the ondes martenot an early milestone in the development of electronic keyboards

By Tom Rhea

JON SIEVERT

A six-octave Ondes Martenot once owned by the late Paul Beaver and now the property of the Berkeley [California] Symphony. The pitch band and ring are below the keyboard (center). Note the left hand control section, with articulation, envelope, and timbre controls.

ALTHOUGH electronic music has been identified almost exclusively with the synthesizer for more than a decade, most readers of *Keyboard* will be aware that the history of electronic music is long and varied, extending back as least as far as the beginning of the century. Of course, history is a great leveller. The exciting new invention of one year quite often winds up as no more than a footnote, once the dust of time has settled. The history of electronic instruments is filled with devices that have come and gone, remaining little more than musical curiosities. Occasionally an instrument appears that makes a significant impact, either commercially or artistically. The Theremin, because of its use in such widely varied music as the film score to *Spellbound* and The Beach Boys' "Good Vibrations," is obviously a successful pre-synthesizer instrument. Is it the only one?

No, there is at least one other: The Ondes Musicales (which means "musical waves"). This instrument, most commonly known as the Ondes Martenot after its inventor, is a success—both commercially and artistically. Its repertoire includes some 600 works, including both orchestral and chamber compositions written by such composers as Olivier Messiaen, Darius Milhaud, Arthur Honegger, Jacques Ibert, Andre Jolivet, Maurice Jarre, and Edgard Varese. The instrument has been heard around the world in virtually every imaginable musical context.

Maurice Martenot (born in 1898) first conceived the idea for his instrument in 1918, while working as a "wireless" (radio) instructor. He came by his musical intuition legitimately, having devoted himself to music from his earliest years. He was barely nine years old when he undertook long concert tours as a pianist with his sister Ginette. He also studied composition at the Paris Conservatory. Despite his multiple activities as pianist, cellist, orchestral conductor, and teacher, he devoted long hours at night to giving form to his instrument. During its inaugural year, 1928, the instrument was hailed as the new voice of the orchestra, and its inventor was lionized by society. In April, he unveiled his Ondes Musicales before an elite group of scientists and artists; and in May, at the Paris Opera and the Salle Pleyel, he and his instrument scored a triumph before the general public. Extensive European tours followed.

Martenot and his creation made their American debut in December, 1930, with Leopold Stowkowski and the Philadelphia Orchestra. A program announcement of the day gives us an idea of the instrument's capabilities:

> The instrument to which he gives the name Ondes Musicales is not merely a curiosity. The aim of the inventor of the Martenot Instrument of Musical Waves is not primarily to imitate the sounds of other instruments, but to provide new resources of expression for composers — sonorities hitherto unknown — and novel color effects to enrich the orchestral palette. The instrument is not automatic, employing no such means as records or perforated rolls. Lamps [vacuum tubes], analogous to those used in radio, initiate electric vibrations with the aid of appropriate circuits. Modified by the playing of the executant, those vibrations become acoustic through the medium of a "diffuser" [speaker].
>
> Various methods of performance are used, in accordance with the character of the music to be interpreted. With the aid of a ring affixed to the index finger, it is possible by simple displacement of the hand through space to modify sound.
>
> The inventor also employs a keyboard instrument, which may be played with extreme ease. . . . The performer is enabled to make his instrument sing like a superhuman voice with a range exceeding that of the deepest bass and the highest soprano, and covering eight octaves. The varieties of effect and of timbre attainable are unlimited trills of semi-tones, quarter-tones, eighth-tones, sustained notes, staccati, glissandi, sounds resembling those of the flute or oboe in their highest register or those of the English horn, bassoon, double bassoon, horn, trumpet, saxophone, strings.

The Ondes Martenot, a monophonic instrument, uses the same *heterodyning* tone generation method as the Theremin: Two ultra-high oscillators produce an audible difference tone. On the first instruments, pitch was controlled continuously using an endless wire or band arranged on pulleys to rotate a variable capacitor within the instrument. A small plastic ring for the performer's forefinger was attached to this band. To help in the location of pitches, a painted "dummy" keyboard was placed under the pitch band. The instrument was keyed by the left hand, which controlled a small button that provided articulation. Several stops governed the loudness envelope. The left hand also controlled other stops which gave a choice of eight tone qualities. Timbre was controlled by switching on filter circuits. Later improvements included the addition of more timbre stops, an acoustic resonator to improve the tone quality, a true keyboard, making non-gliding playing possible, and a more sophisticated variable-pitch scheme in place of the original pulley-controlled version. The newer pitch band can be used in conjunction with the keyboard to create portamento.

The second wave of success for the Martenot came during the '40s and '50s, a time during which Martenot's sister Ginette made a reputation as an Ondes Martenot virtuoso. At the first International Congress of Electronic Music and Musique Concrete in Basel, Switzerland, a reviewer noted that "with remarkable technique, she coaxed from the instrument a synthetic cascade of notes, often shrill, occasionally pleasant, accompanied by a wildly modernistic orchestral background. She got a big hand from the audience."

Commercial success for a musical instrument is often a matter of definition. Obviously, for an instrument to have generated sufficient enthusiasm from composers to generate such a repertoire, there must have been a number of instruments built. But it is perhaps not the number of instruments built — a manufacturer's success—but their peculiar (and continued) use that qualifies the Ondes Martenot as a commercial success.

My first personal contact with this instrument was during a visit to the home of the late Eric Siday in New York City around 1970. Eric was a pioneer in the use of electronic musical instruments to create radio and TV commercials and jingles, having done so from the '50s. Born in England, he had come into contact with the Ondes Martenot in Europe and realized both its musical and commercial potential. His most memorable use of this instrument was in the old sound logo for ABC Television. For this work he was reportedly paid the tidy sum of $25,000! Another piece of Siday's work that comes to mind is the "pocka-pocka-pop-pop" Maxwell House coffee ad, realized on a special rhythm unit built by Bob Moog.

