Sound for the masses

Perfecting Sound Forever: An Aural History of Recorded Music
by Greg Milner
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The first person to make a reproducible recording of sound was not Thomas Edison. As Greg Milner explains in *Perfecting Sound Forever*, it was a French printer, Edouard-Léon Scott de Martinville, who etched sound waves on to a thin film of soot in 1857, some two decades before Edison. It took another 150 years for Scott de Martinville's recording of the human voice to be heard. In March 2008, scientists at the Lawrence Berkeley National Laboratory in Berkeley, California, devised a way of reproducing the sounds he had captured in soot, and the recording — ten seconds of the popular folk song 'Au Clair de la Lune' — was 'played' for the first time.

So Edison's phonograph was the first practical machine for recording the human voice. Milner's book charts the history of recorded music from the late nineteenth century to today, examining how the role of recording has evolved, from merely capturing sound to creating it. Pioneers such as Edison could exert little influence on the recording process other than positioning performers in front of an acoustic horn, offering advice on voice projection or warming the wax on the phonograph's recording cylinder. And once the performance was under way, they could only stand back; a few minutes' worth of sound waves were etched on to the surface of a wax cylinder to create a permanent record (see page 351).

The advent of electrical recording in the 1920s gave recording engineers more scope for shaping sounds by positioning microphones to emphasize certain instruments at certain times. But recording remained passive, the electrical impulses being fed straight from the microphone to a gramophone disc-cutting machine.

Magnetic tape brought with it the possibility of editing, blowing away the notion of a recording being a reproduction of a real-time event. When the Bing Crosby *Philco Radio Time* show aired in October 1947, the audience thought it was hearing a live performance. It wasn't. The show had been recorded in August and the aired version stitched together from different takes, to remove mistakes and improve the flow. The man wielding the editing scissors was Jack Mullin, who had spent the Second World War monitoring communications for the Allies and marvelling at the clarity of the music he had listened to on German radio. At the end of the war, Mullin visited Radio Frankfurt at Bad Neuheim and discovered the source of that quality — Magnetophon tape recorders, superior to any recording device in the United States. He shipped two of them home and used them for those first edited radio shows.

Multi-track recording, developed in the 1950s and 1960s, meant that instruments and vocals could be captured separately and mixed together. Effects such as echo and reverberation could be added. The Beatles and their producer George Martin were among the first to see the creative possibilities of multi-track and used it in the *Sgt. Pepper's Lonely Hearts Club Band* sessions in 1966–67. It is difficult to imagine The Beatles standing on a stage performing any of the *Sgt. Pepper's* songs live. The album is a performance that was created by recording technology, not one captured by it.

MICHAEL OCHS ARCHIVES/GETTY

Les Paul's experiments with layered sound led to multi-track recording.

The latest major development documented by Milner is digital recording: turning analog sound signals into binary code that can be stored and manipulated on computers. In the early 1980s, the first commercial digital instruments appeared — samplers, synthesizers and drum machines. By the late 1990s these had morphed into digital audio workstations: digital boxes of tricks that sample and synthesize sounds, process them and combine them to form tracks. A singer who is out of tune or a drummer who is out of time can be digitally corrected. Milner suggests that digital recording is a core skill needed by today's musicians.

Central to the book is whether or not recordings are better as a result of this technological progress. Milner devotes a weighty section to how the move from analog to digital has affected the quality of recorded music. With a wider dynamic range, the compact disc should offer listeners a more sonically interesting ride than a vinyl LP. But Milner doesn't think it does. The extra dynamic range, he says, has been used to wage a 'loudness war'. Engineers compress signals so that the faintest sounds are boosted up to the level of the loudest. The result is a recording where everything is loud, all of the time.

Milner suggests that this loudness war reflects changes in the way we listen to music. In the pre-digital era, the emphasis was on quality. Record engineers and audiophiles were obsessed with 'presence', trying to recreate the concert-hall experience in our homes. But as we listen to more music from small, cheap speakers in our cars, on our laptops and from MP3 players, the emphasis is now on loudness and convenience. Indeed, the MP3 format is designed to strip music down so that we can cram more songs on to our iPods.

Although these developments are documented elsewhere, *Perfecting Sound Forever* brings them together in a lively and accessible way. Milner focuses on the fascinating characters behind the technology. There is Edison, whose hearing became so bad that he had to 'listen' to music by biting on the wooden frame of his phonograph. The conductor Leopold Stokowski, best known for his score for the Disney animated film *Fantasia*, comes across like a 1920s version of the Nigel Tufnel character in the 1984 film *This is Spinal Tap*, urging the engineers to turn up the volume of the new-fangled electrical recording equipment to the maximum.

