"A Compass of Extraordinary Range": The Forgotten Origins of Phonomanipulation

It's often assumed that the original goal of phonography was to "reproduce" recorded sounds as transparently and faithfully as possible. However, certain transformative manipulations – speed-shifting, reversing, segmenting, mixing, and sampling – were actually integral to phonographic theory and practice from the very beginning, spanning numerous spheres of application, speculation, and experience.

Techniques for manipulating recorded sounds have had a profound impact on developments in auditory and musical culture over the past century, spawning new forms that range from *musique concrète* to the turntablism of hip-hop DJs. Their history is accordingly of considerable importance to our understanding of the genesis of modern sound art. The early application of electricity to music has been extensively investigated in this spirit, as have early efforts by recognized composers and avant-garde figures to use phonography in creative ways.[1] Nevertheless, studies formulated along these lines have failed to trace a number of key techniques back to their points of origin, including speeding sounds up, slowing them down, playing them backwards, cutting them, splicing them, superimposing them, and sampling them. The obstacle, I find, is that influential scholars have tended to assume that these techniques must have originated with electrical media, with self-consciously avant-garde artists, or ideally with both. In fact, they did not. There is nothing inherently electrical about any of these techniques, and we can find them scattered across numerous domains of activity, ranging from whimsical play to scientific experimentation and from "high art" to the quotidian needs of business communication.

A related problem is that most past studies have labored under the misperception that the phonograph was used at first solely to "reproduce" preexisting sound sequences faithfully across space and time, and that transformative applications of the type described above arose only much later, between the mid-1910s and the 1940s.[2] It is true that standard secondary histories of phonography have centered on the cultural aspiration towards transparent "reproduction," and commentators who rely on such accounts for their facts might understandably conclude that phonographic media were used exclusively for such purposes until well-known artistic innovators took them up and found other uses for them. However, a more holistic review of early phonographic practice through primary sources reveals the presence of intensely transformative techniques and paradigms from the very beginning. There was never a period in phonographic history that altogether predated such techniques, and avant-garde artists of the twentieth

century were certainly not the first to invent them, however much they may have done to refine, codify, and aestheticize them. In the present essay, I will survey instances of one large subset of these techniques as found in non-electrical contexts prior to the 1920s. First, however, I would like to define my object of study a bit more precisely and introduce some relevant vocabulary.

We readily understand terms such as *photography, photograph, camera, cinema,* and *movie* as referencing important cultural continuities that span numerous technological divides (such as analog/digital). By contrast, the terminology ordinarily applied to sound media imposes an artificial sense of fragmentation. It is challenging, for instance, to speak about the general category of objects which includes cylinder phonographs, acoustic gramophones, electric turntables, audiocassette players, CD players, and iPods without resorting to clunky and arguably misleading phrases such as "devices for reproducing recorded sound." Past efforts to define sound media terminology more formally have tended to exacerbate rather than reduce these semantic obstacles.[3] For my purposes, any inscription in which one dimension represents a time base and another represents fluctuations in the amplitude of a sound wave will be a *phonogram*. The practice of recording and actualizing phonograms will be *phonography*, and any device that effects phonography will be a *phonograph*. I will refer collectively to the range of creative techniques available for manipulating phonograms – cutting and splicing, montage or collage, changes in speed and direction, and so forth – as *phonomanipulation*. Like photomanipulation, phonomanipulation makes use of "recorded" raw material but foregrounds its transformation, sometimes beyond recognition.

The default language of phonographic "reproduction" implies a focus on fidelity to past reality that isn't particularly appropriate to subject matter of this kind, and it also masks two distinct processes which we will want to be able to discuss separately. First, when we speak of "reproducing" a phonogram, we don't generally mean that the phonogram itself is being duplicated, but rather that sound is being generated from it, and that it is being actualized or "played," to use a metaphor drawn from musical performance. I will use the verb *educe* to refer to this activity, meaning "to bring out, elicit, develop, from a condition of latent, rudimentary, or merely potential existence";[4] *eduction* in this sense is synonymous with *output transduction*. Educing a phonogram entails generating a sound wave based on microchronic patterns of amplitude fluctuation specified in it, much as educing a film would mean to project or display it – that is, to cause its latent program of moving images to unfold over time and become perceptible.

It is also common to speak of the phonograph as "reproducing" sounds it has recorded. This proceeds from the belief that the phonograph is duplicating or making copies of these sounds, but it has been argued to the contrary (persuasively, I think) that phonography always represents such sounds subjectively, for instance by reducing three-dimensional complexes of vibrations to their two-dimensional impact on one or more given points in space.[5] Hence, I prefer a more neutral word for the distinctive relationship that exists between the sounds the phonograph records and the indexically and iconically linked sounds it educes from the resulting phonograms. The word *playback* comes close and is probably best for casual use, but it originated in the film sound field about 1929 with the more specific meaning of eduction carried out for evaluation immediately after recording, a nuance it may still carry to some extent.[6] I will instead say that a phonograph *retroduces* ("brings back")

a sound if it educes a phonogram made by recording that sound and the educed sound has an audible similarity, however tenuous, to the originary sound. The phonograph can retroduce a person's voice as a camera or a mirror can depict a person's face, and some instances of retroduction might diverge quite sharply in effect and intent from what we generally understand as "reproduction," analogous to trick photography or reflections in a fun-house mirror. In such cases, some parameters of an originary sound might be retroduced (such as timbre) while others are not (such as pitch). Educing a fully synthetic phonogram doesn't retroduce anything at all.

The present essay surveys early cases of phonomanipulation, drawing together the oldest documentation I have been able to find of practices and concepts I have organized into five general categories: speed-shifting, reversing, segmenting, mixing, and sampling. Nearly all of my examples date from before the 1910s, and the few exceptions date from before the end of the First World War. Thus, my latest examples were more or less contemporaneous with Dziga Vertov's prospective "laboratory of hearing," and all of my examples predate the pioneering phonomanipulative accomplishments of Darius Milhaud, Walter Ruttmann, Paul Hindemith, Ernst Toch, Edgard Varèse, John Cage, Sidney Bechet, Les Paul, and Pierre Schaeffer.