Another pioneer was the late Paul Beaver, who will be remembered for his ground-breaking studio work, and for his collaborations with Bernie Krause. Paul's Ondes Martenot (pictured here) has an interesting recent history. On his passing, his will stipulated that whoever should acquire his instrument must make it available to a symphony orchestra to be used in performances. It was purchased by guitarist Ronnie Montrose, another experimenter/innovator. Montrose found the instrument fascinating for the same musical reasons that impelled so many others. He used it for some time and eventually donated it to the Berkeley Symphony as stipulated by Beaver.

The one thing common among the people who have had commercial success using this instrument is their profound appreciation of its artistic potential, regardless of which generation they belong to. Commerce with artistry is always a possibility — both for instrument designers and for the musicians who use their creations. ■

TOM RHEA
ELECTRONIC PERSPECTIVES
Raymond Scott's Clavivox & Electronium

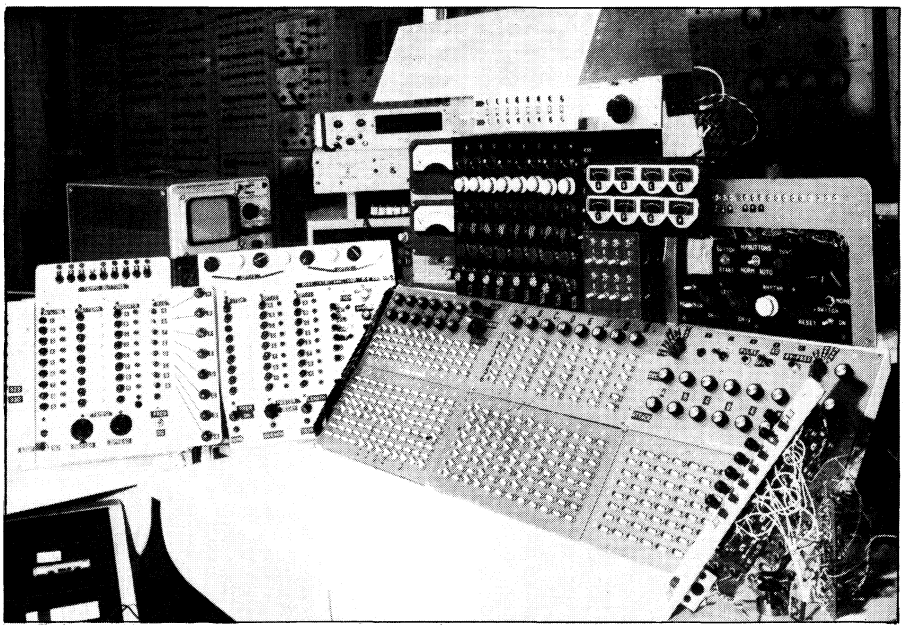
MANY PEOPLE WILL recall Raymond Scott as a musical lion of the Big Band era. He Originated the Raymond Scott Quintette (1936), which appeared in five films. He was musical director for CBS, conductor of the NBC *Hit Parade* radio and TV shows (1949-1958), and composer of hit songs. During the '40s he toured the U.S. and Canada with his own band.

Less well known are Scott's achievements in the design of electronic musical instruments. During the late '40s he founded Manhattan Research, one of the most elaborate facilities for the creation of electronic music and *musique concrète* (tape recorder music). Many of the devices that he built for that studio anticipated modules found on today's synthesizers. For example, Scott had an early trigger delay device, variable envelope shapers, variable waveshape generators, preset programming devices, and sequencers for ordering sound events. During the '50s and '60s, Scott was among the first to produce electronic music for commercials.

More recently, Scott developed a performance keyboard called the *Clavivox* and a huge composer's machine called the *Electronium.* Details of these instruments reveal Scott's understanding of the distinctions between performance and composition. The Clavivox had a keyboard, sophisticated performance control devices, and a unique portamento (glide) capability. The Electronium, on the other hand, was "programmed" using knobs and switches, and actuated by a *single* microswitch!

The Clavivox could be thought of as a Theremin under keyboard control, a synthesizer that allows real-time control of glide by the performer. It was this unique type of glide, or portamento, that gave the Clavivox its unique human quality — a clear departure from most electronic keyboards, with their discrete pitch or uniform-rate glide. But technical difficulties in the design led to its downfall. Portamento was indeed controlled by the performer — *mechanically*, by a system elegant in concept but difficult in construction. At the back end of each key was a peg that came into contact with a vane given a helical twist (like a spiral staircase laid on its side; a "spiral" staircase, since it occupies three dimensions, not two, is really *helical* — not spiral). Because of that helical twist, each key made contact at a different position along the vane, acting to rotate the vane to a unique position. If two keys were depressed, they would act like a seesaw — as one is depressed the other must rise. Obviously, the Clavivox was monophonic. At the end of the vane was a piece of film "smoked" in a continuous gradation. The film interrupted a light source falling on a photoelectric cell. A key was depressed to its bottom; a vane rotated to a unique angle; a film of variable opacity moved in front of a photoelectric cell. This controlled pitch.

In performance, one could control glide rate by first depressing a key, then bringing another key's peg into contact with the internal vane, and then shifting force from the first key to the second. It was a variable-rate seesaw. It worked fine — for a while. Then problems in mechanical tolerances began to show up, and tuning would be affected. This judgment comes from firsthand experience; for a brief time during the '70s I was Raymond Scott's Clavivox demonstrator and sales agent!



The Electronium (in foreground).

Other features were far more successful — worthy of imitation today. The left-hand controller comprised four flat "keys" played by the thumb and first three fingers. They governed "hard attack, soft attack, extinguish, and vibrato (off/on)." "Extinguish" allowed the performer to *stop* the sound abruptly during performance — to produce, for instance the "dot" of "doo-dot doo-dot!" These expression keys and the glide scheme were Scott's way of giving the Clavivox some of the capabilities that a monophonic voice *must have* to be successful: vibrato control, pitch nuance and portamento, and phrasing capability.

