

Is It Live or Is It Memory?

A Brief History of Sound Recording

ATHENAEUM SOCIETY OF HOPKINSVILLE

September 3, 2015

Steve DeMoss

Steve DeMoss

Athenaeum Society of Hopkinsville

September 3, 2015

Is It Live or Is It Memory?

In May of 1973, I did something that many musicians have on their bucket lists – I entered a recording studio with my progressive rock band and spent five days recording two songs. Our two symphonic rock epics were, hopefully, artfully crafted with the help of a couple of young engineers who liked what we were trying to do.

In truth, it wasn't a state of the art facility, but we didn't care. It was a *real* recording studio, with one big room, a couple of small booths for vocals and drums, and a control room. A \$14,000 Scully 16-track recorder occupied a prominent place in the control room. We recorded our basic tracks playing together as a band in the large room, and then we would overdub additional parts onto vacant tracks on the 2" tape on the Scully. Since we were in search of symphonic rock excellence, *lots* of additional parts were overdubbed over the five days we spent in the studio. The sixteen tracks of each of the songs we recorded were mixed down to a stereo ¼" reel-to-reel tape that could be played for a record company's artists and repertoire man.

Sadly, the songs recorded by the band never made it onto vinyl. We went to New York City in search of a recording contract, talking to A&R people at Columbia and Arista Records, but no offers were forthcoming and the band broke up in October of the same year.

By the time my band began its studio sessions, we had all recorded songs at home. The idea that we could book time in a recording studio was something we took for granted. However, it wasn't so long ago that the ability to record and reproduce sound didn't even exist.

This recording (plays the recorded voice of Thomas Edison reciting Mary Had A Little Lamb) is considered to be the first time that sound was recorded in a reproducible form. The voice is that of Thomas Edison, who is generally acknowledged as the father of sound

recording. However, while many historians give the credit to Edison, the truth is that attempts at recording sound date back at least to the early 1800s, when Jean-Marie Duhamel, a French mathematician and physicist, discovered that by strapping a pen to a tuning fork and then tapping the fork, the pen would trace a wiggly line on a piece of paper.

In 1807, English physicist Thomas Young described a 'vibrograph' used to measure the frequency of a tuning fork by etching the vibration of the fork into the surface of a wax-covered cylinder.

In 1856 another Frenchman, Leon Scott, introduced an invention he called the *phonautograph*, which used a cone-shaped horn to capture sound and focus it on a membrane to which was attached a pointed stylus that would inscribe a visual representation of the sound on a soot-covered glass cylinder.

One rather gruesome attempt at capturing sound waves was made by the inventor of the telephone. In 1874, Alexander Graham Bell tested a machine of his own design that used the ear, part of the skull, and the internal hearing-related parts of a cadaver. He called it the "ear phonautograph". After attaching a hay stalk to one of the tiny ear bones, Bell arranged the mechanism so that the stalk would scratch out a trace on the glass of the phonautograph.

The "French Edison", Charles Cros, disclosed his ideas for a machine that would record and reproduce sound, which he called the *parleóphone*. Since he lacked the funds to apply for a patent, he wrote up a description of his invention and sent it to the French Academy of Science. He proposed to make an ordinary phonautograph recording in the form of a spiral on a graphite-covered disc, which would then be used to make a permanent master copy. The copy could then be placed back onto the *parleóphone* and the original sound would issue forth from the device's horn when the stylus traveled through the groove

This brings us to the Wizard of Menlo Park – Thomas Edison. Edison had a background in telegraphy and had worked as a telegraph operator as a teenager. During several years in the 1860s and 1870s, Edison worked at producing improvements in telegraph technology and

trying to interest investors. Two of his inventions from that time period, the stock ticker and the quadruplex telegraph, earned him a reputation as an expert in the field. Since the telephone used many parts taken almost directly from telegraph technology, Edison took an immediate interest in Bell's telephone.

One of Edison's first ideas was a telephone recording device that used a strip of paper coated with wax. However, Edison soon discarded this idea as being unworkable and instead turned his attention to recording sound directly from the air.

Edison's phonograph, introduced in 1877, was a device with a hand cranked steel cylinder covered with tin foil upon which a stylus etched grooves. The depth of the grooves corresponded to changes in air pressure created by the original sound. Playback was accomplished by tracing a stylus through the grooves. The stylus was connected to a funnel-shaped horn via a flexible diaphragm. Edison's device would both record and reproduce sound.

