

## International Committee for the History of Technology (ICOHTEC)

---

### THE SOCIAL CONSTRUCTION OF THE EARLY ELECTRONIC MUSIC SYNTHESIZER

Author(s): Trevor Pinch and Frank Trocco

Source: *Icon*, Vol. 4 (1998), pp. 9-31

Published by: International Committee for the History of Technology (ICOHTEC)

Stable URL: <http://www.jstor.org/stable/23785956>

Accessed: 27-01-2018 00:41 UTC

---

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact [support@jstor.org](mailto:support@jstor.org).

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at <http://about.jstor.org/terms>



JSTOR

*International Committee for the History of Technology (ICOHTEC)* is collaborating with JSTOR to digitize, preserve and extend access to *Icon*

# THE SOCIAL CONSTRUCTION OF THE EARLY ELECTRONIC MUSIC SYNTHESIZER

Trevor Pinch and Frank Trocco

*In this paper we examine the sociological history of the Moog and Buchla music synthesizers. These electronic instruments were developed in the mid-1960s. We demonstrate how relevant social groups exerted influence on the configuration of synthesizer construction. In the beginning, the synthesizer was a piece of technology that could be designed in a variety of ways. Despite this interpretative flexibility in its design, it stabilised as a keyboard instrument. We examine the contrasting development of the East coast (Moog) and West coast (Buchla) systems, and suggest why one has become a commercially viable mainstream instrument, while the influence of the other has remained marginal. We discuss the tension around viewing the synthesizer as a machine, and investigate its transformation into an instrument. Finally, we look at the vast possibilities of sound originally rooted in the synthesizer, and explain its eventual evolution as an instrument with fixed potential. The double character of the synthesizer – it was an outgrowth of the psychedelic counter-culture which it, in turn, dramatically influenced – illustrates the reciprocal, co-evolutionary role of technological artifacts embedded in a milieu which at the same time they help create.*

## INTRODUCTION

In that we can pinpoint the location of any invention, the commercial synthesizer was designed and created in Trumansburg, NY. This is where Robert Moog had his first workshop and factory, and where he produced the legendary Moog Synthesizer in the period 1964–71. This was the first ever mass-produced synthesizer, unlike the one-of-a-kind studio synthesizers to be found earlier at the Columbia-Princeton electronic music studio, or at the Cologne music studio.<sup>1</sup> At about the same time that Moog produced his synthesizer, Don Buchla, in San Francisco, operating independently and unknown to Moog, also developed



**Figure 1:** This is an early promotional picture used by the R.A. Moog company showing a Series 900 modular synthesizer. It is being demonstrated by Bob Moog, the individual in the foreground, Frank Harris, at the back, a musician from St. Louis, and Jon Weiss, the young man sitting down, a musician who started with Moog as a work study student. Photograph courtesy of R.A. Moog.

a synthesizer. Buchla did not produce his synthesizer commercially, mainly designing custom-built modules for studios. It is instructive to compare these two pioneering synthesizers, something we shall undertake later in the paper.

## THE SOCIOLOGY OF THE SYNTHESIZER

In this paper we apply ideas from the sociology of technology to the development of the synthesizer. The reason that the synthesizer can be examined from this analytical frame is that innovation in music, or the development of new instruments or genres of music, is like cultural innovation everywhere, including within science and technology. Formally, the early synthesizer can be described as an analogue computer, and, therefore, a machine. Thus, principles developed in the sociology of technology should have some purchase. In particular we shall draw upon ideas in the Social Construction of Technology (SCOT).<sup>2</sup> Essential to this analysis is the understanding of how the development of a technological artifact is negotiated between the many 'relevant social groups'<sup>3</sup> who participate in its development. A 'relevant social group' is defined as a group who share a particular meaning of the technology. Initially, there may be great 'interpretative flexibility' among the 'relevant social groups'. This means there can be radically different and competing meanings of a technology. For example, in the development of the bicycle, there were many contradictory ideas among cyclists, engineers and public interest groups as to the most appropriate design parameters. Some groups saw speed, others safety or comfort, as the most important consideration.<sup>4</sup>

Eventually, one meaning of an artifact stabilises, and there is closure. In the history of the bicycle, one can see the transition from a range of bicycle designs in the 1890s, to the eventual adoption of the safety bicycle, as a process of 'interpretative flexibility' followed by 'closure'.

The last stage in SCOT is to relate the content of a technological artifact to the wider cultural milieu. The analysis of developments in musical history is especially pertinent for this approach, in that music, like everything, is a socio-cultural product.<sup>5</sup> It is something that is produced, re-produced, consumed, and institutionalised in a societal context. Therefore, it is our hope that this inquiry into the history of the Moog synthesizer will lead to a deeper

understanding of the social environment, and historical background, of this time period, and illustrate how the synthesizer is both shaped by the wider milieu and gives meaning to that milieu.

### **METHODOLOGICAL CONCEIT**

There is very little written material, and no detailed history available of the developments we examine here. Out of necessity, we have relied on interviews with the main historical participants as our primary source material.