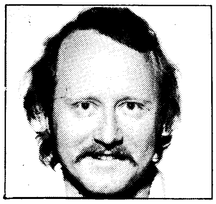
As Raymond Scott said, "... the Electronium is not played; it is guided." Scott worked on this composer's machine during the decade of the '60s. In May 1970 he introduced a completed version that described how the system is used:

> A composer "asks" the Electronium to "suggest" an idea — theme — motive — whatever. He listens to these on a monitor speaker. When happy with one of the ideas, he stops the Electronium, puts the magnetic tape recorder into the record mode and starts recording. The start button for the Electronium is now also pressed and the composition is underway.
>
> Say the opening theme is just about over, the composer (guidance control) decides that, as the first step in the development of the theme — he wishes to repeat it, but in a higher key — he pushes the appropriate button. Or perhaps, he wants to modify the theme somewhat in its new, transposed, higher key — for instance, to widen some of the intervals . . . he turns another knob. Whatever the composer needs . . . to continue the development of the piece, it is but necessary for him to convey his wishes to the Electronium — by manipulating the appropriate controls.
>
> . . . faster, slower, a new rhythm design, a hold, a pause, a second theme, variation, an extension, elongation, diminution, counterpoint, a change in phrasing, an ornament . . . ad infinitum . . . whatever the composer requests, the Electronium accepts and acts out his directions.

Scott reveals his viewpoint about how *specific* he feels one must be when making music. He goes on to say, "... the machine's response to guidance control is — in its details — unpredictable — so that a kind of joint effort takes place — in that the Electronium adds to the composer's thoughts, and a duet relationship is set up between man and machine." Scott's non-numerical approach puts him more in the mainstream of music making — intuitive manipulation of sound elements — even though the means of manipulation is non-traditional.

Raymond Scott's musicianship caused him to make fundamental distinctions between an *instrument* such as the Clavivox, and a system for interacting with sound — the Electronium. There are lessons to be learned in what Scott did in years past.

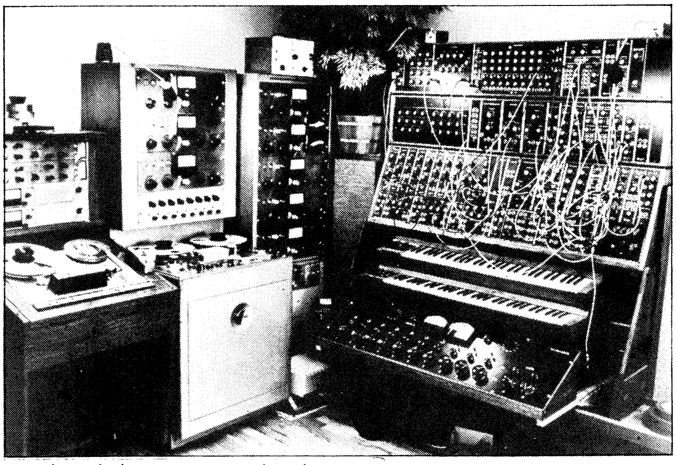
Perhaps it would be fruitful to discard the word "synthesizer." Then designers would have to think about what kind of music their soundmaker is going to produce — and the characteristics of the people whom they intend to use it. And those who use such soundmakers might have to sharpen their aesthetic as well. Better electronic musical instruments and more useful compositional systems might result if we didn't have the catchall "synthesizer" label to describe such diverse things. A word that can mean so many things can mean hardly anything at all. Nowadays everyone seems to know what a "synthesizer" is, and what it "does." Too bad. Vistas unimagined are vistas unrealized. ■



TOM RHEA
ELECTRONIC PERSPECTIVES
The Moog Synthesizer

ELECTRONIC MUSIC WAS BORN in Europe, but it was democratized in the United States. The introduction of the magnetic tape recorder just after World War II allowed the composer to store sound and physically manipulate it using tape editing techniques. Wire and disc recorders existed before magnetic tape, but the editing ease and high fidelity of the tape recorder set the door to electronic music composition ajar.

In Europe in many of the early studios, compositions were developed out of a collaboration between a composer and a technician. There was nothing *inherently* musical about the "instruments" of these early studios. Much of the equipment owed its design more to the laboratory than to the music hall. The "classical tape studio" was more a collection of disparate elements than an integrated instrument designed to make and modify sound. Eventually composers began to master the machines involved, including the new lexicon of electronic music: oscillators and random noise generators, filtering, modulation, amplitude control, reverberation, and tape manipulation. Making electronic music remained, however, the province of the specialist, due to the technical demands. Also, tape cutting and splicing were tedious and it required great skill to produce complex, dynamically varying sounds.



Wendy Carlos' Moog-equipped studio (1968).

The introduction of the Moog Synthesizer took the door to electronic music composition *off its hinges*. The elements for making and controlling sound were integrated into a compatible system. What had previously been the province of strict rationalization became susceptible to intuitive exploration.

Bob Moog commented in an early magazine article: "Engineers and composers now acknowledge that the consistent and systematic use of *voltage-controlled* instruments simplifies both the generation of complex, dynamically varying sounds and the arrangement of these sounds into a composition." The principle of voltage control is disarmingly simple. On early studio equipment, the operating point of a device, e.g. the frequency control of an oscillator or the gain of an amplifier, had to be set by *hand* using panel knobs and switches, and was static except when actually being hand-manipulated. With voltage control, those devices (and others) could be controlled by applying a *voltage level*. Fluctuating voltages can be generated that control pitch, loudness, and timbre easily, quickly, and more precisely than knobs can be operated by hand. Voltage control offers great flexibility in rapidly changing sound textures — making the music *move*.