Speed-Shifting

The first type of phonomanipulation I would like to discuss is *speed-shifting*, which we can define as educing a phonogram at a different speed than the one at which it was recorded, whether slower (*underspeed*) or faster (*overspeed*). Speed-shifting continues to retroduce the parameters of timbre and relative pitch and rapidity, at least in part, but it alters the parameters of absolute pitch and rapidity conjointly and proportionally. Thus, overspeed eduction results in higher-pitched, more rapid sounds, while underspeed eduction results in lower-pitched, more drawn-out sounds. The phonomanipulative techniques available today for changing the parameters of pitch and rapidity independently from each other (*pitch shifting* and *time stretching*) weren't devised until a later period.

Intentional speed-shifting arose very early in the history of phonography – in fact, the first clear reference to the phonograph principle found in Thomas Edison's laboratory notes centers on it. In a note dated 17 July 1877, Edison speculated that educing a phonogram of speech "at rate of 25 words per minute whereas it was sent at rate of 100 per minute," or 400% underspeed, would make it easy for the average clerk to transcribe.[7] In other words, he first linked the value of phonography not to a maximally faithful retroduction of subject matter but to the possibility of slowing it down for transcription, as he had done in his youth with Morse code transmissions that were too rapid for him to copy down in real time.[8] This was still his favored scenario for phonographic business dictation as late as April 1878.[9] Edison also suggested to reporters in that period that the phonograph's speed-shifting capacity would enhance its attraction as a home entertainment device. With musical phonograms, he pointed out, "the pitch can be raised or lowered by increasing or diminishing the speed of the phonograph,"[10] and the consumer of a phonographic book could "make it read slow or fast."[11] However, educing a speech phonogram 400% underspeed actually makes it unintelligible, which eventu-

Figure 1. Early specimen of speed-shifting: a gramophone disc recorded by Emile Berliner on 14 December 1889 at speeds ranging from 50 to 140 revolutions per minute, printed as a mirror image in Prometheus 1890;1:213.

ally led Edison to jettison his original scenario for using the phonograph as a transcription aid. Educing a speech phonogram several times overspeed makes it unintelligible as well, which would have ruled out another proposed innovation: the "skipper knob" envisioned in 1889 by the utopian author Edward Bellamy. This was to have been a control enabling users of the phonographic newspapers of the future "to quicken the utterance of the phonograph in proportion to the pressure to at least tenfold the usual rate of speed, while at any moment, if a word of interest caught the ear, the ordinary rate of delivery was resumed, and by another adjustment the machine could be made to go back and repeat as much as desired."[12] It seems that speech was initially assumed to be more forgiving to extreme speed-shifts than experience proved to be the case.

In spite of the aforementioned obstacles, the phonograph's speed-shifting capacity did in fact serve a number of useful purposes early on in the medium's history. Secretaries of the 1890s sometimes educed phonograms of dictation overspeed to save time when checking them in advance for corrections,[13] and beginning stenographers were encouraged to try transcribing phonograms at ever-increasing speeds for practice.[14] Speed-shifting also provided the basis for some innovative research projects. Already in 1878, acousticians were using tinfoil phonographs to educe phonograms of vowel sounds overspeed and underspeed in an effort to find out whether the shift in pitch would change them into different vowel sounds, as predicted by the "fixed pitch" version of Helmholtz's vowel theory.[15] Later, with the introduction of the wax cylinder phonograph, some researchers found that underspeed eduction helped them analyze recorded phenomena that were ordinarily too rapid for study. This was, for instance, what enabled John Comfort Fillmore to transcribe the rhythm of Kwakiutl songs recorded at the World's Columbian Exposition of 1893: "by reducing the speed very low, I could count the beats, which I found impossible when I heard the songs at Chicago."[16] Percy Grainger advocated this method as well: "It is possible to note down from the machine difficult and very fast tunes with far greater accuracy if the speed-screw be screwed down until the record is running much below its original pitch and speed."[17] Richard Lynch Garner did much the same thing as part of his phonographic study of the "language" of monkeys: "when the velocity of utterance was reduced it became clear that the talk was in syllables and not in inarticulate whistlings."[18] Garner also experimented with 300% overspeed eduction:

One of the very curious feats which I have performed with the phonograph is the conversion of the human voice into the sounds of various instruments. I had my wife sing the familiar Scotch ballad "Comin' Through the Rye" to the phonograph while the cylinder was rotating at the rate of about forty revolutions per minute.... I then increased the speed of the machine to about one hundred and twenty per minute, at which rate I reproduced the song. It was a very perfect imitation of the bag-pipe, with no sign whatever of articulation. The melody was preserved, with only a change of time. The speech character was so completely destroyed that I repeated this record to a large audience in which were several eminent musicians, not one of whom suspected that it was not a real bag-pipe solo. In like manner I have converted the sounds of the voice into a very perfect piccolo, flute, fife, as well as a fairly good imitation of a whistle sound. To produce the whistling effect and the fife sound the rate of speed must necessarily be very high, and some notes will not be perfectly converted, for some reason which I have not yet fully understood. Some voices are much more easily converted into the flute effect than others. To get the best flute sounds a full, smooth mezzo-soprano gives the best effect. In reversing the operation the sounds of these instruments can be made to imitate the human voice somewhat, but not exactly; not only in the fact that the modulation is wanting and there is no semblance to consonant sounds, but the tone itself differs in quality from that of the voice.[19]

Here Garner reported using speed-shifting to generate the sounds of bagpipes and other musical instruments from phonograms of the human voice, effectively retroducing one subject in such a way as to educe another. His purpose was ostensibly to demonstrate the interchangeability of human speech with other sounds, but his efforts to get "the

best flute sounds" suggest an aesthetic motivation as well, a conscious striving for "the best effect." The idea was even explored of using speed-shifting to bring infrasound and ultrasound within the range of human hearing. We find the physician J. Mount Bleyer associated with a plan to use overspeed eduction to study otherwise imperceptible sounds of the human body: "It seems that, while the deepest tone our ears are capable of recognizing is one containing 16 vibrations to the second, the phonograph will record 10 vibrations or less, and can then raise the pitch until the ear can distinguish a repetition of them."[20] Edison himself is reported to have conducted analogous experiments with underspeed eduction seeking to detect sounds made by insects.[21]