### **WHAT IS A VOLTAGE CONTROLLED MODULAR SYNTHESIZER?**

The synthesizers designed by Moog and Buchla were much smaller than their predecessors. For instance, the RCA Mark II synthesizer was big enough to fill a room. One reason why the new machines were much smaller, and commercially viable, was because of the availability of cheap transistors in the 1960s. Moog:

Now I can't tell you how important it was that I could buy a silicon junction transistor for 25 cents. *That's amazing* . . . I can remember during that summer [working at Sperry] the technician over there undid this little box and took out thirty transistors . . . These are the first silicon junction transistors. In 1957 this is \$1000 for the transistors. And there they were [in 1964] for 25 cents.<sup>6</sup>

As well as using transistors, the new synthesizers had two important and connected design features: they were modular units and each unit was 'voltage controlled'. A modular design meant that separate units could be linked together by a patch board, rather like a telephone exchange (See figure 1). For instance, a typical synthesizer would have a number of sources of sound such as oscillators, and a number of sound processors such as filters, amplifiers, and envelope shapers.

Voltage control<sup>7</sup> was a technique which was evolving in electrical engineering at the time, and there was great interest in it largely stemming from the transistor. Because of the exponential relationship between input voltage and output current in a

transistor, dramatic increases in current could be obtained for small voltage changes over the range of frequencies for musical pitch. The Moog synthesizer consists of a number of modular voltage control units linked by a patch board. The output of any unit can be fed as an input into another module. This means the slowly varying beat of an oscillator can be fed as a control voltage into another oscillator to provide vibrato. The early units comprised voltage controlled oscillators, amplifiers, filters, and envelope shapers.<sup>8</sup> Voltage controllers such as a keyboard, noise sources or a ribbon controller<sup>9</sup> could be added as separate control units.

In short, a voltage controlled modular synthesizer is an electronic instrument built from separate and interchangeable modules that are controlled by varying the incoming voltage.

## THE HOBBYIST TRADITION

Having traced out what a synthesizer is, let us examine the route Robert Moog took towards developing such a machine. Moog's interest in electronics began in childhood. His father was an electrical engineer for Consolidated Edison in New York, and had a workshop in the basement of the family home. He and his father were avid readers of hobbyist magazines, and engaged in a number of recreational projects. Moog was always fascinated by sound, and built musical toys such as one-note organs.

An early and unusual electrical musical instrument, the Theremin, is played without being touched. The musician moves her hands in the space near its two antennae to regulate pitch and volume. It was regularly featured in hobbyist magazines such as *Radio Craft* and *Radio News*, and building Theremins became a hobbyist cult of the 1940s and 1950s.

In 1949, at the age of 15, Moog built his first Theremin,<sup>10</sup> and in 1954 he wrote an article for *Radio and Television News* on how to do it. This article elicited some interest, and he and his father were often contacted by fellow hobbyists requesting them to make Theremins. The Moogs eventually started a small business making Theremin kits. In 1961 Moog wrote a lead article for *Electronics World*, and his Theremin was featured on the cover. This helped his kit business which continued to thrive. When Moog went through graduate school in engineering physics at

Cornell he sold many Theremin kits at \$50 each, enough to drop out of graduate school for six months!<sup>11</sup>

### **A BUMPER CROP**

Moog's Theremin kits were sold in New York City by a sales representative, Walter Sear, who made his living playing the tuba in Broadway shows. Sear also sold tubas. In December 1963, Sear was showing his tubas at a regional educator's convention, and he invited Moog along to demonstrate the Theremin. It was at that exhibit that New York experimental musician Herb Deutsch introduced himself to Moog. Deutsch had been using a Moog Theremin and was delighted to meet the designer in person.

Deutsch invited Moog to a concert of his music in a loft belonging to Jason Seley, famous for his sculptures made out of automobile bumpers.<sup>12</sup> The music was electronic, including a prerecorded tape accompanied by a percussionist who hit Seley's sculptures. Moog: 'I was excited. What Herb was doing [was] artistically just, you know, it sounded like fun. It sounded like something that I'd like to help him with.'<sup>13</sup>

### **WHAT IS THAT WEIRD SHIT?**

At this point, Moog had a small shop in Trumansburg, NY, north of Ithaca, employing two people designing musical instrument amplifier kits. Deutsch came for a visit in the late Spring of 1964. Moog:

And I asked him, 'You know what do you want to be able to do Herb?' He says, 'Well, I want to make these sounds that go brooo, brooo broough' [yelping sound] . . . And somehow, during those first months of 1964 when I was thinking of what to put together for Herb, voltage control suggested itself. I knew of voltage control. Voltage control was a technique that was just becoming practical because of the properties of these new silicon transistors that were coming out.'<sup>14</sup>

Moog put together a breadboard<sup>15</sup> with three circuits: two voltage controlled oscillators and a voltage controlled amplifier. Here is what happened next:

Herb, when he saw these things, sorta went through the roof. I mean, he took this and he went down in the basement where we had a little table set up and he started putting music together. Then it was my turn for my head to blow. I still remember, the door was open, we didn't have air conditioning or anything like that, it was late Spring and people would walk by, you know, they'd listen and they'd shake their heads. You know, they'd listen again – what is this weird shit coming out of the basement?<sup>16</sup>

These were the first sounds of the first Moog synthesizer, although at that point the name 'synthesizer' was not used.