A company called the Edison Speaking Phonograph Company was formed by investor Gardiner Hubbard, who paid Edison \$10,000 for the manufacturing and sales rights to the phonograph. Edison collected thousands of dollars in royalties during the first year of exhibiting his invention.

Other inventors sought to improve upon Edison's idea. Alexander Graham Bell's brother, Chichester, and Charles Sumner Tainter, working in Bell's laboratory developed a machine they called the graphophone. Using wax-coated cardboard cylinders, the graphophone improved upon the phonograph in several ways. The American Graphophone Company, formed in 1887, later evolved into a company called Columbia Records.

The record market changed in 1894 with the introduction of the gramophone, invented by German immigrant Emile Berliner. Using a flat shellac disc rather than a cylinder, the home versions of the gramophone were incapable of recording. Although early disc and cylinder recordings had about the same audio fidelity, the 78 rpm discs were easier and cheaper to mass produce.

In 1901, the Victor Talking Machine Company was formed. The label's trademark was an English bull terrier gazing quizzically at the horn of a gramophone accompanied by the words "His Master's Voice". Victor's disc player, the Victrola, came out five years later. For several years, disc and cylinder records battled it out in the marketplace until finally, in 1912, the Edison Phonograph Company capitulated and began offering disc phonographs and records for sale.

Meanwhile, Edison and Columbia Records sought to open another market for their recording devices – the business world. After an unsuccessful first attempt by both entities, "mechanical dictation" began to catch on in the early 1900s. Columbia split off its business product and called it the Dictaphone. A few years later, Edison's competing office product would be renamed the Ediphone.

All of this innovation took place in the first era of sound recording – the Acoustic Era, which lasted from 1877 to 1925 during which the sound of a musical performance was captured by a funnel-shaped horn connected to a moving diaphragm. The fidelity of records from the acoustic era was necessarily limited.

Magnetic recording was demonstrated in principle as early as 1898 by Valdemar Poulsen in his telegraphone, which used wire spools and looked and worked somewhat like a tape recorder. The American Telegraphone Company began manufacturing in Wheeling, West Virginia, producing a few hundred telegraphones, mainly used in offices. The machines required considerable maintenance, and by 1920, American Telegraphone was out of business.

Then came the telephone man...

Several developments in telephone technology ushered in the next era of sound recording, the Electrical Era. After a decade of research that brought forth the vacuum tube amplifier, the condenser microphone, and the balanced-armature loudspeaker, Western Electric introduced a new integrated recording system, called "Westrex", comprised of the aforementioned inventions coupled with an acoustic recorder in 1925. This system was first licensed to Victor, who used it in April of that year to make the first electrical recording of the

Philadelphia Orchestra. A new playback system, also designed by Western Electric, was sold in October of 1925 by Victor as the Orthophonic phonograph, "orthophonic" referring to uniform sound at all frequencies.

The Westrex system revolutionized studio recording. Unlike acoustic recording, which used a sound receiving horn which had to be judiciously placed in order to evenly pick up the sound of an ensemble, the Westrex system used microphones whose signals could be mixed electronically to form a single signal. Amplifiers made it possible to spread musicians farther apart in the studio, freeing up their playing styles. Amplifiers in the recording circuit made it possible to boost soft sounds and cut loud ones. It was a revolution in sound.

The Westrex system was also used to record sound for motion pictures, which was played back from 16" discs on special turntables operating at 33-1/3 rpm.

In 1926, Victor displayed a phonograph that replaced the conventional horn and diaphragm with an electric pickup and connected to a special jack on the back of a Victor radio, thus allowing the phonograph to share the amplifying circuitry of the radio, resulting in improved sound and the ability to adjust the volume of the music. With the old acoustic phonographs, if one desired lower volume it was common practice to insert a sock into the mouth of the horn, thus giving rise to the phrase "put a sock in it"! By the end of the 1930s, plug-in or stand-alone electrical phonographs virtually replaced the acoustical phonograph.

Even though recording technology was better than ever, record companies themselves were failing due to competition from radio and the effects of the Great Depression. Edison dropped out of the phonograph business altogether in 1929 and Victor was purchased by the Radio Corporation of America in the same year. In 1934, Columbia was absorbed by the new Columbia Broadcasting System after several years of flagging sales.