Bob Moog's roots include piano study and an early interest in electronic musical instruments. One of his first instruments was a Theremin — the "space-controlled" instrument that you play by moving your hands before two antennae. In fact, he worked his way through graduate school at Cornell (earning a Ph.D. in physics) selling Theremins. His business and interest in music led him to a meeting of music teachers, where he met teacher/composer Herb Deutsch. They met, and talked shop. Herb invited Bob to a concert of electronic music (tape music), and Moog's imagination was stirred. Eventually the two collaborated, in 1964, to produce the two most basic elements of the voltage-controlled synthesizer: the VCO (oscillator) and a crude version of the VCA (amplifier). Other avant-garde musicians learned of this and made suggestions that Moog used to create other modules of the system. Vladimir Ussachevsky of Columbia-Princeton studio fame specified the four-part (ADSR) envelope generator, an improved VCA, and an envelope follower. The much-celebrated lowpass filter was first ordered by Gustav Ciamaga, now at the University of Toronto. The first customer for a complete system was Alwin Nikolais, the choreographer. As you see, the Moog synthesizer was originally designed to create new music — an era of exploration.

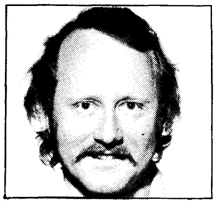
The first commercial uses were by producers of jingles (music for TV or radio commercials) and recording studio musicians. The late Eric Siday was a pioneer in using electronic instruments to make jingles — he was Bob Moog's second customer. Studio musicians Walter Sear and Paul Beaver soon began to use the instrument, and synthesizer sounds began to appear on albums. According to Moog, the first such usage was by Paul Beaver in 1967. This period prepared the public for the conscious acceptance of synthesizer sounds.

The event that brought the Moog synthesizer to public attention was the success of Wendy Carlos' *Switched-On Bach* [Columbia, MS 7194], which contained transcriptions of works by the Baroque master. The album, which became a classical best seller in 1968, showed people that the synthesizer could make beautiful music as well as strange sounds. The album and the Moog synthesizer were beneficiaries of intense media coverage. Its success caused a flood of other "switched-on" recordings that used the multitrack tape recorder to stack up single lines into complete compositions. Unfortunately, many of these albums were made in ignorance of the more subtle techniques that Carlos and producer Rachel Elkind used to achieve their artistic success. A few exceptions demonstrated the versatility and musicality of the instrument; highly recommended is Gil Trythall's *Country Moog* [Pandora Records (Box 2281, Westover, WV 26505), 6003], which has cuts that rival any practitioner of the "switched-on" technique. Also, Carlos and Elkind have recently released *Switched-On Brandenburgs* [CBS Masterworks, M2X 35895], a retrospective/perspective of the era they started.

Carlos and Trythall made the synthesizer sing; Keith Emerson made it *scream*. His razzle-dazzle keyboard and synthesizer work were the centerpiece of Emerson, Lake & Palmer. Emerson introduced the large modular Moog synthesizer to rock radio, and later used a Minimoog to produce early classics in rock synthesizer. If you aren't familiar with ELP, try *Tarkus* [Cotillion, SD 9900].

The '70s saw the introduction of small, portable synthesizers specifically oriented toward live performance. The Minimoog was an early example; for me, its unquestioned master is Jan Hammer. Hammer was among the first to recognize the power of pitch inflection and nuance required to play a successful solo on the synthesizer. His work is well known, but perhaps you don't know *The First Seven Days* [Nemperor, NE 432], an album of original music that portrays the Biblical story of Creation.

Today, Bob Moog is no longer associated with the company that bears his name. He is alive and well in the hills of North Carolina, where he has founded a new company called Big Briar [Leicester, NC 28748]. And where is the pioneer of the voltage-controlled synthesizer going? Toward the development of better control devices — things musicians can touch to turn the synthesizer into a more sensitive instrument. Among his recent developments are a keyboard for John Eaton of the University of Indiana that is touch-sensitive in *three* axes independently on each key. ■



TOM RHEA
ELECTRONIC PERSPECTIVES
Buchla Electronic Musical Instruments

My instruments have been developed, to a certain extent, due to my inclination to investigate new musical structures. I have tried to build instruments that are not biased toward tradition or the *status quo*.

DONALD F. BUCHLA had an early artistic background in sculpture, but his musical needs compelled a career as a musical instrument designer. When you approach Buchla's instruments you realize that the experience is intended to be visual and tactile as well as sonic. Buchla grew up near San Francisco, and so was aware of Harry Partch's unique acoustic instruments, as well as developments in sound sculpture internationally. Buchla's first instruments were acoustic instruments that defy traditional classification.

Buchla's interest in *electronic* musical instruments stemmed from his affiliation with the San Francisco Tape Center in the early '60s; he used their tape recorders to edit his music. As he put it: "My building electronic instruments grew out of my observation that there was a *lot* more one could do with electronics than use those [laboratory] oscillators to put sine waves on tape." The Tape Center later (1967) moved to Mills College, where Buchla's first modular system still resides.

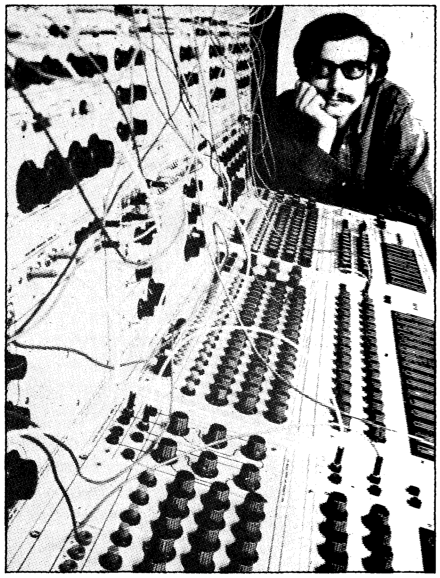
Buchla spent the '60s constructing various modules, relying on his experience and feedback from avant-garde composers for assistance in module function definition. This yielded the *100 Series Modules*, which were superseded in 1970 by the *200 Series Modules*. The 200 Series modules are a refinement both electrically and conceptually and are the backbone of Buchla's analog modular systems today.