### THE ROLLER COASTER GETS ROLLING

At this point, Moog regarded the project as something which was 'really neat',<sup>17</sup> but he didn't immediately abandon his amplifier kits. As he told us, 'This sorta stuff I did for the hell of it while everybody else tried to make the shop go . . .'<sup>18</sup>

Moog and Deutsch demonstrated the early modules (consisting of two Voltage Controlled Oscillators and two Voltage Controlled Amplifiers) to the Toronto Electronic Music studio. There, composers Myron Schaffer, Anthony Gnazzo, and Gustav Ciamaga got very excited. Moog: 'Myron Schaffer encouraged me. He says "Boy, this is great. I'm sure a lot of people will be interested in this". Little by little the idea began to form that maybe we could sell this shit.'<sup>19</sup>

The endorsement of the Toronto studio was important because Deutsch at that time was a young academic composer, working with limited resources, unlike the composers associated with the Toronto studio who were well-funded by the Canadian National Research Council.

From there on Moog started to take orders, including one from Vladimir Ussachavesky, of the well-known Columbia-Princeton Studio for Electronic Music, who wanted particular modules built. Ussachavesky specified a voltage controlled envelope generator with ADSR (Attack, Decay, Sustain, Release) terminology.<sup>20</sup> This subsequently became the standard for specifying envelopes on all synthesizers.

During this period Moog saw himself as a builder of equipment for electronic music composers, including the electronics for tape



recorders. In 1967, after three years selling customised units designed for individuals, Moog decided that the units could be sold as complete standard systems. This was the first time that his catalogue used the word synthesizer. At about \$10,000 each, these 'synthesizers' were mainly for use in studios or for individual wealthy musicians.

### **THE MAN FROM MOOG AND HIS FABULOUS 'SANITIZER'**

This is an early promotional picture used by the R.A. Moog company (See figure 1). It shows a Series 900 modular synthesizer, apparently being played by three people. This photograph is a mock-up. Two of the people are musicians and one is an engineer. Bob Moog, the engineer, is the individual in the foreground.<sup>21</sup> The person at the back is Frank Harris, a musician from St. Louis, who was an early customer of Moog's, and who happened to be in the studio that day. The young man sitting down is Jon Weiss, a musician who started with Moog as a work study student, and who proved adept at learning the synthesizer. Moog counted on him for insights into the sort of technology musicians needed.<sup>22</sup> Because he was the person who delivered the synthesizers, and taught their new musician-owners how to use them, Weiss became known as the 'Man from Moog'.

There is something striking about this picture. It has to do with the left hands of the two musicians. Both have their left hands extended upwards adjusting potentiometer knobs. The right hands are lower – in the case of Weiss, his hand is on the keyboard. This was a posture deliberately used by Moog in his advertising. As he told us, this seemed to encapsulate the link between the music and the machine:

The keyboards were always there, and whenever someone wanted to take a picture, for some reason or other it looks good if you're playing a keyboard. People understand that then you're making music. You know [without it] you could be tuning in Russia! This pose here [acts out the pose], graphically ties in the music and the technology.<sup>23</sup>

The visual representation of the synthesizer to be used in promotional literature must somehow capture the fact that the

machine plays music, but that it is not just a keyboard. The synthesizer is an odd instrument because, unlike most instruments, it is very hard to play a tune on it, and, unless it is outfitted with a speaker or headphones, it doesn't make a sound. Weiss:

People don't understand ... that the synthesizer itself doesn't produce any sound. When I got the synthesizer to London [for Mick Jagger's use in filming the movie 'Performance'] and I brought it onto the set ... I had to go through this with the English workers saying, 'Agh, it's a fabulous sanitizer, and what does it do?' you know, 'Play us a tune'. ... Moog heard that so much that in one series of synthesizers he put a little speaker and amplifier in one so that you could actually hear something. People couldn't conceive that this is an instrument, but it doesn't do anything.<sup>24</sup>

Playing the 'sanitizer' required musicians to learn a whole new form of 'body technique' (to use Marcel Mauss' term).<sup>25</sup> The use of the synthesizer for live musical performance, a rarity in those early days as the time needed to set up the patches made it more suitable for studio use, involved a whole new series of practices. The patch changes would take so long that one early synthesizer band, Mother Mallard, from Ithaca, NY, played cartoons between pieces to keep the audience amused.<sup>26</sup>

### THE KEYBOARD BECOMES A SOURCE OF CERTAINTY

In terms of the development of the synthesizer, something even more interesting is going on in this picture. Why use a keyboard at all? Indeed, Moog initially saw the keyboard as only one option for a controller. He developed a new controller, the 'ribbon controller', a long potentiometer strip which worked by sliding a finger up and down its surface. Don Buchla, who was an experimental musician as well as synthesizer designer, was even more radical. Buchla rejected the use of a conventional keyboard.<sup>27</sup> For Buchla, it was restrictive to use an old technology associated with wires and hammers with the new electronic source of sound. He wanted to 'build an *intentional* electronic musical instrument.' Buchla:

No, I think you have to go a little further back and say what does electronic music mean? The term bothers me a little bit, even now. To me it meant simply the source of sound was electronic rather than vibrating strings, membranes, and columns of wind. And to me, that meant that it was a potentially new source, and therefore instruments based on it would probably be new and different. I saw no reason to borrow from a keyboard which is a device invented to throw hammers at strings, later on operating switches for electronic organs, and so on. But I didn't particularly want to borrow the keyboard to control. . . . I tried once to put a keyboard on my system . . . And I found myself overwhelmed by the psychological aspect of looking at this very familiar twelve tone structure, and wanting to do music that was very much against what I was conditioned to do. . . . If you ask the man on the street, 'What's a synthesizer?' He will reply, 'A synthesizer is a keyboard instrument.' If you go into a retail store and say, 'I want to see some electronic instruments,' they'll send you to the keyboard department, because a synthesizer is a keyboard instrument by default. The tying of the keyboard, the wedding of the keyboard, with the synthesizer was a disaster for a creative composer who doesn't want to do twelve-tone melodic, and doesn't want to imitate violins and saxophones and so on and so forth, who wants new kinds of dynamics, and networks attached to his sounds . . .<sup>28</sup>