There are John and Alan Lomax, the father and son team who toured the United States in the 1930s in a desperate race to record 'authentic' music before it disappeared as performers started to emulate the styles they heard on their gramophones and radios. And there is Les Paul, the guitarist whose experiments with layering sound onto single-track tape paved the way for multi-track recording. King Tubby also stands out: he was the Jamaican recording engineer who pioneered the idea that you could take pre-existing sounds and turn them into new music in the studio.

One outcome of the developments that Milner describes is the shift in the balance of

power between the recording industry and musicians. Digital audio workstations allow musicians to produce professional-quality recordings at home, with the result that many recording studios have closed down. Musicians can disseminate tracks though the Internet, bypassing the distribution channels controlled by the big recording companies. Karl Marx would have approved — control of the means of production has passed from the elite to the man in the street. It is a shame that *Perfecting Sound Forever* doesn't dwell on the political significance of the developments it charts — a subject for a future book, perhaps. ■

Peter Border is deputy director of the Parliamentary Office of Science and Technology, 7 Millbank, Westminster, London SW1P 3JA, UK.
e-mail: peter.border@googlemail.com

Q&A: The inventor with an ear for the past

Engineer **Duncan Miller** has spent decades reviving the lost art of acoustic recording to wax cylinders, a technique pioneered by Thomas Edison. *Nature* finds out how his Vulcan Cylinder Record Company, based in Sheffield, UK, has combined sleuthing and modern chemistry to craft a new repertoire for the hand-cranked phonograph.

Why did you become interested in old recording techniques?
As a teenager I played with gramophones. I found out that many 78 rpm discs were recorded and played back without electricity. It surprised me that something as complex and delicate as sound should be captured by purely mechanical means. I've studied radio and microphones, and built amplifiers and transistors, but I was drawn to acoustic recording. In 1981, I started making new phonograph cylinders, just as Thomas Edison had done about a century earlier.

When was the wax cylinder invented?
In 1877, Edison patented a device that would inscribe a groove of variable depth using a diaphragm set in vibration by sound. He called it the phonograph. First he tried tin foil as a recording material but it got damaged quickly, turning into a Christmas decoration when played a couple of times. While Edison was inventing the light bulb, the people working for his competitor, Alexander Graham Bell, realized that wax supported on a cardboard tube was more durable. Seeing what they'd done, Edison perfected a phonograph that used a solid wax cylinder. His innovation was to use metallic stearates, which are harder and less crystalline than Bell's wax.

Is it easy to make such cylinders today?
The process by which Edison made a copper mould from a wax master is documented in outline, but I've had to invent the details on my own. Some of it was quite secret; I've examined court cases and figured out what works. He actually stopped using wax in 1912 and moved to celluloid plastic. I have adapted modern plastics to suit the product. The raw materials have also changed — the stearic acid used to make the cylinders more durable is now vacuum distilled, not pressed as it was in the 1900s, for example — so minor adjustments have to be made to the compound formulae to get the best results.

D. BOCKING

Waxing lyrical: Duncan Miller's cylinders can capture more overtones than gramophone discs.

How was Edison's 'talking machine' received?
Edison's device was never intended to record and sell music. It was supposed to be a dictation machine; when you finished, you shaved the cylinder and dictated again. But the demand for music was so strong that the Edison company had to crank out recordings. The machines weren't designed to make duplicates, so a band would have had to play all day, simultaneously into 20 phonographs making 20 records at a time. But soon the cylinder had competition from the disc. It was partly a matter of branding. The cylinder was associated with cheap and vulgar music, such as that played by travelling showmen at fairs and circuses.

Is wax recording different for musicians?
The instruments have to be placed at the proper distance from the recording horn to get the right balance. I recently had a nine-piece jazz band in my dining room, which was fine until the sousaphone hit the chandelier. Unlike with a microphone, I can't do anything on the cylinder to make you sound better; if you lose energy the finished record sounds distant. Singers must learn to produce more sound pressure and can feel the way the horn responds to their voice.

Is there a difference in fidelity between discs and cylinders?
A new phonograph cylinder sounds better than most discs. The stylus can vibrate quicker without dissipating energy, so there is nearly another octave of overtones in the higher registers that you need for speech, strings and brass. A cylinder's groove speed is constant, so the recording fidelity is the same at both ends. With a disc, the fidelity at the inside is lower because it's going slower. So a new cylinder will have less noise than a new disc. But when we get our hands on them these days, cylinders have often been badly treated and eaten by mould because the waxes contain soaps and fatty acids. By contrast, the 78 rpm discs, which are often made of slate powder and shellac resin, don't deteriorate so badly.

Is there a market for wax cylinders today?
The Edison company alone made 2 million machines capable of playing cylinders, and thousands of them are still in operation. A fraternity of people has these machines and wants recordings for them. Our goal is to produce a cylinder record that plays well — one that would have stood up to the market in its day. The great thing at the moment is that we have little competition. ■

Interview by **Jascha Hoffman**, a writer based in New York.
e-mail: jascha@jaschahoffman.com