The cases mentioned so far all served more or less practical or scientific ends, but speed-shifting was also implicated from the beginning in the entertainment side of phonography. Most tinfoil phonographs of 1877-1878 were rotated directly by hand, so it was actually easier to speed-shift in that period than not, and exhibitors were advised to adapt subjects for recording with the inevitability of speed fluctuations in mind: "The airs should be played in rapid time, since, when there is no system of clock-work, they will be more perfectly reproduced than those which are played slowly."[22] Meanwhile, underspeed and overspeed eduction were also demonstrated intentionally as novelties, as in this instance:

Mr. Edison ... said to the instrument, "Now is the winter of our discontent made glorious summer," etc. Turning the crank slowly a Richard *was heard to speak with deep and diabolic voice. Turning the crank rapidly, the same words were heard in a shrill and petulant voice, as though* Richard *was in a bad humor and did not care to play his part*.[23]

This account was typical in assigning familiar social meanings ("diabolic" versus "petulant") to voices that had been speed-shifted into new registers; elsewhere, we find the underspeed eduction of a speech phonogram described as yielding "the voice of a decrepid [*sic*] old man with his mouth full of water," while overspeed eduction gave "the shrill voice of an angry old woman."[24] Musical notes were similarly transposed during these events; for example, we read that the phonograph "not only follows [cornetist Jules] Levy, but surpasses him, by reproducing cornet notes in entirely new octaves of its own origination, proving itself to have a compass of extraordinary range, if not especial tonefulness and brilliancy." Insofar as Levy himself was renowned for his wide tonal range, the writer of this account playfully represented the phonograph as winning a victory over him,[25] although another report of the same event put rather a different spin on it: "Owing…to the crank being turned by hand instead of by clock-work, and the consequent irregularity of the motion, the key was changed, and many discords and false intonations were introduced that caused Levy to writhe in his chair, and sent shudders through the audience."[26] The speed-shifting phonograph may have outdone Levy in sheer tonal range, producing a striking aural novelty, but it had failed when measured by the yardstick of traditional musical aesthetics.

Speed-shifting continued to play a role in entertainment phonography once a commercial recording industry had developed and machines came equipped with well-regulated motors (except for the first gramophones of the early 1890s, which still had to be rotated manually by hand). To some extent, this was an unintentional consequence of a lack of standardization in recording speeds. In 1902, 160 revolutions per minute was established as a commercial standard for phonograph cylinders, but until then consumers

had been faced with a range of possibilities extending from roughly 80 to 180 revolutions per minute, requiring them repeatedly to adjust the speed controls of their machines by trial and error:

The method usually adopted for determining the correct speed of a given reproduction, in the case of musical records, is to listen to the words of the announcement at the beginning of the cylinder, and when the tones of voice seem to be in a natural key, and neither too high and shrill nor too low and heavy, to assume that the proper speed has been reached.[27]

Under these circumstances, speed-shifting would have been a regular feature of phonographic listening, whether desired or not. It allegedly enabled "a man to hear how his voice would sound if he had been born a high tenor like Campanini, or the young girl if she had been born a basso profundo,"[28] but listeners could still discern speech and song "in a natural key," implying that speed-shifted voices sounded more or less unnatural, which is to say that the effect differed qualitatively from ordinary auditory experience and didn't merely replicate preexisting vocal types. Edison's National Phonograph Company relocated the speed controls on its phonographs to the underside of the mechanism in 1905, a few years after the establishment of the 160-rpm standard, on the assumption that owners would no longer need to use them on a regular basis,[29] but recording speeds for gramophone discs continued to fluctuate, and gramophone speed controls accordingly remained out in the open, where consumers continued to tinker with them. Once the appeal of educing gramophone discs at the "correct" speed had worn off, some people turned to using the speed controls more creatively, as Hubert C. S. Colborne advocated in a 1915 article on "Gramophone Tricks":

Gramophones are extremely entertaining instruments, and a large collection of good records is almost a joy forever; but even the largest stock of the very best records becomes well known at last, and, as the ever-enthusiastic operator lovingly starts off another on his beautiful machine, the bored listener comes out harshly with that awful cry, "Oh, we've had that one before!"

This is the time to play "tricks." Many remarkable tricks can be done which one would never have dreamed of with quite an ordinary machine, and with a few seconds' preparation only. Indeed, a highly comical effect can be obtained by twisting the "time button" sharply up and down at every note while you are running a sentimental love duet. Have you ever tried it? When the lady sings high, run it up to a perfect shriek, and then, when the loving Bass comes in, run him down into the wine-cellar. The effect is charming beyond description.[30]

Here the goal was to exaggerate the highest and lowest notes of a duet, possibly for comic effect, though the adjective "charming" invites a variety of interpretations. Edwin E. Slosson, literary editor of the *Independent*, described a similar technique in 1917:

Before I got my phonograph I suspected that the advertisements might be exaggerated. But I found that they had not even mentioned its most interesting features. They tell how you can play on it but not a word about how you can play with *it. They do not hint that*

by moving the speed regulator back and forth you can make a monolog into a dialog and a solo into a duet between an upper-attic alto and a sub-basement bass.[31]

Slosson would have achieved the described effect by alternating between overspeed and underspeed eduction, creating a "dialog" or "duet" from the two contrastive retroductions of the same originary voice. Clearly this wasn't the way in which manufacturers intended their equipment to be used or perceived: Slosson acknowledged that speed-shifting wasn't suggested as a possibility in the official promotional literature. The phonographic advertising rhetoric of the early twentieth century was all about "fidelity" to original sound sources,[32] and the speed control was ostensibly provided to allow consumers to eliminate speed-shifts, not to create them. From this perspective, Colborne and Slosson were mischievously transgressing the boundaries of the technology's prescribed uses; indeed, that was probably a large part of the appeal. In practice, however, the industry was itself covertly fostering speed-shifting of a subtler sort. Early in the twentieth century, the Victor Talking Machine Company instituted a regular policy of recording at a slower speed (76 revolutions per minute) than the one recommended for eduction (78 revolutions per minute) in order to make the results sound "more brilliant."[33] Thus, it seems one of the leading companies of the day hoped to introduce a small speed-shift into all the phonograms it issued.