Donald Buchla pioneered in the development of voltage-controlled electronic instrumentation. In fact, Buchla's first system (1963) had some elements that predate Robert Moog's voltage-controlled modules (1964). Distinctions are complicated, and more important than similarities; it's hopeless to try to discuss the matter in brief. But one particular does exemplify Buchla's avowal to "... investigate new musical structures." Buchla's early oscillator — while voltage-controlled — did not feature the one-volt-per-octave (exponential) scaling that lends itself to the easy, predictable production of tuneful music, music based on a scale with equal interval size. It wasn't a traditional *melodic* tone generator.

Another of Buchla's tendencies has been a reluctance to adopt the traditional keyboard as a necessary or sufficient control device. But contrary to rumor and apocryphal stories, he doesn't "dislike keyboards." He uses them when he feels them *appropriate*, as he indicates:

For years I didn't build a keyboard instrument. But I've composed for them and played them. I see a limited use for the black-and-white piano-like keyboard — the use for which it was designed: extremely rapid, simultaneous access to a large number of notes of fixed pitch. There is no compelling obligation to use it in another context.

Recently I *have* built a keyboard instrument, the *Touché*, that is oriented to keyboard technique. It has no editing, automation, or sideman [rhythm box]. The Touché and my Electric Cello (1979) capitalize on existing techniques and — necessarily — existing form and repertoire. Twelve-tone tuning; four strings; a traditional keyboard — each tends to force you into traditional expressions idiomatic to those systems. In most of my instruments, I have tried to avoid these kinds of bias.



Don Buchla with a Buchla Synthesizer.

Buchla has built a variety of *non*-traditional "keyboards." One version from the early '70s, the Model 217, gives us an indication of some possibilities. The Model 217 has an array of 21 flat, nonmoving metallic touch pads that can be activated by the fingers, using body capacitance. These keys are sensitive to the area covered by a finger; this is perceived as pressure sensitivity by the performer. One section features keys with individual timing and control voltage outputs; another features pressure outputs for each key. Two ribbon-like metallic analog controllers provide output voltages that are proportional to lateral finger position. These elements may be configured in a variety of ways that sense finger positions, pressures, and operations involving finger release. Output voltages are "remembered" when a finger is lifted, and the sustaining of one key does not inhibit the action of another. The keys may be used traditionally — in a string — to produce scales of equal or unequal interval size. Or the keys may be thought of as individual control and timing elements to key complicated analog patches. In Buchla's current hybrid systems, the concept has been extended under computer control to embrace *logic* functions, e.g., "When keys A, B, and C are touched simultaneously, condition X obtains."

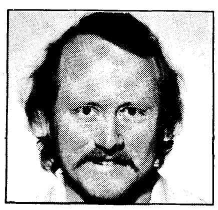
Buchla has received little publicity for his early examples of devices that have later been popularized. For instance, he designed a user-programmable instrument in the early '70s, and the first analog sequencer during the mid '60s. Of the sequencer he says:

The invention of the sequencer was an attempt to eliminate tape splices. It was not thought of so much as a rhythm box or repetitive device, simply as a way of presequencing a bunch of notes that would otherwise be difficult to play. In other words, it was an analog programmer for short durations of music. Obviously it had other ramifications and possibilities, but that was the primary motivation: the elimination of very tiny tape splices.

The programmable instrument is the *Music Easel* (1973), know colloquially as the "Weasel." Programming requires that you set up the control panel for the desired "instrument definition," and translate slider values into resistor values by reading lines drawn on the front panel. Appropriate resistors are selected from a supplied kit and soldered onto a prepunched plug-in circuit card. Several cards may be plugged in, and switching among these allows rapid change of sound texture during performance. (Buchla's later instrumentation uses computer memory for this storage and retrieval function.) I like the visual appeal of the Music Easel's hardwired memory; and the sound of the instrument is refreshingly different from the VCO-VCF-VCA chain that is rapidly becoming a cliché. Since the Easel is highly integrated (non-modular), it offers the keyboardist an excellent entry point to Buchla's instruments — even though it has a non-moving "keyboard."

Buchla began using computers in his instruments in 1969, and in 1975 introduced his *300 Series*, a hybrid system that features computer control of both analog and digital devices. Buchla is particularly interested in developing computer/musical languages that give the composer/performer access to musical specification at every level, from subtle nuance to sweeping gesture. His 300 System is very open; he says, "One might look at it as a matrix, a way of correlating possible input gestures to every possible system response." His emphasis now is centered on input devices such as three-dimensional motion detectors, signal conditioners for physiological information (brainwaves, etc.), and other physical phenomena that can be translated into voltages.

To hear some of Buchla's instrumentation used well, listen to any of Morton Subotnick's records on Nonesuch or Columbia, a series specifically conceived for the recording medium.



TOM RHEA

ELECTRONIC PERSPECTIVES

Music & The Computer

DO YOU PLAY voltage-controlled synthesizer? Then you could call yourself a programmer and operator of an *analog computer.* Your "computer"processes and outputs a continuous (analog) electrical signal that can be connected to an amp to make sound. If you hooked up a *digital* computer to your amp you might get little more than an incinerated computer, amp, or both. The digital computer knows nothing of sound — just numbers. It does not have an inherently continuous output like the analog computer — the output of the digital computer is *discrete*; that is, represented in distinct steps by numbers.