Weiss:

He [Buchla] had a distaste of the keyboard, and I think for a legitimate reason. In that he didn't want his machine to be a glorified electric organ. So the only controller that he provided like that was a touch-sensitive pressure pad . . . His designs were wild and wonderful. Moog's were conservative, rigorous, and well-controlled . . . all you had to do was look at the names of some of his modules. Moog on the 900 Series had VCO, VCF, envelope generator, blah, blah. Buchla has 'Source of Uncertainty', and sample and hold circuits, and bizarre things that he designed while he was high.<sup>29</sup>

Buchla's machine had much in common with Moog's. Both were modular voltage controlled synthesizers, but they were

critically different in how they were to be used. The interesting issue here is that a new sort of instrument is coming into being, and radically different meanings are being given to it. There is 'interpretative flexibility.'

It is worth considering how few new musical instruments ever become commercially viable and mass-produced. If a new instrument does come along, how do people recognise that instrument and its sound, and how does it get incorporated into the wider corpus of musical culture? In the history of the synthesizer, there is a path that can be traced from the Moog, through the Mini-Moog (a hard-wired Moog with no patching), to the Yamaha DX7 (the first commercially successful digital synthesizer), and all the myriad Casio keyboard synthesizers. In this developmental path, the synthesizer finally becomes a version of the electronic organ, only with a greater range of voices and special effects. The first step in this process is the idea that the keyboard is the preferred interface, and the notion that control voltages are correlated with conventional octaves.<sup>30</sup>

It is at this point that the 'relevant social groups', of musicians and synthesizer users, voice their preference, through sales and personal feedback, to Moog. The original interpretative flexibility, where many controller interfaces were imagined and possible,<sup>31</sup> has collapsed into only one repetitive configuration, the keyboard.

The paradox of the Moog becoming defined as a keyboard instrument was apparent to Moog. Unlike Buchla, who wanted to make unique, individual instruments, Moog came from a tradition of mass-production. Moog's dream was to have a small shop that produced electronic devices. It was no particular concern of his how musicians used his instruments, he was simply providing them with tools. He told us that he could just as easily have been designing power drills as synthesizers.<sup>32</sup>

It is important not to view Moog's attitude simplistically, as the work of a short-sighted engineer. Moog's view was that if the musicians wanted keyboards he would supply them as another module. This is an indication of Moog's responsiveness to the needs of the musicians with whom he was collaborating. Unlike Buchla, who was himself a musician and held on to a philosophical ideal even if it meant that his instruments would remain inaccessible to the majority of musicians, Moog was involved in developing an instrument that could be purchased and utilised by every musician. Moog:

It began strictly as separate parts . . . nothing biasing one way of hooking up versus another way of hooking up. And we just responded to demand. I didn't stand there and say, you know, 'I'm going to do it the right way, and you can't have it any other way . . .'<sup>33</sup>

Compare this to Buchla:

I'm an instrument builder . . . I don't build machines, I never have built a machine. I build only things that you play. I don't build things that you program, I don't build things that are involved in issues. I am an old fashioned builder of instruments.<sup>34</sup>

## SWITCHED ON BACH

The difference between Moog and Buchla, and the meaning given to their respective instruments, can also be seen by the type of music that gets played on synthesizers. We probably never would have heard of Moog if it had not been for the recording sensation of 1969 – Wendy Carlos' 'Switched on Bach'.<sup>35</sup> On the album cover a wiggled figure (presumably Bach) is pictured listening to a Moog synthesizer. This record became a best seller, and made Carlos and Moog famous. It is the best selling Bach record of all time, and one of the best selling classical music records ever.<sup>36</sup>

Moog:

The conventional wisdom back in the music business . . . [was that] nobody believed that this kind of thing could be used as anything more than a novelty. You couldn't make real music with it. You couldn't be expressive with it. You couldn't make it swing. And then Carlos and a few other people demonstrated that they were wrong. You know, they just did an end run around the music business. And *then* in 1969 all hell broke loose. Everybody had to have a, you know, every commercial musician had to have a synthesizer. In 1968 at the AES [Audio Engineering Society] at the Electronic Music Session, and it was a big session, I gave a paper . . . this was a couple of weeks before 'Switched On Bach' was to be released. And I had probably 100–150 audio-engineers listening. And Carlos let me play a track from

'Switched On Bach' as an example . . . I put the tape on and just walked off the stage. And I can remember people's mouths dropping open, and I swear I could see a couple of those cynical old bastards starting to cry . . . Those cynical experienced New York . . . [engineers], they had their minds blown . . .<sup>37</sup>

The success of the record got Moog onto prime time TV, into *Time* magazine,<sup>38</sup> and the *New York Times*. It also prompted a deluge of orders, as every musician and recording industry hack sent their people out to buy a Moog to try and emulate Carlos. None ever did it successfully.<sup>39</sup>

Walter Sear, who by this time had become Moog's synthesizer representative in New York, sold forty module synthesizers to commercial music producers in New York in 1969. His representative on the West coast, Paul Beaver, sold even more. 1969 was the only year that R.A. Moog of Trumansburg recorded a profit. Weiss:

I could see the difference, and there was a world of difference pre-'Switched on Bach', and post-'Switched On Bach'. Before 'Switched On Bach' came out, the synthesizer was basically resigned to well-to-do academic institutions, a few private individuals, very few . . . And it was pretty much considered lunatic fringe, there's no question about it, you know, weird space sounds . . . there was some rigid thinking about what's music and what isn't music, what's permissible and what's not, and then Carlos came along. Like Wham, and then suddenly the world thought, 'Oh yeah, this is great . . .'<sup>40</sup>

The use of the synthesizer to play conventional keyboard music, although with new timbres, further defined the Moog synthesizer as an instrument to be interpreted within the traditional genre of music. It may have been switched on – but it was still Bach. Curiously, when Moog went on the 'Today' show with his synthesizer, switching it on actually became an issue. There was a dispute between the electricians' union and the musicians' union as to who should switch on and operate the synthesizer.<sup>41</sup> Was it an electrical device or a musical instrument? Subsequently, there were many worries from the musicians' union that the synthesizer might cost them jobs.

Pop musicians and the newly emerging rock bands also took up the instrument with a vengeance. The Beatles used it on their album 'Abbey Road'. One of the popular songs from that era, George Harrison's 'Here Comes the Sun', utilises the spacy melodious tones of Moog, and the song 'Maxwell's Silver Hammer' uses the synthesizer to emulate a conventional instrument, the French Horn.<sup>42</sup> Keyboard 'whizzes' became associated with the synthesizer, people such as Keith Emerson and Rick Wakeman in the UK, and Don Preston in the US. One of the most familiar pop uses of the synthesizer was the closing bars to Emerson, Lake and Palmer's 'Lucky Man'.<sup>43</sup>

For both pop music and so-called serious music, the Moog synthesizer was increasingly being taken up as a keyboard instrument. The new-found success of the keyboard players with the instrument further helped define the meaning of the synthesizer. Obviously, in the modern recording industry, the success of records plays a key role in defining how sounds are heard and in recognising the capabilities of instruments.

The sound of the Moog and the sort of music that gets played on it can be contrasted with the sound of the Buchla. At the same time that 'Switched on Bach' was released, electronic music composer Mort Subotnick released 'Silver Apples of the Moon',<sup>44</sup> played on a Buchla. The weird, clearly electronic sounds on this recording represent a completely different genre of music and sound to 'Switched on Bach'.

The use of the Moog to play keyboard music in this way wasn't necessarily followed by all musicians. For instance, Weiss, although shown in the staged picture playing the keyboard, always used the instrument in his own compositions without the keyboard. Weiss:

I was interested in the synthesizer because it gave the potential of creating sounds that couldn't be produced by any other means. And create kinds of sounds, kinds of music, that you just simply couldn't orchestrate ... The beauty of it was you could conceive of a sound, or sound event, in your mind, and you wouldn't have a chance in hell of getting an orchestra to be able to create it ... When I used the synthesizer I didn't use the keyboard ever. That's a ... confusion that many people have a difficult time overcoming. They feel that a synthesizer is a keyboard instru-

ment . . . I had no interest in using the synthesizer to create instrumental sounds . . . if you wanted something to sound like a French Horn then play a French Horn. Why use this machine to do just that?<sup>45</sup>

We do not want to suggest a deterministic history of the synthesizer. That Weiss could use the Moog in this way reminds us again of the interpretative flexibility which resided in the synthesizer at this early stage of development. Other possibilities of construction and design always remain open on the margins (e.g., Buchla, although he experimented with keyboards, developed his own distinct controllers). We are describing the main commercial path of development. Since designs can always be reinterpreted and reconfigured, closure is never final.

The Moog synthesizer, like the Theremin before it, was quickly taken up by Hollywood. One obvious usage was its capabilities for producing sounds suitable for science fiction or horror movies.<sup>46</sup> Dave Borden, the musical director of *Mother Mallard*, told us how he was commissioned to do some sounds for the movie *'The Exorcist'*. 'I sent him three things and he used them all in the film . . . He paid me well for three minutes. It took me about one morning, he paid me a few thousand dollars . . .'<sup>47</sup>

The technical versatility and flexibility of the Moog was increasingly being exploited, and significantly, it was finally able to make the sound of music.

### **SWURPLEDEEWURPLEDEEZEECH!**<sup>48</sup>

The meaning given to the synthesizer as an instrument is inseparable from the kind of sound it produced. There is no doubt that the early synthesizers had a particular sound and this was related to the technology.<sup>49</sup> Several people told us that the distinctive sound of the Moog came from its voltage controlled filter. This filter was a unique design, and was the only element that Moog patented, although this did not prevent others from copying it.