So far, I have been characterizing speed-shifting as a manipulation of eduction, but it should be clear from this last example that it can also constitute a manipulation of recording, depending on where the departure from a "normal" speed is understood to take place. If we consider 76 revolutions per minute the "normal" recording speed, then eduction at 78 revolutions per minute is overspeed relative to it: consumers were being encouraged to play Victor discs "fast." On the other hand, if we consider 78 revolutions per minute the "normal" speed of eduction, then recording at 76 revolutions per minute is underspeed relative to it: Victor aimed to record its discs "slow." Overspeed recording corresponds to underspeed eduction, and underspeed recording corresponds to overspeed eduction; to a point, these phenomena exist only relative to one another. When recording is consciously undertaken at an "abnormal" speed for eduction at a "normal" speed, however, speed-shifting has plainly become an aspect of the making of phonograms, and not just something that is done with them once they have been made.

This is especially true of cases in which the speed was intentionally changed during the recording process, resulting in a phonogram that would display speed-shifting effects when educed at any constant speed. In a *Scientific American* article of 1905 entitled "Fun With the Phonograph," Dexter W. Allis suggested that home recording enthusiasts try the following experiment:

"Speech by Tom Thumb." The machine must be speeded up as high as possible, and the above announcement recorded on a blank in a deep, loud voice. The machine should be quickly slowed down to about eighty revolutions per minute, and the speech or monologue recorded at that speed, care being taken to articulate distinctly. When the blank is full, the reproducer may be substituted for the recorder, and the machine be brought up again to high speed at which the announcement was made. When the record is reproduced at this speed, the result will be the loud voice of the announcement followed by a rapid, pinched-up little voice making the speech.[34]

The *Speech by Tom Thumb* trick involved recording an announcement at around 190 revolutions per minute (the approximate upper speed limit of consumer-grade cylinder phonographs) and then abruptly slowing the machine down to record a speech at 80 revolutions per minute. When the phonogram was educed at the designated "normal" speed – again, around 190 revolutions per minute – this would have yielded a "normal" announcement followed by a speech educed overspeed in a "rapid, pinched-up little voice." One phonogram conceived along similar lines was a gramophone disc recorded on 14 December 1889 by Emile Berliner, who rotated it at about 50 revolutions per minute while counting from one to twenty-five in German and then increased the speed gradually and intentionally from about 55 to 140 revolutions per minute while reciting the alphabet and saying good-bye ("ade"). In the space where Berliner ordinarily specified a recording speed "so that...people will know at what velocity to revolve the disc,"[35] he wrote simply "50"; educed at a consistent 50 revolutions per minute, the recorded speech drops dramatically in rapidity and pitch until, towards the end, it finally becomes unintelligible. Berliner apparently decided the results weren't suitable for exhibition, since he sacrificed the disc to be used as a printing plate in the weekly magazine *Prometheus* (Fig. 1); however, the phonogram was educed digitally from an ink print in 2010 and may now be the world's oldest playable "trick recording."[36] Such cases exemplify the use of speed-shifting as a creative production technique – that is, as a means of making a phonogram with unusual aural properties built into it.

Slosson describes another comparable example in his 1917 essay, this time created not by varying the recording speed but by physically modifying an existing phonogram:

A young lady who had studied Futuristic painting at the Y. W. C. A. art school sent me a record with the loveliest centerpiece of ultra-modern appliqué*, containing all the colors of the rainbow and some unknown to nature and found only in the aniline dyes. And it plays Futuristic music, too. You see she has covered over the hole in the center and cut another half an inch away. This produces eccentric music, like the Hawaiian, only more so.*[37]

The aspiring Futurist artist had introduced a continuous series of speed-shifts into a gramophone disc by moving its spindle hole off-center. A constant rotational speed would thus have caused the stylus to pass along the groove at a linear speed that alternately increased and decreased over the course of each revolution – an extreme instance of the type of distortion commonly known as "wow." Collectors occasionally turn up commercially manufactured discs that must have been modified by consumers for precisely this purpose, judging not just from the off-center spindle hole, but also from tell-tale wear patterns. It is noteworthy that Slosson represented the result not just as a trick, but as a work of art with both visual and aural components; however playfully, he identified the phonomanipulated sounds as "Futuristic music."

Reversing

A second type of phonomanipulation which we encounter in early phonography is *reverse eduction*: educing a phonogram in the opposite direction from the one in which it was recorded. In 1878, the term *musical kaleidoscope* was coined to describe the reverse eduction of phonograms of music, "by means of which an infinite variety of new combina-

tions may be produced from the musical compositions now in existence."[38] In fact, each reversal generated only one new sequence of sounds, but Edison suggested privately to an associate that the results of such manipulation would still constitute new, commercially exploitable works:

...by turning cylinder backwards the song is still melodious in many cases, and some of the strains are sweet and novel, but altogether different from the song reproduced in the right way[.] *Wagner hasn't the monopoly of the music of the future= I'm going in to the machine composing business*[.] *Just think of it, "Faustus backwards by Edison in 56 sheets=phonographically price 30 cents for sale by all dealers in phonographic material*["][39]

A reporter later quoted Edison as saying that he found some Offenbach "made better music backwards than it did forwards," and that he could "take a dozen old familiar tunes sung by a good voice, grind them out backwards, publish them, and they will be as good as new, and sell in forty-eight hours for more than the old tunes ever did."[40] Edison's remarks were plainly intended as humor, but his idea that "the music of the

