"Digital Music"

by Brian Newbury

What it is & what it isn't...

"YOU SAY YOU WANT A REVOLUTION? WELL..."

The recorded sound. You've come a long way, baby.

From the telegraph to wax cylinders, phonographs to our current age of digital electronics, the compact disc and the amazing recent advances in MIDI (Musical Instrument Digital Interface) sequenced musical recordings: it has been quite a century of sounds—the "real," the "synthesized," as well as the "sampled."

Where did it all come from?

And more importantly, how revolutionary are the latest technological advances that have created a whole new world of recording techniques? Some of which have made musical sound reproduction faster, easier, and ultimately less expensive than ever imagined.

Perhaps a look back at the history of the reproduction of sound will provide a perspective before we tackle the present day world of this thing called MIDI.

"LET'S START AT THE VERY BEGINNING..."

Sound reproduction was originally invented by someone who wasn't looking for it at all.

Thomas Edison had already spent years keeping busy with a variety of new and improved telegraphs and by 1877 was experimenting with a method of recording and repeating telegraph signals. Because of an accident with a telegraph repeater and perhaps also because of his own defective hearing, he found that indentations placed into foil could store and reproduce the human voice and other sounds. Edison's invention of the cylinder phonograph caused an audio revolution throughout the world. Parlors that had previously been graced with a piano could now enjoy a new world of sound—from operatic arias to vaudeville skits (although they were limited to a maximum play time of just over three minutes).

Then, an engineer with the Copenhagen Telephone Company had a truly radical idea: to magnetize steel wire and then play back the original message without any physical change in the original recorded material.

Valdemar Poulsen was a Danish telephone engineer and inventor and was best known for his Telegraphone. By 1889 it was the first practical apparatus for magnetic sound recording and reproduction. The Telegraphone recorded the varying magnetic fields produced by a sound onto a wire. The magnetized wire could then be used to play back the sound.

Poulsen stretched this wire across his laboratory and put the recording apparatus on a trolley that traveled along that wire. He would run along with the moving trolley, talking into its microphone to record the sound. To play back this sound, he would roll a second trolley containing the playback equipment along the wire for the sound reproduction.

Having proven the principle of magnetic recording around the turn of the century, Poulsen and others began to develop wire recorders. In these devices, a wire rolling from one drum to another was used to record and play back sound. These wire recorders were the origin of what was to become the dominating recording industry standard for many years: magnetic tape.

The Synthesizer

The clicking of the telegraph receiver led to audio experimentation.

Due to the development of Dr. Thaddeus Cahill's electronic synthesizer, the Telharmonium, it was possible to hear music at the other end of 50 miles of wire used to send a telegraph message.

The Telharmonium consisted of a massive assembly of 145 electrical alternators, whose currents could be combined by using a keyboard to create a full range of musical notes. Although Cahill looked forward to the day when four concurrent services would provide electronic music, 24 hours a day, to subscribing commercial

Digital photography by Sam Burnette

establishments and private homes, the invention ultimately proved impractical, in part because the high currents that it produced interfered with adjoining telephone lines.

The earliest experimental telegraphs employed multiple connecting wires—in some cases a wire for each letter of the alphabet. Over time, simpler setups requiring fewer and fewer wires were developed.

"THEY TOLD MARCONI, WIRELESS WAS A PHONY..."

In 1895 Guglielmo Marconi would discover what was to become the "next best thing"—eventually—ground wave radio signals. Marconi became the first person to successfully transmit and receive long-range radio signals. Marconi, ignoring conventional wisdom, had discovered "radio" which was a historic milestone. His use of radio waves naturally led to speculation about future developments. However, unlike the telephone, which was quickly adopted for business and home use, it took many years before radio's financial returns would match its great potential.

"ALL I WANT IS A PHONOGRAPH"

Alexander Graham Bell used a cash prize for his invention of the telephone to finance independent research on better ways to record and reproduce sound. Bell's personal experience dealing with his own deafness, as was the case with Thomas Edison, was an incentive to find new and improved methods for recording and reproducing sound.

While Edison and the new Columbia Company competed for the music hits of the latest cylinder recordings, a relatively unknown inventor, with some success in the infant telephone industry, began to develop a new form of sound reproduction: the disc.

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Emile Berliner's first hand driven disc models were put on sale in Washington, DC as early as 1893. These single sided seven-inch discs were made of celluloid. The surface noise of the discs certainly kept sales down, and he was not taken seriously by any investors.