The peculiarities of these early instruments were well known to musicians. There is a story told by Brian Eno of how his synthesizer (a VSC-3) developed a fault with a unit called the ring modulator. Eno loved the sound this fault produced, so every time he had his synthesizer serviced he attached a note to it telling the technician to leave the ring modulator alone.<sup>50</sup>



A similar story is told by Weiss about the musician Sun Ra, and his 'Solar Arkrestra', one of the most interesting characters to visit the Trumansburg shop. He always travelled with a huge entourage in a fleet of 20-year-old black Cadillacs:

He came to Trumansburg back in 1968. This was a fairly rigid sleepy little New York state town, and here's this bizarre looking Black guy in his robes and stuff sitting down in the local ice cream parlor . . . It was in the days of the Mini-Moog; he saw one and thought that he wanted to incorporate it into his act . . . I happened to hear this machine, and he had taken this synthesizer, and I don't know what he had done to it, but he made sounds like you had never heard in your life. I mean, just total inharmonic distortion all over the place, oscillators weren't oscillating any more, nothing was working, but it was fabulous. He had taken that machine and somehow, I know he hadn't gotten inside of it; who knows what he had done or what it had been subjected to, but he created these absolutely out-of-this-world sounds, that the engineers could never have anticipated. That's the important thing about all this, you know, that's analogue and this is even before integrated circuits, there was a lot of instability. Moog couldn't put his finger on it . . . So it really was an instrument more than a machine, we've been talking about it as a machine; it took on characteristics of whoever was using it.<sup>51</sup>

The inaccuracies of the instrument were something noted by Borden<sup>52</sup> and Weiss:

The interesting thing about the synthesizer is that the machine was not as accurate as all the engineers wanted it to be. And the wonderful thing about that is, there were characteristics of the Moog synthesizer that existed only because of certain inaccuracies in the equipment that resulted in wonderful and bizarre events, that were many times positive. Jim Scott [a Moog engineer] and I were talking about this just the other day, and Moog himself knew that himself. Here was a machine that was supposed to be absolutely infallible, you can't get anything more well-defined than a perfect sine wave, but it wasn't perfect. The oscillators wouldn't keep exactly perfect pitch, there would

be some drifting, depending on the temperature, depending on inaccuracies in the line voltage they would change. They were temperamental. One day you'd get something incredible, and you'd try and get it the next day and you couldn't. Your tape recorder was your best friend. If you got something, some incredibly complex sound, and you worked on it and you finally got it then you'd better get it down on tape because you'd probably never get it again. That was what was so wonderful about the machine, in the sense that it was an instrument, it wasn't machine. A machine would have created no inaccuracies, and I think that's why these computer digital generated sounds are not as interesting as the analogue sounds. Because they are too accurate . . .<sup>53</sup>

There is a paradox here that has created an interesting tension. Beginning with Moog, engineers have worked vigorously for years developing the synthesizer to be more and more closely able to mimic the sounds of conventional musical instruments. Eventually, they were able to produce synthesizers that, for most purposes, were indistinguishable from conventional instruments. Interestingly, the closer that the synthesizer came to this mimicry, that is, the more predictable and machine-like it became, the less interesting it was to many avant-garde musicians. The imprecision of the old instruments was eventually lost as the machines developed technologically, and Buchla's fear of the keyboard synthesizer becoming 'a disaster for the creative composer', may have been realised.

The imprecision was finessed out of the synthesizer by the engineers who recognized that making a more precise instrument was a fascinating puzzle (and who had, as time passed, more advanced components such as microprocessors), and the musicians who wanted to use it to emulate other instruments. This was not a determined outcome for the synthesizer, but the influence of the relevant social groups of engineers and musicians. The result was mixed: it worked for some musicians, but was lacking for others who preferred the analogue imprecision.

## SYNTHESIZER DAZE

No story of the early synthesizer days would be complete without some reference to the wider culture of which the synthesizer was

part, indeed an often over-looked part. The story of the synthesizer is not one of 'technological pessimism'<sup>54</sup> – for many people the technology was an integral part of the liberating late 1960s and early 1970s.

It is difficult to conceive of now, but during this period music was integrated into something much larger. The synthesizer, and the sound it produced, was part of the counter-culture, the 'sixties thing', and the psychedelic revolution. Life styles blended with the technology, communal living, and mind expansion were the order of the day, and music was often made, and listened to, in a mind-altered state. This is how people participated in the early Moog (and John Cage) concerts. Weiss described what was billed as the first ever live electronic music concert, held in the garden of the Museum of Modern Art in New York:

These machines came down the day of the concert, and the machines weren't ready. They were there but not working. We got them to the garden and Moog and his engineers were there with soldering irons up to the minute before the whole thing started. And it was wild . . . There was music, and it was cranking and it was cranking, and then the power went out. But nobody cared. It was in the garden at night, the garden at the museum was filled, it was outdoors and everyone cheered. It was like a happening . . .<sup>55</sup>

Experiencing the music was a form of transcendence, a way to mind expansion – especially the hypnotic minimalist style of bands such as Mother Mallard. Drove of people would show up and lie around stoned on the floor as the band played. The ability to use the synthesizer, and make such music, was also an expansive experience for many musicians. Linda Fisher, a New York artist and musician in Mother Mallard, described this way of experiencing the music in the course of a discussion as to whether the synthesizer is gendered:

My experience, whatever it was, whether it came from being a woman or just from being Linda, I'm sure most of it came from just being Linda, to be able to express that reality in sound gave me palettes that, you know, were really unimaginable to me before that . . . Living through that time was very intense politically, but there was also that sense that we

---

could do anything we wanted. It was very idealist that we could be who we wanted, of course, and always be totally politically responsible, and totally creative, everything, there really was that feeling in the early seventies.<sup>56</sup>

Weiss also describes a similar impression:

There was a real interest, there was an interest in expanding consciousness, which meant expanding musical palette, and, you know, creating environments and sound . . . I think we all, I think everyone was plotting for a brave new world. Everything would be a little nicer, everything would be a little more harmonious . . .<sup>57</sup>

Moog himself used to introduce Mother Mallard and attend many 'happenings', plus go to recording studios with musicians. But he was never part of the culture, or the music of the time:

'Back then I didn't have a hell of a lot of time to listen to it. I hardly knew who the Beatles were, I didn't know who the Grateful Dead was. You know, I learned about them over the years, but I just didn't sit around listening to music.'