Recording onto tape was still in its infancy in the 1930s. On Christmas Day, 1932 the British Broadcasting Corporation first used a steel tape recorder for their broadcasts, a huge and dangerous machine which used steel razor tape 0.1" wide and 0.003" thick running at

approximately 300 feet per minute past the recording and reproducing heads. This meant that the length of tape required for a half-hour program was nearly 1.9 mi and a full reel weighed 55 pounds!

In 1935, engineers at AEG (*Allgemeine Elektrizitäts-Gesellschaft*) in Germany, in cooperation with IG Farben, demonstrated the first practical magnetic tape recorder, the K1. By 1943, AEG had developed stereo tape recorders.

Our military, meanwhile, was carrying out a development project that used a tape recorder in a novel way. Western Electric had developed a small but powerful public address system called "the heater". A Bell Labs proposal involved fitting the heater and a magnetic tape recorder inside a 21-foot torpedo. When it neared the shore of enemy-occupied territory, the torpedo would automatically stop, drop anchor, and then float vertically with its nose above the water. The nose cone would pop off and a loudspeaker would emerge and aim itself at the shore, playing back the sounds of a fake invasion from the tape recorder. It is not known how many of these devices were produced, nor how successfully they were deployed.

The Magnetic Era of sound recording got its start in part thanks to American audio engineer John T. Mullin and entertainer Bing Crosby. Mullin served in the U.S. Army Signal Corps, and was given two suitcase-sized AEG high-fidelity recorders and fifty reels of recording tape near the end of the war. He had them shipped home and over the next two years he worked to improve their performance.

Mullin gave two public demonstrations of his machines, and by luck, in the audience at Mullin's second demonstration was Bing Crosby's technical director, who arranged for Mullin to meet Crosby. In June 1947, he gave Crosby a private demonstration of his magnetic tape recorders.

Crosby was stunned by the amazing sound quality and instantly saw the huge commercial potential of the new machines. Live music was the standard for American radio at the time, but Crosby disliked doing live broadcasts, preferring the relaxed atmosphere of the

recording studio. He had asked NBC to let him pre-record his 1944–45 series on transcription discs, but the network refused, so Crosby had withdrawn from live radio for a year, returning for the 1946–47 season only reluctantly.

Crosby realized that the tape recorder would enable him to pre-record his radio show with a sound quality that equaled live broadcasts. Tape could also be edited to give the shows the flow that Crosby desired. Mullin was hired as Crosby's chief engineer to pre-record the series, and Crosby became the first major American music star to use tape to pre-record radio broadcasts. Wanting to make use of the new recorders as soon as possible, Crosby invested \$50,000 of his own money in Ampex, which soon became a world leader in tape recording.

Magnetic tape media development was also being carried out by the Minnesota Mining and Manufacturing Corporation, today known as 3M. The company's Scotch brand magnetic recording tape became a staple of recording studios the world over.

The first development in multitrack recording was two-track recording. Two-track quickly became the norm because it enabled signals from two separate microphones to be recorded simultaneously, enabling stereophonic recordings to be made and edited easily. Stereo quickly became the norm for the recording of classical music, although many pop and jazz recordings continued to be issued in monophonic into the mid-1960s.

Guitarist Les Paul ordered the first recorder capable of recording eight parallel tracks on a two-inch tape from Ampex in 1956. The recorder allowed one track to be recorded while other previously recorded tracks were playing back, a development Ampex called Sel-Sync. Les Paul and Mary Ford's multi-layered recordings pioneered many techniques still in use by recording artists today, and brought multitrack recording to the attention of many other musicians and engineers.

Multitrack recording came to the fore in the 1960s in recordings by such artists as the Beach Boys and the Beatles. Brian Wilson, the musical mastermind of the Beach Boys, took three months, five studios, and seventeen recording sessions just to finish the song *Good*

Vibrations. The album in which the song is featured, *Pet Sounds*, contains some of the Beach Boys' finest music, with densely layered, almost symphonic arrangements.

The Beatles took the release of *Pet Sounds* as a challenge. Working at Abbey Road Studios in London, the band spent 129 days during 1966 and 1967 to record *Sgt. Pepper's Lonely Hearts Club Band* using two separate four-track recorders. Many of the layering techniques used by Brian Wilson of the Beach Boys were also employed by the Beatles. By one account, the album took 700 hours to record and mix.