His new invention was called the gramophone.

The late 1800s and early 1900s were just bursting with new inventions that advanced the recording of sound:

- A method of spattering metal on non-conductive surfaces was achieved in 1884 and whose basic concept is found today in the modern Compact Disc
- A stereo record player was patented in 1898
- Edible records made of chocolate were a culinary delight in 1903
- The first picture record was sent through the mail in 1905
- The microgroove, long-play record was already a reality by 1908

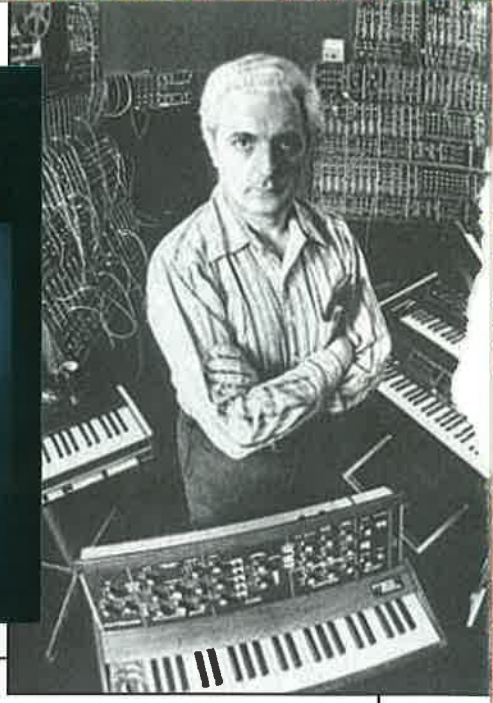
Although the synthesizer as a concept is a relatively new one, electronic instruments have been with us for a long time. The world's first electronic instrument was invented by Leon Theremin in 1920. The "Theremin" is one of the few electronic instruments that does not require contact to play—you simply wave your hands in the air around two antennas to activate its sound. The Theremin can be heard on numerous recordings, such as the soundtrack to Forbidden Planet and the song "Good Vibrations" by the Beach Boys.

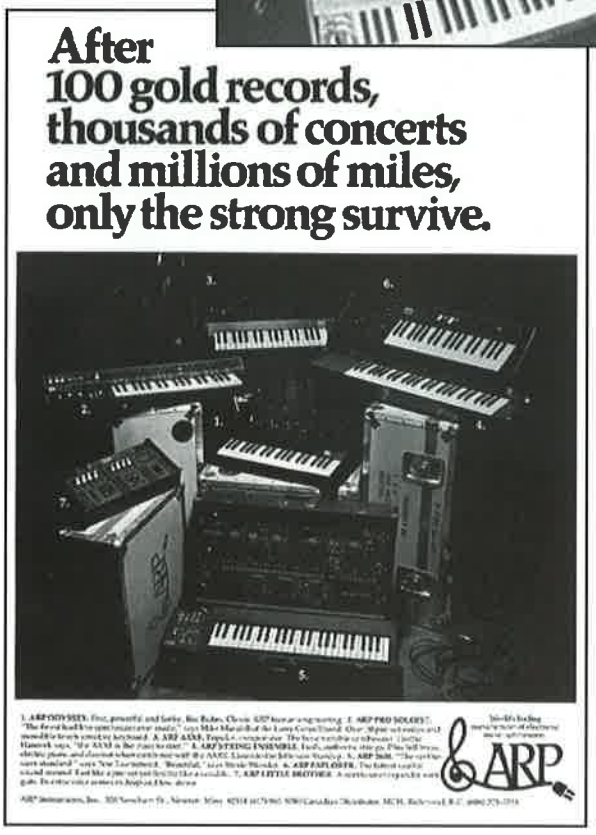
Most of the rest of the electronic instruments produced in the '20s, '30s, and '40s were of the electric organ variety. Most noteworthy is the electronic organ made by the Hammond Company, which was first introduced in 1935. The Hammond Organ became one of the most respected and collected musical instruments of the 20th Century.

The first generation of synthesizers were extremely difficult to handle. They were costly, very large in size and could be found in only the very few modern recording studios of the day. They were not terribly reliable as musical instruments either—they needed a long warm-up period and would quickly drift out of tune.