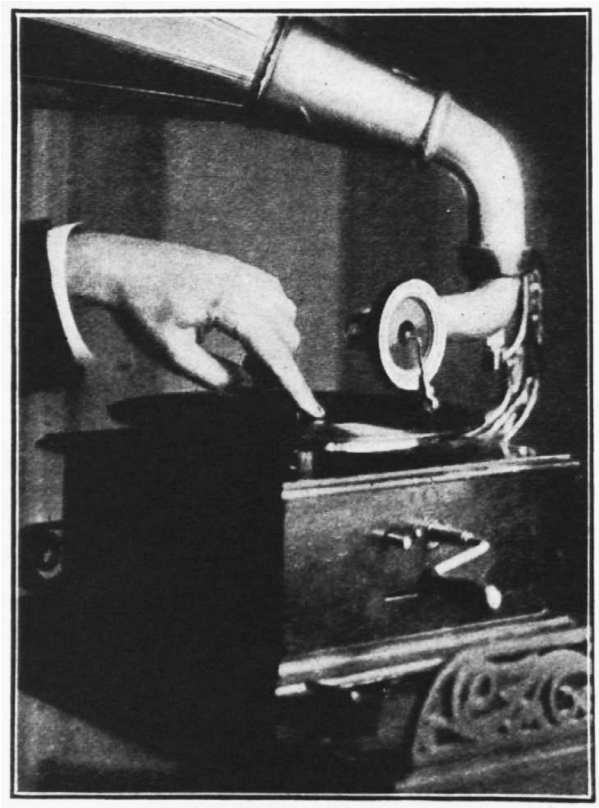

Figure 2. One method of reverse eduction, originally captioned "Playing a Gramophone Record Backwards." Strand Magazine*, 1915;49:358.*

future" might center on phonomanipulative "machine composing" is still noteworthy, as is his suggestion that a reversed phonogram such as *Faustus Backwards* might become a distinctive commodity, as contrasted with the practice of educing "normal" phonograms in reverse. Much as speed-shifting can be understood as a manipulation of either recording or eduction, depending on circumstances and perspective, so reverse eduction has its inverse or counterpart in *reverse recording*, colloquially known as backmasking.

Reverse eduction was exploited as a source of novel effects during some of the first tinfoil phonograph exhibitions; we read, for instance, that "'Yankee Doodle' was whistled and given backward, producing a different tune,"[41] and that "the tale of the little lamb was brought out in an unrecognizable form."[42] More specifically interpretable results were possible as well, as we find illustrated in a demonstration before the Physical Society of London:

Another experiment was the turning of the cylinder in the reverse direction after it had received a communication in the ordinary way. The communication submitted to this experiment was the song "We don't want to fight," &c., and the result of the vibrations constituting this composition when rendered backwards was very curious, and gave rise to the remark that it would be specially appropriate as the song of the peace party.[43]

"We Don't Want to Fight" was the anthem of the party that favored British military opposition to the Russian advance on Constantinople in 1878, and the phonographically reversed version of the same song struck one of the listeners as an appropriate anthem for the opposing party on the assumption that the song's sentiments must have been reversed along with the rest of it. A similar linkage between reverse eduction and an inversion of meaning appears in the following anecdote:

During his recent [3 May 1883] *lecture at the Institution of Civil Engineers, Sir William Thomson proposed the term* mho *for a unit of conductivity. Conductivity is the reciprocal of the resistance which is measured in ohms, and* mho *is found by saying "ohm" into a phonograph, and then turning the drum backward. How Sir William finds the reciprocal of a value equivalent to a word spoken backwards he does not explain, and, on the whole, we think he has chosen a somewhat fanciful way of finding a new electrical term.*[44]

Fanciful or not, Thomson had tapped the phonograph's reversal of sounds as a metaphor for a multiplicative inverse, or the relationship between x and $1/x$. Granted, *mho* is arguably just *ohm* spelled backwards rather than "spoken backwards" by the phonograph, but Thomson had proposed the new term orally during a lecture, so *mho* may initially have been an effort by others to transcribe the sequence of sounds he had uttered – we also find it written *moh*.[45] The specific sounds of phonographically reversed speech were exploited in other ways as well. Edison's assistant Charles Batchelor is said to have "projected several times in succession the words 'mad dog, mad dog,' and the little machine replied, being turned backwards, with the utmost disregard of the distinguished persons present: 'God d—m, God d—m.'"[46] Simultaneously, acousticians began using the same technique as a serious experimental methodology for the study of consonants and vowels:

We have here a standard as to what does really constitute a single letter or element of articulate speech; it is any one reversible part. Your readers who possess a phonograph may most easily verify this observation by saying a word backwards, and hearing the phonograph say it intelligibly forwards; for instance, noshäeesossa *produces* association *beautifully*.[47]

Unlike speed-shifting, reverse eduction was not always available as a phonomanipulative technique in the tinfoil era. Many of the phonographs manufactured for exhibition purposes in 1878 could only educe in one direction, and at least one exhibitor had to explain in response to a question from the audience that his machine couldn't be made to "talk backwards."[48]

The Bell-Tainter graphophone introduced in the latter half of the 1880s lent itself well to reverse eduction, since its interchangeable cylinders of wax-coated cardboard could be fitted on the machine either forwards or backwards. Richard Lynch Garner used one of these machines in his early efforts to record and study the "language" of monkeys, and the reversibility of graphophone cylinders seems to have led to some amusing incidents. Once, Garner was reportedly the victim of a practical joke:

After he left the boys got into his shop and reversed the cylinder, so that when Garner arrived the next morning, and set the phonograph in operation, a volume of sound poured forth that scared the monkeys and cost the professor several hours of acute mental agony and bewilderment before he finally discovered that the cylinder had been reversed and the conversation had been running backward.[49]

On another occasion, Garner is supposed to have sent a cylinder to Otis T. Mason of the Smithsonian Institution:

When Professor Mason put the cylinder in his own machine he heard distinct vowel and consonant sounds, but no intelligible words. Thinking the sounds were the much-talked-of monkey language, Professor Mason was much surprised at the result, and called a number of other professors to hear and be mystified. The next day there was a crowd around the phonograph to hear the queer sounds, but when the machine was started there issued from the ear pieces the words of a letter dictated at Roanoke, Va., by Professor Garner. The explanation of the mystifying sounds was found in the fact that when first used the cylinder was placed in the machine in such a way that the words were heard backward.[50]