The first 8-track tape machines became commercially available in late 1967, and by 1970, the track count was up to 24. More tracks meant more possibilities for musicians and singers to realize their artistic vision and more flexibility in how and when certain parts could be added to an arrangement.

All this time, the final medium for the musical consumer was the 12", 33-1/3 rpm LP. Stereophonic mastering had become the norm for classical, jazz and popular music, using the Westrex 45-45 standard, universally adopted late in 1957. However, well into the 1960s, two separate versions of LPs were commonly released – one in monophonic and the other a stereophonic version, with the mono version often being the artist's original concept.

Before 1963, when Philips introduced the compact audio cassette, almost all tape recording had been done on open reel equipment. The Philips compact cassette gained in popularity in the decade after its introduction, although recorded sound on cassettes remained lower in quality than that of other tape formats. As cassettes grew more popular, attempts were made to reduce the tape hiss inherent in the small format. The most popular remedy was from Dolby Laboratories, whose Dolby B system reduced hiss when cassettes were played back.

Many studios today still have analog multitrack recorders in their control rooms for clients who prefer the warmth of analog. Some artists prefer to record their original tracks to analog tape and then transfer those tracks to digital for final mastering, which brings us to the current era of sound recording.

The Digital Era actually began in 1972, with the introduction of digital 8-track reel-to-reel equipment by Denon. Soundstream, Mitsubishi and other manufacturers soon introduced their own PCM digital tape recorders, in which the analog signal is sampled at regular intervals and the amplitude and frequency of the samples translated into binary format. Most early digital recordings were of classical music and were transferred to high-quality vinyl LPs. In 1978, Telarc's recording of Frederick Fennell and the Eastman Wind Ensemble playing Holst's *Suites for Military Band* and Handel's *Music for the Royal Fireworks* became the first digitally-recorded classical release in the United States. The first all-digital pop music album with vocals released in this country was Ry Cooder's *Bop 'Til You Drop*, in 1979. All-digital studio recordings soon became the norm.

As personal computers advanced, becoming faster and more powerful, dedicated recording hardware soon was no longer necessary. With the introduction of digital audio workstation software packages such as Avid's Pro Tools, Steinberg's Cubase and others, studios could have unlimited audio tracks, non-destructive editing, software-based signal processing, automated mixing, and the ability to easily share files and collaborate over long distances. Such is the standard in today's recording studios – the computer (usually an Apple Macintosh Pro), a few dozen channels of analog to digital audio converters and preamps, a control surface with motorized faders, and lots of monitor screens to display all of the various parameters that are in play.

We have seen the changes brought about by digital audio in the studio, but up until the late 1970s, albums that were digitally recorded still wound up as analog LPs. A change was necessary in consumer playback equipment in order to improve the listening experience for the home listener.

In 1979, Japanese electronics giant Sony and Dutch electronics conglomerate Philips demonstrated the digital compact disc, or CD, which can hold roughly 80 minutes of music or 700 megabytes of digital information. CDs were not a commercial overnight success. Sony's

first player to be marketed in the United States sold for around \$2,000, and album releases on CD sold for anywhere from \$12-\$15 at a time when most albums were retailing for around \$8. It was not until 1994 that the CD outsold cassettes worldwide.

But consumers *did* grow to love the CD for a time. In 2004, worldwide sales of audio CDs, CD-ROMs and CD-Rs reached about 30 billion discs. By 2007, 200 billion CDs had been sold worldwide.

However, with the advent and popularity of portable music players like Apple's iPod and Internet-based distribution of song files in formats such as MP3, sales of CDs began dropping in the late 2000s. During the eight-year period ending in 2008, despite overall growth in music sales, major-label CD sales declined overall by 20%. The future of music distribution seems to lie with a combination of streaming audio, downloadable digital audio files and CD sales via mass marketers and online outlets. Many artists now bypass traditional record labels and market their music themselves via iTunes and others.

Digital audio seems to have hit the sweet spot that inventors and engineers have been striving for since the beginning of the recording industry. Covering the audible frequency spectrum of 20-20,000 Hz, with lifelike dynamic range and nearly inaudible background noise, there seems to be little room for improvement except to satisfy a few purists.