There is no doubt that the 'spacy' sounds the synthesizer could produce perfectly matched people's explorations into inner-space. With bands such as Hawkwind and the Pink Floyd in Britain, and Jefferson Airplane in the US, who packaged their material with the imagery of outer space exploration, the synthesizer provided a means to experience all sorts of spaces.

## **CONCLUSION: MIRACLES OF SOUND**

The story of the analogue synthesizer is like that of many technologies. One meaning stabilises, and the other meanings slowly vanish or play a smaller role within niche markets. Also, as with many stories of technological innovation, the pioneers are often not the ones to receive the financial rewards. Although the Mini-Moog was a commercial success, the market for the modular units collapsed in 1970 after the recording industry became

disillusioned with the Carlos imitators. Moog never went bankrupt, but in 1971 was forced to sell his business and his name.

The meaning of the synthesizer as a keyboard instrument, a meaning which was slowly embedded in the technology, reinforced in the way the instrument was used and the type of music performed on it, and which in turn was responded to by changes in the technology (e.g., Mini-Moog), in the end wins out. The pay day only comes when Japanese companies such as Yamaha enter the market in the early 1980s, and every pop star had to have a keyboard synthesizer. Moog is by then out of the business, as were many of the early companies, missing out on what was, by 1990, a three-billion dollar a year business in the US alone. Today, Moog manufactures Theremin kits in North Carolina.

We have shown how an inventor/engineer, in collaboration with a relevant social group of musicians, initiated the idea for, and fashioned, a new kind of musical instrument. The Moog synthesizer allowed the musician to produce a previously unheard category of sounds. From a flexible variety of possible control configurations, the synthesizer eventually stabilised into a keyboard instrument, widely accepted by pop and rock musicians, composers, and creators of original sounds. As the keyboard synthesizer became established, a continuing design effort was made to make it predictable, easy to use in live performance, and to enable it to replicate the sound of conventional instruments. This allowed it to become widely available. The synthesizer had evolved into the instrument that everyone thought they wanted, but, as it lost its early promiscuity, it also lost some of its original appeal to instrumentalists, composers and engineers on the frontiers of musical creativity.

The synthesizer's stabilisation as a keyboard instrument, while an attempt to increase its versatility, and a major step in allowing wide distribution and maintaining its commercial viability, may have begun the process of delimiting its creative freedom. The synthesizer's musical identity, today almost indistinguishable as unusual to a new generation of listeners, still remains symbolic of the initial dream for an innovative instrument that could perform miracles of sound. The synthesizer, once an instrument upon which the radical musician could manufacture any sound he or she could imagine, has stabilised, perhaps where it originally began, as a magnificent music machine.

## ACKNOWLEDGEMENTS

We would like to thank the Lemelson Center for the Study of Invention and Innovation at the Smithsonian Institution National Museum of American History for supporting this work. We would also like to thank all the engineers and musicians who agreed to be interviewed.

## NOTES

1. For the early history of electronic music see T. Darter and G. Armbruster (eds.), *The Art of Electronic Music*, W. Morrow (New York, 1984). For an interesting account of the early days of the Cologne studio see Elena Ungeheuer, 'Concepts of Technology in the Early Days of Electronic Music', paper presented to the 23rd Symposium of the International Committee for the History of Technology, Budapest, Hungary, 7–11 August, 1996.
2. W. Bijker, T. Hughes and T. Pinch, *The Social Construction of Technological Systems: New Developments in the History and Sociology of Technology*, MIT Press (Cambridge, MA, 1987).
3. Ibid.
4. Ibid.
5. Our forays into the sociology of music have thus far been rather limited. There is undoubtedly a large strand of work in ethnomusicology which is relevant to this project. For some work in the sociology of music which we have found informative see Simon Frith and Andrew Goodwin (eds.), *On Record: Rock, Pop and the Written Word*, Routledge (London, 1990); Simon Frith (ed.), *Facing the Music: Essays on Pop, Rock and Culture*, Pantheon (New York, 1988); Simon Frith, *The Sociology of Rock*, Constable (London, 1978); Michael Chanan, *Repeated Takes: A Short History of Recording and its Effects on Music*, Verso (London, 1995); Peter Wicke, *Rock Music: Culture, Aesthetics and Sociology*, Cambridge University Press (Cambridge, 1993); Paul Friedlander, *Rock and Roll: A Social History*, Westview Press (Boulder, CO, 1996).
6. Interview with Robert Moog, 5 June, 1996.
7. R.A. Moog, 'Voltage-Controlled Electronic Music Modules', *Journal of the Audio Engineering Society*, July 1965, 13, No. 3, 200–206.
8. A control voltage which can be applied to any voltage-controlled parameter to give shape to a note.
9. A slide device for producing variable resistance.
10. A.V. Glinsky, *The Theremin in the Emergence of Electronic Music*, Ph.D. Thesis, New York University, 1992. See also the recent movie documenting the story of the Theremin, 'Theremin', directed by Steve Martin, Orion (Hollywood, 1995).
11. Moog's graduate research at Cornell was in low-temperature physics and had little direct connection with his pioneering development of the synthesizer.
12. Seley became head of the Department of Fine Arts at Cornell, and some of his sculptures of automobile fenders can still be found on campus.
13. Interview with Bob Moog, 5 June, 1996.
14. Ibid.
15. A circuit board whose components can be attached to pins, used for prototypes.
16. Interview with Bob Moog, 5 June, 1996.
17. Ibid.
18. Ibid.