The synthesizer's ability to create completely new, unheard sounds was its initial claim to fame, and it wasn't until the 1950s that electronic instruments began to be treated more seriously. This was primarily due to the newly invented method of capturing sound recordings: magnetic tape.

Sounds could now be recorded on this new magnetic tape, then have the music pitch electronically raised or lowered, then the tape could be spliced, and/or looped. The final result was an entirely new musical composition from the original acoustic sound recording.





The difference between acoustic and electronic instruments, by the way, is that acoustic instruments are all mechanical—something must be moving or resonating for sounds to be created. Synthesizers, on the other hand, do not create direct sounds—only electric signals. Without loudspeakers or headphones to amplify the signals, we'd never hear a sound from a "synth." CD players work very much the same way in that they do not make direct

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sounds either, only electric signals that are turned into sounds with the aid of speakers or headphones.

Many tape studios in the '50s and into the '60s started looking beyond the real world for sounds and began collecting a wide variety of electronic devices to help produce these new sound creations, such as oscillators, amplifiers, and other signal processing devices.

In the mid 1960s the Beatles used tape loops such as backward guitar solos in several songs, and also a Mellotron (an early "sampler" that used tape loops to create its sound) on others. Film composers too were looking for ways to create unique sounds as well. Commercial synthesizers began to be manufactured and the music recording industry would never be the same.

The first "portable" synthesizer was the Minimoog, designed by the American engineer Robert Moog in 1971. At the end of the 1970s the first programmable synthesizers appeared, such as the infamous Prophet 5. These synths were state-of-the art at the time and were also extremely expensive.

"THE TIMES THEY ARE A' ...Digital..."

Technology has propelled us into the digital domain, and synthesizers have incorporated new digital technology into their latest styles.

Internal digital sounds are stored in memory as numbers. When a sound is activated, the microprocessor inside the digital synth retrieves these numbers from the memory and converts them to actual sound with the utmost speed and precision.

The first wave of digital synthesizers had a slick and clean design where the user could program the instrument using a menu-driven operating system.

Today, new recording systems that originated from early synthesizers are at the forefront of music technology, and all the programming is done with switches, touch-sensitive screens, and computers.

Digital Sampling has been perfected to the point where actual musical instrument sounds are recorded, stored, then triggered to play back at the touch of a keystroke. Music producers can now create a virtual "orchestra" from internal digitally sampled data.

"CHH, CHH, CHH, CHH, CHANGES..."

Sound recording and the synthesizer have undergone some radical changes in the last one hundred or so years. Today a wide variety of techniques and methods for creating sound are possible. But the basic concept has very much remained the same all this time. Start with an electronically generated signal, process the signal and emerge with a sound that is pleasing to the ear, at a cost these days that is also a pleasant experience.

About the Author

Brian Newbury is a freelance writer and sponsorship marketing consultant for radio and television producers, as well as a jazz musician. He makes his home in Los Angeles, California.

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Interview with Electronic Music Expert, Bert Elliott

For a truly professional view of modern day electronic music recording I talked to an expert, Bert Elliott. Since 1980, Bert Elliott Sound, Inc., an audio post production house, has been home for many commercial, corporate, and music business related clients. In the airline industry, he's produced music for Air Belgium, Air Jamaica, Aerolineus Argentinus, Aero Mexico, America West, Avianca, Delta Air Lines, Royal Brunei, Tower Air, US Airways, Varig, and more. Bert designs sound for film and video and is also a location sound recordist. His experience in sound design goes right along with the creation of original music.

I talked with Bert at his Atlanta recording studio about the evolution of recording technology that he has lived through personally over the last 30 years.

Newbury: *So Bert, we've been talking about the history of recorded sound and electronic music, but can you tell me a little about what tools are currently used today, like MIDI for instance. Talk about what MIDI is and especially what it isn't.*

Elliott: "First of all MIDI should not be mistaken as reproduced sound. It's an acronym for Musical Instrument Digital Interface. MIDI makes it possible to electronically activate sounds that were originally played on an electronic keyboard or other triggering devices by a musician. The actual sounds are generated through sound modules containing hundreds of sounds of different instruments. The different sound modules interface with each other by way of a MIDI cable. That is what MIDI is all about, the interfacing of multiple sound modules.

Now the sequencer, another tool, allows a composer to create a piece of music playing one instrument at a time. The first instrument is recorded as a guide track. Then, while listening back to the guide track, the musician records another instruments' part and on and on. There is no limitation to the amount of parts or tracks. A full symphony orchestra is at the lone composer's fingertips.