Quite apart from practical jokes and mistakes, Garner found it illuminating to educe cylinders in reverse for certain types of analysis:

I have called attention to the fact that by reversing the cylinder of the phonograph and repeating the sound recorded thereon a musical note or sound would repeat alike each way. Most of the sounds made by other animals do this, but those made by man and simian alike show modulation, not, however, equally distinct. The notes of birds repeat alike both ways, except that their order is reversed.[51]

On the other hand, the new phonograph Edison introduced in the late 1880s didn't readily permit the same kind of manipulation, as Garner objected privately in a letter to the inventor: its mandrel and the internal bores of its solid wax cylinders were tapered so that they would fit together in only one direction, so using it for reverse eduction required physical modification.[52] One person who went to the effort to have apparatus modified to this end was phonograph enthusiast Edgar Caypless of Denver, Colorado, who was considered remarkable at the time for owning four machines and 1,760 cylinders: "He tells me," wrote a *Phonoscope* correspondent, "that he has had made by an expert machinist in Denver a reversible motor phonograph, so he can play the record from start to finish, reverse the motor and play from finish to start. He says that you get some very funny effects from this."[53] In a more serious vein, the physiologist John G. McKendrick in Glasgow had the electric motor of a phonograph modified to run in reverse, enabling him in the mid-1890s to continue the investigations of reversed speech that had begun back in 1878: "Fargonof," he noted, became "Fonograf." He wrote further:

The difficulty, of course, is in emphasising the proper syllables. In pronouncing a word backwards not only may the emphasis be placed on the wrong syllable but suppose that in an emphasis one begins the sound crescendo and ends it off diminuendo, when the reversal takes place we have the opposite, often giving a ludicrous effect. This is well observed on listening to reversed music. Not only are all one's notions of the relations of tones thrown into confusion, but as with many instruments the tone is sharply and distinctly taken and then is allowed to weaken in intensity, the effect is produced of tones beginning diminuendo and ending loudly and abruptly.[54]

McKendrick may have been the first investigator to describe the aurally strange results that come from reversing attack-decay envelopes. A few years later, it was reported that the letter *a* reversed sounded "as though the phonograph were trying to say 'ear,' but could not quite make it.... Musical sounds are reversed in the same way, and the intonation of a banjo makes that instrument sound like a church organ, while piano music would be thought to come from a harmonium by nine out of ten musicians."[55] Some commentators saw broad potential in reverse eduction and its peculiar sounds; for example, the Abbé Pichot claimed that "reversing the phonograph...positively introduces us into a new world, gives us a new language and a new music,"[56] and occultist Aleister Crowley advocated listening to "phonograph records, reversed" as a method for learning to think backwards.[57]

The commercially available phonographs and gramophones of the early twentieth century weren't as conducive to reverse eduction as they were to speed-shifting, but there were still ways for an imaginative consumer to effect it without having a machine rebuilt. As noted earlier, it wasn't possible to slip a *whole* cylinder backwards onto the mandrel of an ordinary Edison phonograph because of the tapered bore. Nevertheless, if a cylinder were cut in half, *part* of it could be fitted onto the mandrel backwards, as Allis pointed out in his "Fun With the Phonograph" article of 1905:

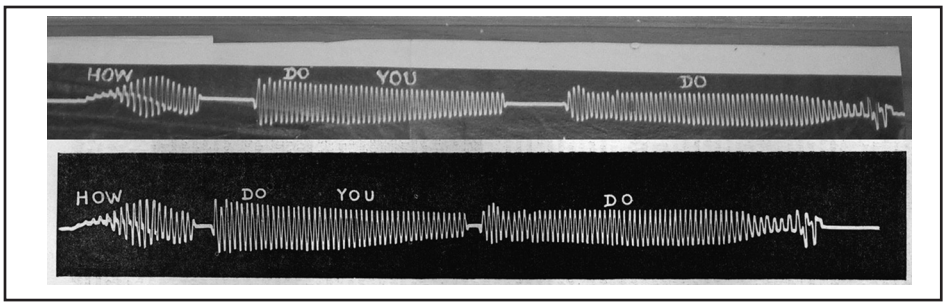

Figure 3. Sound splicing in 1878. Top: print of original phonogram recorded by Eli Whitney Blake, Jr. (Alexander Graham Bell family papers, Library of Congress, box 317). Bottom: the same phonogram as published in Nature, 1878;18(25 July):339.

With care the thinner half...may be slipped halfway on, in a reversed position, and when made to run true, will produce everything backward. A curious thing about such records is that the voice once heard in the proper direction is instantly recognized when reversed, but is, of course, unintelligible.[58]

An amusing case of phonograph cylinders being physically altered to enable reverse eduction through ignorance rather than by design is recounted in a story of 1904 about a woman who supposedly telephoned her local Columbia dealer to complain that she and her husband kept breaking "rolls" when trying to fit them onto a newly bought graphophone. The proprietor quickly diagnosed the problem:

"You are putting them on wrong. Put the other end of the roll on the mandrel."

"That wouldn't be right, I know, because the name of the piece isn't on that end, and at the store the name of the piece was given first and afterwards the piece itself, but we tried something else and it seems to work pretty good. My husband cut away some of the inside of the roll with a knife and we managed to get it on and then we put tooth picks in to keep the other end from wabbling [sic]*, and it seems to play all right."*

The customer was confused because the printed title information on Columbia cylinders of this period was engraved at the "bottom," while the opening spoken announcement was recorded at the "top," where the phonogram began. The dialog continued:

"Can you bring the graphophone closer so that I can hear it?"