19. Ibid.
20. The four controls found on the commonest type of envelope generator, which determine the relative shapes of the segments of the envelope.
21. Although he learnt piano as a kid, and likes and is knowledgeable about music, Moog does not regard himself as a musician.
22. Dave Borden, another Ithaca-based musician, also played a similar role as resident composer.
23. Interview with Bob Moog, 5 June, 1996.
24. Interview with Jon Weiss, May 1996.
25. See Marcel Mauss, 'Les Techniques du Corps', *Journal de Psychologie Normale et Pathologique*, 1934, 32, Nos. 3–4, 271–93.
26. Interview with David Borden, of Mother Mallard, 3 May, 1996.
27. See Jim Aikin's *Keyboard* interview with Buchla, reprinted in *The Art of Electronic Music*. For the early history of electronic music, see *The Art of Electronic Music* (1).
28. Interview with Don Buchla, 27 May, 1996. See also the interview in *Keyboard* in Darter and Armbruster (eds.), op. cit. (1). For the early history of electronic music, see *The Art of Electronic Music* (1). See also Mark Vail, 'Buchla's First Modular System: Still Going Strong After 30 Years', *Keyboard*, October 1992, 45–6, 48, 50.
29. Interview with Jon Weiss, June 1996.
30. It must also be added, however, that in one way Buchla's design is more conservative than Moog's. In the Buchla system, control voltages and signals are kept separate and designated by different wires and plugs. This means that with a Buchla it is hard to use an inappropriate signal voltage as a control. The Moog allowed for more experimentation in this respect and enabled some very unusual sounds to be made.
31. Instead of a keyboard, Buchla's touch sensitive controller was called the 'Kinesthetic Input Port'.
32. Interview with Bob Moog, 6 June, 1996.
33. Ibid.
34. Interview with Don Buchla, 27 May, 1996.
35. W. Carlos. 'Switched on Bach'. CBS Records, 1968.
36. I. Berger, 'The Switched on Bach Story', *Saturday Review*, 25 January, 1969, 45–7. Hubert Saal, 'Electric Bach', *Newsweek*, 3 February, 1969.
37. Interview with Bob Moog, 6 June, 1996.
38. 'Into Our Lives with Moog', *Time*, 7 March, 1969, 50–51.
39. One exception may be the film 'Last Escape from New York' by John Carpenter, 1981, the music for which was produced on a synthesizer. This film contains a superb rendering of Debussy's *La cathédrale engloutie*.
40. Interview with Jon Weiss, May 1996.
41. Interview with Dave Borden, 3 May, 1996.
42. George Harrison purchased a Moog Synthesizer in Los Angeles in November 1968. Harrison made an album of electronic music, 'Electronic Sounds', issued by the Apple experimental label 'Zapple'. On 'Abbey Road' John Lennon also uses the synthesizer on the track 'I want you'. Bob Moog told us that he thought he detected the sound of his synthesizer on an earlier Beatles track, 'Lucy in the Sky with Diamonds' on the album 'Sergeant Pepper's Lonely Heart Clubs Band'. However, in discographies of the Beatles' music (e.g. Ian MacDonald, *Revolution in the Head: The Beatles' Records and the Sixties*, Fourth Estate (London, 1994) there is no reference to a synthesizer being used on this track.
43. Emerson was a rare exception in taking the Moog modular synthesizer on live tour. Most musicians favoured the mini-Moog for live performance. For a rather more interesting use of the mini-Moog by a rock band, 'see' Don Preston's playing on various Frank Zappa and The Mothers of Invention albums (e.g. 'Lonesome Electric Turkey' on *Live at Fillmore East*). For Frank Zappa and a series of

- reflections on modernism, postmodernism and music see Ben Watson, *Frank Zappa – The Negative Dialectics of Poodle Play, Quartet* (London, 1995).
44. M. Subotnick. 'Silver Apples of the Moon'. Nonesuch Records, 1967.
  45. Interview with Jon Weiss, May 1996.
  46. This fits with Ben Watson's point that the avant garde is only taken up by mainstream culture in horror movies.
  47. Interview with Dave Borden, 3 May, 1996. The 'him' was the director Billy Friedkin.
  48. 'Swurpledeewurpledeezeech!' *Time*, 4 November, 1966: 44.
  49. For an exploration of the issues raised by trying to emulate conventional instruments see Trevor Pinch, 'Towards a Sociology of the Electronic Music Synthesizer: Some Ideas', paper given at CRICT, Brunel University, 8 February, 1995.
  50. Interview with Brian Eno, 'Keyboard' in *Art of Electronic Music* (1).
  51. Interview with Jon Weiss, May 1996.
  52. Interview with Dave Borden 3 May, 1996.
  53. Interview with Jon Weiss, June 1996.
  54. Y. Ezrahi, E. Mendelsohn and H. Segal, *Technology, Pessimism, and Postmodernism*, Kluwer Academic Publishers (Boston, 1994).
  55. Interview with Jon Weiss, June 1996.
  56. Interview with Linda Fisher, 14 May, 1996.
  57. Interview with Jon Weiss, June 1996.