So that's what MIDI is. Really the only thing MIDI isn't is a totally human experience. To me there's nothing like a live performance. Of course that would take a lot of bodies, one for each instrument. That could get expensive."

Newbury: *Well, then why not use MIDI for everything?*

Elliott: "I say use it, but don't over use it. Look at it as the tool it has become. (And a great tool it is). I like to bring in as many different musicians as a budget will allow to enhance the MIDI sounds. The sound becomes amazingly human."

Newbury: *Looking back to the fairly recent history of synthesizers, what are your thoughts on the famous "Switched-on Bach" Moog Synth recording from the late 1960's?*

Elliott: "Oh yeah, that record changed a lot of things in the studio - and for the better. The Moog Synthesizer sound was really embraced by musicians and recording studios everywhere. Multiple track recordings—16 then 24 track grew directly from that monumental recording. Then with multiple track capability came the ability to overdub: to record a part while listening back to previously recorded parts…much like the sequencers of today. That made it possible to record instruments separately on separate tracks of analogue tape and be able to control each instruments loudness, treble and bass, etc."

Newbury: *The late 60's and early 70's were groundbreaking days for electronic music then?*

Elliott: "Absolutely. Before that, the really early days of electronic music, the sounds they ended up with were really not very musical…[they were] very experimental and electronic sounding. "Switched on Bach," and then CLOCKWORK ORANGE were the introductions of electronic music, in my view, that finally sounded musical and pleasing to the ear. Of course today synthesized and sampled sounds have become so refined that most human ears can be easily convinced that the electronic music is real. The subtitles of human performance can be created using sequencing tools. These same tools can be traced directly to these early recording milestones."

Newbury: *Why was the music from the film CLOCKWORK ORANGE so important?*

Elliott: "CLOCKWORK ORANGE was significant because it brought Synthesized music to the forefront by way of the enormous popularity of that movie. Plus Wendy Carlos (the musician responsible for these recordings) was very smart in using Bach and then Beethoven with all of the counterpoint compositions of single musical lines. The Moog could handle one musical line at a time but was fairly limited in the way of chords."

Newbury: *Seems like ancient history now doesn't it?*

Elliott: "Back in those days you could only play one note at a time—it was not possible to play a chord or more than one note at any one time. A characteristic of modern day synthesis, for example, is pressing one note on a MIDI keyboard and a full orchestral sound can be heard."

Newbury: *What about a live orchestra versus a synthesized and sampled performance?*

Elliott: "Although it is possible to create a wonderful sound with synthesis and sequencing, it is much harder, in a totally synthesized and sequenced world, to create the magic of music. Because the real magic comes from the interaction between musicians in a live performance…it just happens...these days producers with limited budgets are forced to make it happen by bringing into the studio at least a few live musicians playing real acoustic instruments. Even that limited human addition to the synthesized sequenced track, many times, will create a magical result."

Newbury: *Is there some sort of a happy medium these days?*

Elliott: "I think so. As a matter of fact that's really the key to making a quality music product. When it was first available, MIDI was the most popular and easiest way to produce a piece of music. But to make a musical piece sound more real and have that magical spark, we would add at least a couple acoustic instruments (Violins or horns, etc.).

I've been in business twenty-five years here in Atlanta and over the years I've surrounded myself with the very best of musical talents. The combination of the latest technology and the best musicians equal a world class musical product."

Newbury: *Walk me through the current "state-of-the-art" and how AVION readers in the airline industry may be affected.*

Elliott: "With the advancement in technology, especially in synthesized and sampled music, and the use of MIDI and sequencing, the In-flight Entertainment Business is in a pretty favorable position. That is being able to offer beautifully produced music while still being cost effective.

The number of airlines who have opted for custom music for their audio programming channels or for their boarding music, can be counted on the fingers of one hand. But you don't have to be a large airline to have custom audio programming that is economical and a quality musical product. There are real advantages in doing so—particularly if an airline only uses boarding music, but does not feature In-flight Entertainment, in which case licensing fees are eliminated. In the past, and even today, airlines pay enormous licensing fees for the right to play prerecorded music. I see today's technology as a way for In-flight Entertainment Managers to save a lot of money and be able to offer original music."

More information on Bert Elliott at www.bertelliottsound.com