Recording of original material, likewise, is more accessible and less costly than ever. A budding songwriter can put together a home studio with a computer, a digital audio interface and workstation software, a microphone, and headphones, and only have to spend a few hundred dollars. Musical publications refer to the "democratization" of the recording process, in which the songwriter or artist retains control of his music with record companies having less influence in music buyers' purchasing decisions. In the recording business, change seems to be the only constant.

And here's a postscript: The music my band, Pre, recorded in 1973 never wound up on vinyl. But in 1994, a small independent label pressed a couple thousand CDs and sold them

worldwide through mail order. I even heard that it was played on a radio station in Rome for a while! I earned \$37.50 in royalties, after the record company recouped its expenses.

These days, I routinely encounter people who reminisce to me about the good old days of vinyl LPs. When they talk about the “warmth” of vinyl, I counter with vinyl’s pops and crackles. When they extol the virtues of analog, I remind them of the drawbacks – limited dynamic range, more background noise, lower frequency response and the fact that each play of a vinyl LP degrades the performance of the audio for the next time it’s played. I lived through the LP, reel-to-reel, 8-track and cassette days and I’m not nostalgic for them. Thirty years ago, my home studio was limited to four tracks on a reel-to-reel recorder. Now I have an unlimited number of tracks at my disposal with pristine sound quality, and it’s all in a desktop computer that allows me to easily edit my music and track the changes so I can revert to a previous version of my work if I like.

To the analog purists, I say this: keep your warmth. I’ll take my digital. It’s been a fun ride, and it can only get better.

References

Morton, David L, Jr., *Sound Recording, The Life Story of a Technology*. The Johns Hopkins University Press, 2004

Horning, Susan Schmidt, *Chasing Sound – Technology, Culture & the Art of Studio Recording from Edison to the LP*. The Johns Hopkins University Press, 2013

Vander Lugt, Mason. *Phonograph History*. SoundBeat.org, 2013

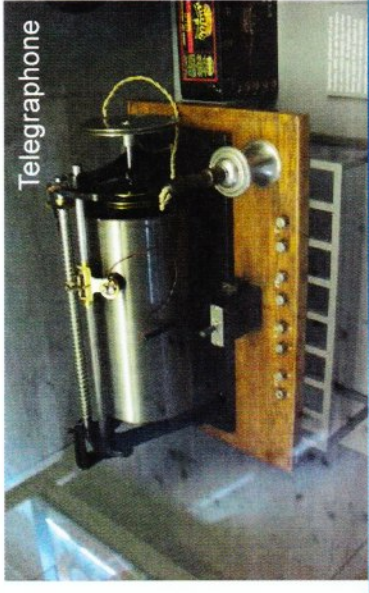
Wikipedia contributors. "*History of Sound Recording*." Wikipedia, The Free Encyclopedia, 2014. Web.

Schoenherr, Stephen E. "*Sound Recording Research at Bell Labs*." www.AES.org, The Official Website of the Audio Engineering Society, 1999. Web.

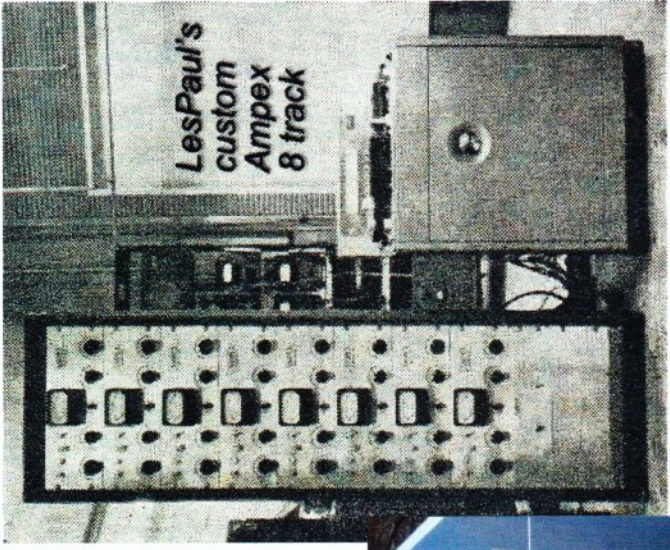
Recorded Sound Section, Library of Congress. "*A Recorded Sound Timeline*." Compilation from various sources. www.local.gov. Web.



