, for sure.

BERNSTEIN: That's very different from the Moog, right?

BUCHLA: Well, the whole approach is pretty different, even though they had common elements.

BERNSTEIN: Well, the Moog seemed to go totally toward the commercial side.

BUCHLA: Well, that's what he [Robert Moog] wanted to do . . .

BERNSTEIN: . . . with the rock groups, and the whole thing.

BUCHLA: Yes.

BERNSTEIN: Do you remember the Chamberlin music master?

BUCHLA: Very well. I got my fingers dirty on that one quite a bit.

PAYNE: We had the Chamberlin Rhythmate as well. I don't know if you knew that box; it was a . . .

BUCHLA: It had a lot of heads in it?

PAYNE: Yes, right.

BUCHLA: Well, there was that one, too. There were two in New York at the same place. And I did the Playboy Club and places like that in Los Angeles.

PAYNE: Yes, I remember that David Rosenboom had been involved with you in the Electric Circus.

BUCHLA: I brought him in.

BERNSTEIN: I once went there. I saw the Chambers Brothers perform. It was great. It was in the East Village. And it had a light show. But that was probably in the 1970s.

BUCHLA: Well, that was the later one. The earlier one was done in a big tent, a monstrous tent made of stretch fabric. I liked it a lot. And the later one had a finished projection surface that was optically correct. Unfortunately, it wasn't acoustically correct too, so that you could be down on the floor and you could hear, very distinctly, conversations coming from the projection gallery. And they had to put up a sheet of Lucite across the whole gallery, which was fifty feet long.

PAYNE: That's expensive.

BUCHLA: It was an inch thick—it was very expensive. But they had to do that for the sound. But it was a fabulous projection surface. And I built the very high-powered carousel projectors—modified them for registrations, so we could have eight projectors covering the whole surface and could have them all registered so we'd take 8 × 10 pictures and cut them up and make slides of them. We had 1,200-watt bulbs in each projector, and they had to have that cooling, of course. By the time you put the fans in . . .

BERNSTEIN: . . . lots of noise!

BUCHLA: Well, we had organ pipes—ten-inch organ pipes—coming down from the huge blowers above the ceiling, so the noise wasn't too bad. And then we used two-inch vacuum cleaner hoses into each projector. And then there were thirty-two projectors, four stacked from each location on the eight subdivisions, so we could overlap four pictures. So, as you can gather, there's a lot of power there. But it took a full-time five-man light show just to feed the whole thing.

BERNSTEIN: So you've been interested in both light and sound from the beginning.

BUCHLA: All the perceptions.

BERNSTEIN: And that's actually gone into your instrument building over the years, a multisensory approach. That's another thing that you have in common with the whole Tape Music Center milieu.

NOTE

1. Ramon Sender recalls that "during the buildup to the Trips Festival, [Don] put the ORB in the window of [the] City Lights [bookstore] with rotating (dental?) mirrors in front of it. The distance of a person in front of the window dictated the melody it played, and people would quickly [realize] that they were making the music and start to move back and forth on the sidewalk." Ramon Sender, e-mail to David W. Bernstein, December 28, 2006.

BUCHLA: I do. I forgot what you called it, the Rhythmate?

PAYNE: Yes, the Rhythmate, I think.

BUCHLA: There was an Echoplex built along the same lines.

PAYNE: I remember there were voices and some instruments, and I think I remember some sound effects on that Chamberlin? Do you remember? Wasn't there a rhythm section as well?

BUCHLA: Yes, and there were chickens cackling, too.

PAYNE: Yes, and the dog barking, which the Beatles used, I believe.

BERNSTEIN: Those were pre-programmed tape loops that were in the machine, right?

BUCHLA: Yes.

PAYNE: Yes, you could send the Chamberlin sounds, and I think they could record them.

BUCHLA: Yes, it wasn't that easy to make the recordings.

PAYNE: Yes, there were three tracks, and I think you had like nine seconds or so before it would spring back or something.

BUCHLA: Then you had six locations.

PAYNE: There were three heads.

BUCHLA: Yes, there were three heads this way and then six locations that you could start at and move the tape up and start somewhere else. So it was quite powerful, the number of sounds you could put in it.

PAYNE: Oh, I just remember that you'd had to move your hands after nine seconds or else. [Laughs]

BUCHLA: Yes. It would go into the next track.

BERNSTEIN: I thought you couldn't program those.

BUCHLA: Yes, we could.

BERNSTEIN: Oh, you did.

BUCHLA: As I said, it was with difficulty. The tapes were not standard format, and there was no recording yet on the Chamberlin per se.

PAYNE: Yes, I remember using it at Mills. And finally it just got so crotchety . . .

BUCHLA: Yes, it squeaked a lot. It was pretty crotchety when I worked on it, too. [Laughs]

PAYNE: [Laughs] Yes, it was barely usable. But it was so great when it was. And "Blue" Gene Tyranny used it a considerable amount for all sorts of films.

BERNSTEIN: The Chamberlin has a wonderful sound in *Desert Ambulance;* it's beautiful.

BUCHLA: Yes, it is.

BERNSTEIN: Did you work with Tony on the Buchla? Did you use the controls on the light sources?

BUCHLA: Not very much, no.

BERNSTEIN: Was the Buchla used at any time for controlling light?

BUCHLA: There were some modules that were specifically designed for lighting control.

BERNSTEIN: And were they used at the Tape Music Center? Or did that happen later?

BUCHLA: No, I had—I lived a life outside the Tape Music Center, too.

PAYNE: Were they interfaceable?

BUCHLA: Oh, yes.

PAYNE: So you could have the audio . . .

BUCHLA: It was the same control voltages that controlled lighting.

BERNSTEIN: Did you use it at any of the ballrooms? Or the Fillmore?

BUCHLA: I used it extensively; I did all the Electric Circuses.

BERNSTEIN: In New York?

BUCHLA: In New York and Toronto. Well, two in New York actually. And [the lighting] was quite elaborate. I built each console for controlling all the projectors. I put in forty projectors into the . . .

PAYNE: Are these film and slide projectors or . . . ?

BUCHLA: . . . forty slide projectors and quite a few film projectors as well, and projection strobes, once that caught on.

BERNSTEIN: That is in the late 1960s, right? After Mort left the Tape Music Center.

BUCHLA: There were two Electric Circuses, and I'm a little confused with the dates there.

BERNSTEIN: One of them was in Toronto, you were saying?