Numbers first became sound at the Bell Telephone Labs in Murray Hill, New Jersey, in the late '50s. Max V. Mathews and others developed a technique called *pulse code modulation* that allowed the simulation of telephone equipment using a high-speed digital computer. They didn't invent all of the hardware necessary to make the computer speak, but they developed the *software,* or computer programs that made realization of sound and music possible. Although the expressed purpose was to test new designs for telephones through computer simulation, the implications for making music were not lost on Mathews; in 1963 he wrote: "The quality of sound is of great importance in two fields — that of speech and communication and that of music." The method developed at Bell Labs is today's most popular method for computer music generation. It is based on a sampling method that requires the computer to specify *many thousands* of numbers in order to produce a single second of sound. [*Ed. Note: See the articles on digital recording and synthesis in the March 1981* Keyboard *and on p. 18 of this issue for further explanation.*] The burden of this level of specificity raises questions concerning human capability to respond, as Mathews pointed out:

> To specify individually 10,000 to 30,000 numbers for each second of music is inconceivable. Hence, the numbers-to-sound conversion is useless musically unless a suitable program [set of computer instructions] can be devised for computing the samples from a simple set of parameters. The central contribution of the Bell Telephone Laboratories to computer music is a program for computing the many samples in a note from the few parameters characterizing it. The details of the program determine the limits of the sounds now obtainable [from the standpoint of practicality] with a computer. The program represents a compromise between a general procedure, through which any sound could be produced but which would require an inordinate amount of work on the part of the composer, and a very simple procedure, which would too greatly limit the range of musical sounds obtainable. In order to give the composer flexibility between these two extremes, the program is divided into two parts. In the first part the composer specifies, in computer language, the characteristics of a set of musical instruments. The program unit that represents the instrument [the "instrument unit"] may be as simple or as complex as he desires. He then prepares a score consisting of a list of notes to be played on the instrument-units he has created. The samples of sound wave are generated by putting the score, in a form the machine can read, into the computer, together with the instrument-units, and turning on the computer. The numerical output is recorded on a digital magnetic tape for subsequent conversion to acoustic form.

During the research of Mathews and others, many questions in psychoacoustics — the relationship of human beings to sound — have been raised. In the early '60s Mathews commented:

> Our experience has shown how little we know about the relation of the quality of sound to musicians have had very little experience in trying to predict the effect of a given harmonic-composition factor or a given attack-and-decay function on the timbre of a note.
>
> An example of a psychoacoustic surprise is the dominance of the rates of attack and decay in determining the character of a sound. *These rates are a much more significant factor than the harmonic composition.* Thus, a "violin," if artificially given the attack-and-decay characteristic of a piano, sounds much more like a piano than a "piano" does when it is given the attack-and-decay characteristics of a violin. [*Italics added.*]

In the early days, one often had to wait minutes or hours between specification of sound and actually hearing it. It took a long time for the computer to "crunch" the necessary numbers and prepare them for conversion — via a digital-to-analog converter — into sound. Early computer music was necessarily a composer's medium; the "instrument" couldn't be played in *real time* (live) by a performer. Advances in computer technology are now making it possible to produce and control sound fast enough to create real-time instruments.

But let's backtrack just a bit. Recently, I interviewed Dr. Mathews. I was particularly interested in why Bell Labs had built a *hybrid* device in the '70s (a hybrid uses voltage-controlled oscillators, filters, etc., under computer control), since their totally digital system of the '60s could (theoretically) produce any sound imaginable. His answer was direct and refreshing: "Because it's fun to *play* things."

The Groove hybrid system was conceived as a general system that could be applied to many nonmusical tasks, such as numerical control of industrial processes. In its audio application it did not generate audio directly, but was ". . . a program which makes possible creating, storing, reproducing, and editing functions of time . . . functions typical of those *generated by human beings.*" As with previous developments involving Mathews, we see an interest in the nominally "non-technical" aspects of the design. In a paper coauthored with F.R. Moore he stated that "the environment for effective man-machine interaction has been carefully nurtured." Some further comments seem pertinent today, especially in light of the "souped-up organ" direction that so many designers today seem to be following:

> Originally we had thought simply of attaching an organ keyboard to a DDP-224 computer which was being used to study speech synthesis and was equipped with 14 digital-to-analog converter outputs. In this way we hoped to make possible the nuances of real-time performance in computer music. *However, with a simple program there seemed to be greater danger of imposing on the computer the limitations of the organ rather than improving the organ by means of its association with the computer.* Further thought convinced us that the desired relation between the performer and the computer is not that between the player and his instrument, but rather that between the conductor and the orchestra. The conductor does not personally play every note in the score; instead he influences the way in which the instrumentalists play the notes. The computer performer should not attempt to define the entire sound in realtime. Instead, the computer should have a score and the performer should influence the way in which the score is played. His modes of influence can be much more varied than that of a conventional conductor who primarily controls tempo, loudness, and style. He can, for example, insert an additional voice of his own, or part of a voice such as the pitch line while the computer supplies the rhythm. He should also be able to modify or edit the score. The computer should not only remember the score, but also all the conductors' functions, so when he achieves a desired performance, it can subsequently be replayed by the computer from memory. These concepts led directly into the Groove program for composing and editing time functions. [*Italics added.*]

We are about to embark on an exciting new era in music in which the computer will be used to enhance music-making. In my opinion, the artistic — *and commercial* — success of the instruments produced in the next ten years will depend more on the willingness of their designers to research and read *existing* literature on psychoacoustics and ergonomics (human engineering) than on startling technological breakthroughs. This is the final column of some four and one half years of columns that have maintained the consistent perspective that technology should be the handmaiden of the arts, not their master. In the future, I hope those who have ears will hear, and more important, *speak.*

HARALD BODE
1909-1987


COURTESY TOM RHEA

Harald Bode, a pioneer of electronic instrument design, passed away in January. An engineer whose career spanned three generations of electronic music history, he anticipated many of the problems faced by today's electronic manufacturers, and provided ingenious early solutions. His ideas about modularity influenced Bog Moog's development of the analog synthesizer in the '60s. His keyboard inventions for several American organ companies paved the way for the high-tech boom in the keyboard industry. And his frequency shifters, vocoders, and other rack-mount devices are still in use around the world.

Born in 1909 in Germany, Bode attended the University of Hamburg and did postgraduate work at the Heinrich Hertz Institute at the Technical University of Berlin. In 1937 his Warbo Formant Organ provided a solution, through the use of discrete components, to the problem of assigning a limited number of voices to the many keys on a keyboard. The organ also featured a means of routing voices through a dual filter, making it an early multi-timbral instrument. The next year he built the touch-sensitive Melodium, which he played with the Berlin Philharmonic Orchestra. The Melochord, his 1947 successor to the Melodium, anticipated another modern feature, the split keyboard. Werner Meyer Eppler, an early proponent of electronic music at the University of Bonn, was so impressed with the instrument that he helped win Bode a commission to build an advanced Melochord for the Cologne Electronic Music Studio, the first studio of its kind.