["]*Certainly, just a moment, please."*

The strains of music that came from that telephone receiver were soul stirring and thrilling, as Edward M. Favor rendered "Bedelia" backwards.[59]

The spring motors furnished with gramophones likewise ran in only one direction, but it was possible for a user to educe a disc in reverse by pressing a finger down on its label and rotating it backwards manually. This technique was described in Colborne's "Gramophone Tricks" article of 1915 (Fig. 2):

Perhaps the most curious experience in human life is to hear backwards. Such an idea seems impossible; it is quite a simple "trick" on a gramophone.... Twist the "sound-box" into a perpendicular position, or rather with a slight slope backwards, in order that the disc may run in the opposite direction to what is usual. Start the pin near the centre of the disc, turning lightly with the finger.... It will not injure the machinery of the gramophone, but it is advisable not to experiment with a favourite record – at least, to start with – as one is liable to get a very bad scratch right across the plate and very deep! But the effect is worth the danger; it is unique. If you play a brass band even the composer himself would not recognize his masterpiece; if you put on a talking record, the man appears to be speaking a foreign multisonous language. But the most remarkable effect is to put on a "chime of bells." In this reversed manner there is no "strike" of the bell; the sound simply rushes up in ever-increasing waves, and then suddenly ceases, just when you are expecting the clash of the hammer. The sound of the bell is reversed, and the ear is not startled with a sudden strike. The effect is pathetic and beautiful, something like cats at night.[60]

The resemblance of the reversed chimes to "cats at night" may have been due in part to the "wow" of speed fluctuation caused by irregular manual rotation, but it centered on the same type of reversal of attack-decay envelopes that McKendrick had noted twenty years earlier. Colborne represented the effect not just as curious, but as aesthetically gratifying: it was "unique," "remarkable," "pathetic and beautiful," and "worth the danger" of damaging a disc.

However simple a "trick" reverse eduction may have been, one instance of the phenomenon hints that listeners of the early twentieth century weren't familiar enough with it to recognize it when they heard it. The earliest known phonograms made in Togo were recorded about 1905 by Julius Smend, including one identified as a "chorus song with flutes and rattles, hunting song 'tantana.'" Following its usual practice, the Berliner Phonogramm-Archiv had a galvanoplastic mold prepared from this cylinder to allow for the manufacture of duplicates, a process that typically destroyed the original.[61] This time, however, the original cylinder was apparently oriented upside-down when the mold was made, with the result that all copies had the tapered bore running in the wrong direction and could only be educed in reverse. The mistake is plain to a modern ear familiar with the distinctive sound of backmasking,[62] but it doesn't seem to have been apparent even to sophisticated listeners a century ago. Erich Moritz von Hornbostel was certainly no stranger to phonography; as the Berliner Phonogramm-Archiv's first director, he worked carefully to establish methods and standards for ethnographic sound recording. And yet he included Smend's backwards "tantana" cylinder as item 78 in his pioneering Demonstration Collection and even published a (backwards) transcription and analysis of it in an article he wrote on the general characteristics of African music.[63] The unfamiliarity of Togolese music itself in the West doubtless helped to conceal the error, but Hornbostel's failure to detect the aural hallmarks of reversed voices and musical instruments suggests that he wasn't attuned to recognize them.

Segmenting

Present-day critics like to point out that commonly available phonographic media didn't lend themselves to physical cutting and splicing until the widespread introduction of optical film sound tracks and magnetic tape, which occurred after the period I am considering here. Even so, the physical cutting and splicing of phonograms wasn't completely impossible in the earlier period, as we will see. Furthermore, physical cutting and splicing is only one way of achieving the effects we tend to associate with it: namely, the excerpting of segments out of longer phonograms or the juxtaposition of phonograms (or parts of phonograms) recorded at different times. These effects were achieved in early phonography not only through postproduction editing, but also as part of the recording and eduction processes themselves. Rather than identifying the technique exclusively with cutting and splicing, therefore, I suggest that *segmenting* better covers the principle as a whole.

Consider the practice of *segmentary eduction*: educing one or more parts of a continuous phonogram separately or selectively rather than the whole thing straight through from beginning to end. By the time "The Phonograph and its Future" was published under Edison's byline in May 1878, it was expected that a clerk would transcribe phonograms of dictation not by educing them underspeed, as originally planned, but by "causing as many words to be uttered at one time as his memory was capable of retaining until he had written them down."[64] When Edison temporarily dropped the phonograph to work on the electric light later that year, his latest model was designed so that "you can stop it at any time by pulling a cord," the idea being that the "office boy can run out a half dozen or dozen words, stop the machine by pulling the cord, and write out what is desired."[65] The wax cylinder phonograph Edison introduced commercially a decade later had analogous controls, operated by hand or by foot, for raising and lowering the diaphragm and stylus and, if desired, backing them up to repeat a section while the cylinder kept rotating in the meantime:

She [the typewriter operator] *rattles off the "Dear sir, your favor of the 1st inst. at hand, and would say in reply" – and there she throws the switch till she catches up. Then it goes ahead – "that we can ship you seven car-loads of assorted gum-drops at the following rates F. O. B.," and so on.*[66]

Here the phonograph's value lay in its ability to break a continuous dictation into convenient chunks for transcription. The user would educe *parts* of a phonogram at the original recording speed but would abandon the time base of the phonogram as a continuous whole.

Segmentary eduction took place in other contexts as well. On 5 October 1888, for example, George Gouraud – Edison's agent in London – used a phonograph to coordinate a program of after-dinner speeches. Many of the phonograms prepared in connection with this event survive today, and some of them include prerecorded summons for individual guests to speak in response to particular toasts. It would have been necessary to stop and restart the machine periodically during eduction to accommodate the responses.[67] In 1902, a phonograph was reportedly used as the basis of a name-that-tune game, but since it was usual in that period to open every phonogram with a spoken title

announcement that would have defeated the purpose of the game, the eductionist had to be "careful to just avoid the announcement which precedes the record."[68] Here too the phonograph's value depended on its ability to educe specific excerpts of phonograms on demand – to retroduce select snippets of past aural reality.

On the other hand, when the machine was stopped and restarted during recording rather than during eduction, this constituted what I will call *segmentary recording*, a practice that resulted in a continuous phonogram comprised of discontinuously recorded parts.