Edison Phonograph,
ca. 1899



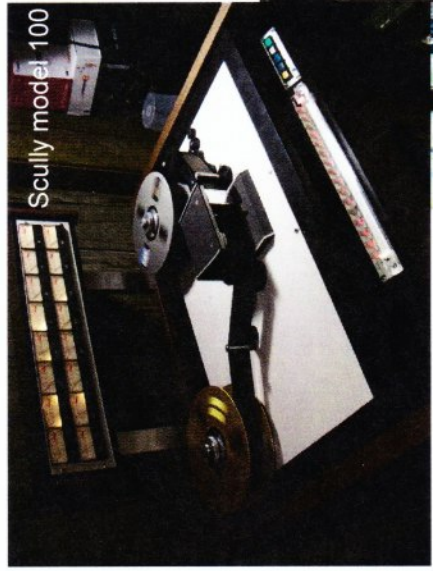
Telegraphone



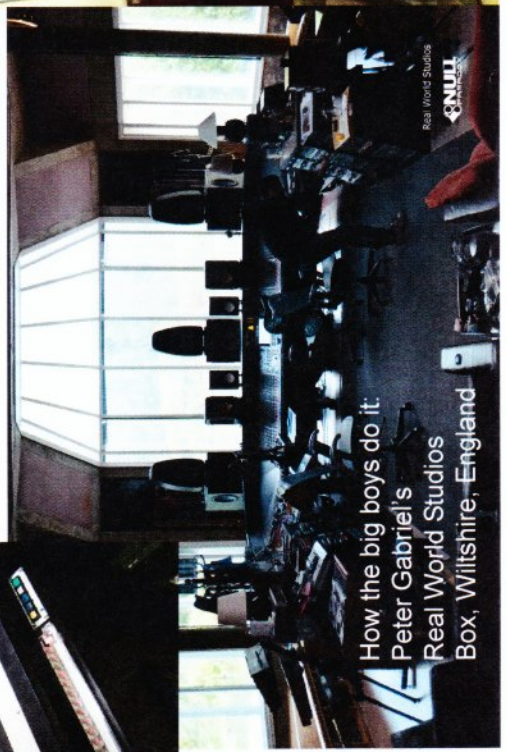
LesPaul's
custom
Ampex
8 track



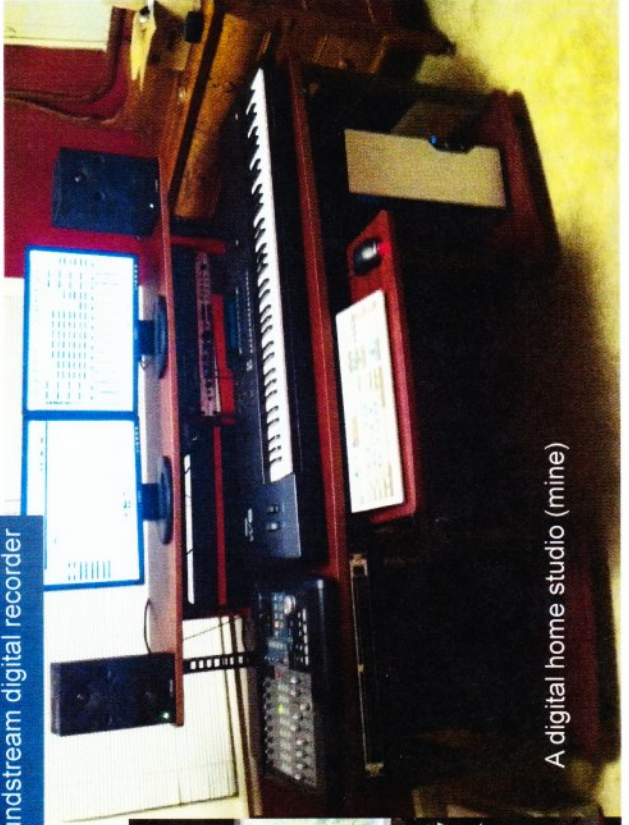
Soundstream digital recorder



Scully model 100



How the big boys do it:
Peter Gabriel's
Real World Studios
Box, Wiltshire, England



A digital home studio (mine)