The Cologne Melochord had two 37-note manuals and so-called step-by-step filters that could be tuned from a keyboard. By playing pitch on one keyboard and tone color on the other, the player could glissando on the tone-color keyboard and thereby move the center frequency of the filter up and down. In using a keyboard as a generalizable device, Bode developed the concept of modularity in music systems. His article on the subject in the early '60s helped spur Bob Moog's creation of the modular analog synthesizer.

Bode held more than thirty U.S. and foreign patents in electronic music, and contributed regularly to various technical journals in the field. He worked for the Wurlitzer Organ Co. for ten years and for Bell Aerospace before leaving to do freelance consulting and run the Bode Sound Co. in North Tonawanda, New York. (For more on Bode and his inventions, see *Keyboard*, Dec. '79, Jan. '80, and Feb. '80.)

—*Tom Rhea*

Where The Jobs Are, Part 8:

NASHVILLE

Behind The Scenes In Music City U.S.A.

By Beegie Adair
As Told To Tom Rhea

YOU KNOW WHERE YOU are when the deer trophy on the wall is wearing headphones. The land of rhinestones and Rudy's Farm sausage. Customized tour buses and Lear jets. Goo-Goo clusters at the Opry and the sweet smell of success. The mecca of buckskin music — music by the numbers. Music City — Nashville.

The place is the Sound Shop, a top Nashville recording studio. The time seems to be irrelevant. If there is a clock in the place, no one seems to know or care where, not even the guy paying for the session. After a seemingly interminable period of joking, instrumental noodling, and repartee between the producer and the sidemen, the arranger kicks off the group. The language is strictly down-home: "Make it go *boom* there. We want this à *la* Waylon, but with better chords." Then, to the drummer: "No, don't do that there; it sounds like snuff-dippin' disco." As the producer explains that the artist is trying to reach a particular market sector, the director interjects: "I thought a sector was something a king has."

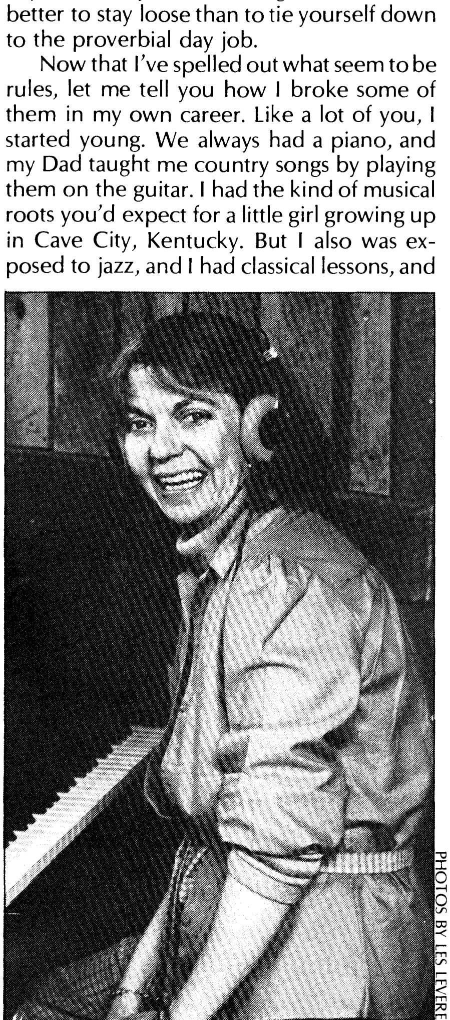
Sure, the musicians are laid back. They are also highly talented and experienced professionals, and Beegie Adair is one of them. She became part of the Nashville studio crowd some 20 years ago. Her album credits include work with Perry Como, Henry Mancini, J. J. Cale, John Loudermilk, and Al Hirt, and she has played on network television specials for Carol Burnett, Dolly Parton, Lucille Ball, Florence Henderson, Ed Ames, Glenn Campbell, Petula Clark, Mac Davis, and others. A songwriter as well, she wrote the "Let's Go Tennesseeing" jingle that won an award as the best promotional jingle of 1979.

Beegie came to Music City back when it was still just Nashville. Her story shows that Nashville offers a career in country music and a lot more to those willing to chance it in a tough recording town.

* * * *

RECORDING IS KING here, and that's what draws musicians to Nashville. Recording scale is high, but don't expect to make a fortune right away. Most of the successful sidemen here didn't just fall into playing master sessions day and night; they paid their musical dues. It's tough to get in, but there is enough work in town to get you started. If you are versatile you have a better chance. If you can arrange, do copy work, teach, conduct, sing, engineer, or write jingles, you're more likely to be around long enough to get into recording. Availability is a key word if you want to get sessions; it's better to stay loose than to tie yourself down to the proverbial day job.

Now that I've spelled out what seem to be rules, let me tell you how I broke some of them in my own career. Like a lot of you, I started young. We always had a piano, and my Dad taught me country songs by playing them on the guitar. I had the kind of musical roots you'd expect for a little girl growing up in Cave City, Kentucky. But I also was exposed to jazz, and I had classical lessons, and eventually had teachers at Western Kentucky State University who had been students of Claudio Arrau and Ernst Von Dohnányi. I also learned about jazz from my classmates there, and would often go to Nashville on weekends to play dance jobs.



PHOTOS BY LES LEVERETT

In 1961 I settled in Nashville to attend grad school and to work with [singer] Hank Garland, never really with the intention of doing recording. It was a small industry then and pretty well closed, with only one rhythm section in town that did everything, and that was all country music. So I settled into playing clubs and singles, playing with rehearsal bands at the Union hall, which is still a good way to meet musicians around here, and doing day jobs.

I came in the studio through the back door, by subbing for the piano player on *The Noon Show*, a local live TV program. After a while, I picked up some more work subbing on *The Waking Crew*, an early morning radio show, and then I was asked by Ralph Emery if I would like to be in the band for his early morning television show. I stayed with Ralph until 1969. I was already starting to get occasional studio work, mostly from contacts made on the show, but when I left Ralph it was the first time just about since I was born that I didn't have a steady job. I just went out and said, "Here I am!" That's what it takes to get session work — that, plus ability.

Certain myths have grown up around the Nashville recording industry. Sometimes people come to record here, and later we'll read or hear on TV about how "those folks down there don't read music," and it all sounds like we're running around down here with hayseeds stuck all over us. Very entertaining, but if you listen to that guy's record, it's likely to have 15 strings on it and a full horn arrangement. So what are they reading — chopped liver?

On the other hand, blinding technique won't assure your success here. A keyboard player will do a lot of work as part of a rhythm section, a job that rarely is technically threatening. But it is very important to know what to do stylistically. Sometimes people arrive here with the attitude that there is nothing to playing country music, for instance. It does sound easy; all you do is sit there and go *boom-chicka, boom-chicka*. But there

Beegie Adair recording at L.S.I. Studios, Nashville.

really is an art to it. I'm still learning how to play good country rhythm that meshes well with the other parts. A lot of it is knowing what to leave *out*. But country rhythms do tend to be more formulaic than pop or jazz rhythms. This is one style where you do tend to play your part the same way each time.

There is usually a grain of truth in every myth, and it's true that some sessions are done without any music being written, especially for the rhythm section. But personally, I think music reading is a very important skill. I know that being able to read has gotten me extra work. At a minimum it will be necessary for a piano player to read a lead sheet, with chord symbols and general directions about rhythm and style. Also, the music here is changing so rapidly. The big network TV shows and specials that originate here call for people who read fluently. If you show up on a gig like that and don't read, you're up the creek.

Another aura that Nashville has is the "laid back" image. We do talk slower in this neck of the woods, and the atmosphere in the studio is very open. The musicians often contribute a great deal to the final product. But the successful players don't forget that the singer, studio, or producer is putting out a lot of money in the studio. The atmosphere is friendly and relaxed, but there really isn't much goofing off musically. A lot of the lingo stems from some of the people not having a formal music education. Where I might say that the third bar has a dotted quarter note tied to an eighth-note that should be accented, they'll stop there and say, "When you get to that part right there, just push it!"

One other way in which the Nashville studio scene may differ from the West Coast is the fact that synthesizers really haven't hit as hard here. Everybody plays a little — I use an ARP Omni — but usually the synthesizer call is separate from the piano call. There are some guys who get a lot of work — Shane Keister and Alan Steinberger are two of the top synthesists here — but since there's so much country and MOR music, there isn't as much demand here as in LA. People may want someone on synthesizer to play string parts on the road, but in sessions they usually still use a real string section.

If you're planning to seek work in Nashville, you should keep in mind that country music really is a big part of the scene. I strongly advise any prospective arrivals to loosen any heavy musical bias they have before trying to make it here. I respect people who have made a commitment to a certain kind of music, but they should consider whether this is the town that will best support it. Nashville is smaller than many people think; there are only about 420,000 in the whole county, and this means that opportunities in some areas are limited. I play jazz whenever I can at various local spots, but even though these gigs are a joy, there aren't enough of them around for anyone to make a living from them.

Nashville is not Mecca. There are a lot of starving musicians here. Business was very slow during the recession, and a lot of people had to go on the road to support themselves. I'd say there are about 30 or 35 keyboard players who are earning a living here. Maybe five or six make real good money; some make three or four times what I earn, but that means working nonstop. The pay scale is very high, but if you only work once a month, or if a thousand-dollar session is the only thing you get in six months, it doesn't last long. I don't want to spread gloom in the picture; just reality.

In spite of this, though, I'd say there are opportunities here. Opryland, for example, employs a lot of musicians. We have 11 or 12 universities, which offer lots of teaching jobs, and there are a lot of private teachers making a living as well. And I really believe that if you come with the right attitude on Friday morning, by Saturday night you can have a gig, if you don't mind what music you may have to play. It might be just a wedding, a party, or a small club, but there is work.

The first thing to do if you're new in town is to contact the business agent at the Musicians Union. He knows the names of all the local bandleaders and where they are playing. The fact is that because there is so much of an emphasis on studio work that there is a bit of a shortage of people who play live gigs. There aren't nearly as many people in Nashville who know the old standards, or certain kinds of ethnic or country club music, as there are studio people, so finding the bandleaders and the live jobs is probably the best first step to take.

Meeting people is important. If possible, get into a group and play to be heard. Check the bulletin board at the union hall for jobs. Sit in with a rehearsal band. One of the better ones, Dave Converse's Jazz Machine, meets every Monday night. It's an ongoing group of about 18 pieces, mostly studio players, and almost every Monday night there's somebody new sitting in or bringing in an arrangement. If you do arrangements, these bands are very open to trying them out.

Visit the publishing companies and meet the songwriters. Watch for "writer's nights," especially at the Exit/In, a club where new material is auditioned. Don't be afraid to introduce yourself; we're friendly. Some publishers have house bands, or keep lists of players to make up bands for demo sessions. Many a session player has started out by playing demos under very modest circumstances.

If you want to record, stay available. Try to keep on the fringes, if not at the center of the community of musicians. Write, arrange, sing, do what you can to make money and meet people. Playing skills do matter. Scratch any overnight success in this town and you'll find someone who has been around for 20 years. And please, don't make the mistake of playing incredible "canned" solos during warmup, even if you can follow the changes during the job. The musicians here are experienced, and are not impressed with feats of derring-do from players who can't mesh with the group and make music.

Nashville is a strange little town. There are country music clubs on every corner, and churches right next door to them. After years of following my own muse and playing jazz, I've learned, and Nashville has helped to teach me, that there are a lot of different kinds of music, and even if you wind up playing something you hadn't expected to play, you'll find that each style has something to say. ■