Like segmentary eduction, segmentary recording was recognized as a practically valuable technique in the phonographic dictation sphere. Already in 1878, Edison had promised that businessmen dictating to the phonograph would be able to "stop when they please and wait for ideas" and then "let someone else copy the production as the phonograph repeats it."[69] In the era of the wax cylinder phonograph, when such scenarios had become a reality, dictators were advised as follows: "Raise the lever whenever desired, to save the waste of surface, while collecting your thoughts, and lower again when you have decided upon the word, phrase, or sentence you desire to record."[70] The method prescribed here involved lifting up the cutter or "recorder," disengaging it from the forward motion of the feedscrew while the cylinder continued to rotate underneath, and then dropping it again, perhaps a half of a second ahead or behind the point at which it had left off. As an alternative, users sometimes interrupted recording by stopping the rotation of the cylinder instead, without moving the stylus. When this happened, the cylinder didn't stop rotating immediately but slowed down over a brief span of time – causing the phonogram to be recorded increasingly underspeed – until it came to rest, a state we can think of as recording infinitely underspeed. The audible result during eduction at constant speed is a distinctive and drastic leap in pitch, either in the main subject matter or in the ambient noise during moments of "silence" – very noticeable, and potentially jarring. If the rotation of the cylinder resumed and the machine started recording again, an inverse effect resulted as the medium accelerated from a state of rest; during eduction, this sounds like an abrupt drop from a high pitch back to normal. I will refer to such a distinctive leap and/or drop in pitch – or the corresponding bunching-up of a waveform relative to the time axis – as a *pitch asymptote*. Because pitch asymptotes are so aurally disruptive, they tend not to appear in commercial entertainment phonograms, but they are not at all uncommon at the beginnings, ends, and segment transitions of early amateur home recordings, revealing that segmentary recording, effected in this way, was a widespread home-mode practice.[71]

The practice of segmentary recording actually extends back into the pre-Edisonian period during which phonograms were made for visual rather than aural apprehension. Evidence of it already turns up in the earliest surviving phonautogram Édouard-Léon Scott de Martinville is known to have made in the form of a long helical trace around a cylinder rather than as a short, split-second pass across a flat plate. Dated July 1857, this phonautogram is labeled "Chant de la voix – changements de ton" ["song of the voice – changes of pitch"], suggesting that Scott's intention was to document the pitch changes of continuous singing, and yet the presence of pitch asymptotes reveals that Scott occasionally started and stopped the cylinder rather than recording continuously from start to finish.[72] Other phonautograms Scott made later that same year relied even more

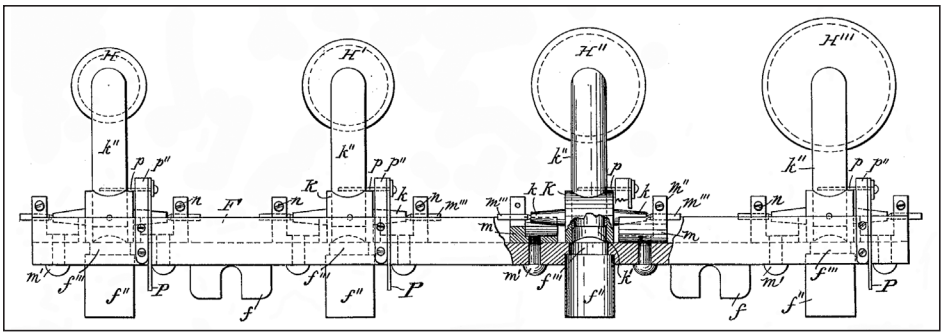

Figure 4. Four-track recording apparatus, as depicted in Thomas H. Macdonald, "Multiple Graphophone," U. S. Patent 711,706, filed 11 June 1898, issued 21 Oct. 1902.

fundamentally on segmentary recording for their impact. In a phonautogram labeled "voix et cornet sans déranger la position du style" ["voice and cornet without disturbing the position of the stylus"], for instance, he alternated between the two subjects to allow for a convenient visual comparison, stopping and restarting the machine at each switch – again, leaving telltale pitch asymptotes at the transitions.[73] Even the famous *Au Clair de la Lune* phonautogram of 9 April 1860 has a pitch asymptote in its tuning-fork time-code, showing that rotation slowed during recording – likely to a complete but brief stop – between the sung words "au clair de la lune, mon ami Pierrot" and "prête-moi."[74]

Like cutting and splicing, segmentary recording allowed the makers of phonograms to assemble non-contiguous snippets of aural reality into new, artfully contrived sequences. Consider the case of the home phonograph enthusiast of 1901 who

…let the horn project out of the window and sat down and waited for trains. As fast as they came along, I took possession of each train, so to speak, using only a small portion of the blank for each train. In that manner I got a complete record of a passing railroad train; the whistle, the bells, the blowing off of steam; also the peculiar whistling sound that the air brakes make with which everyone is familiar, together with the rattle and rumble of the wheels, and even the sharp click as they passed over the rail joints.[75]

The "complete record of a passing railroad train" contrived in this way was just as much a composite creation as if its maker had spliced it together from pieces of film or tape. The main difference is that the selection and juxtaposition of material took place at the time of initial inscription rather than afterwards.

The commercial recording industry of the early 1890s routinely applied segmentary recording to spoken title announcements – the same convention I mentioned earlier as complicating early efforts to use the phonograph for name-that-tune games. Performances were typically "taken" on a number of different phonographs at once, but a subject such as a brass band could be registered on more phonographs at one time than the sound of the average human voice could, so some recordists made a practice of recording the spoken announcements individually beforehand:

Each phonograph being supplied with a smooth and fresh cylinder of wax, the expert in charge shouts into each horn separately the title of the piece to be played. When he has done this the electric motor is turned on again, the cylinders revolve beneath the recording needles, the band starts up at a signal and the music pours into the big trumpets until each cylinder is as full of sound impressions as it can hold…. The five full cylinders are taken off the instruments and put aside in pasteboard boxes, and five more fresh ones are put on. After the title of the next piece has been shouted into each horn, the band starts up again at the signal and the process is repeated.[76]

This approach also allowed recordists to modify their equipment during the interval so that they could record the announcement and the body of the phonogram under different conditions. When Charles Marshall recorded Cappa's Seventh Regiment Band on ten phonographs simultaneously, he not only made ten separate spoken announcements beforehand but also substituted a speaking tube for the recording horn when he did so, since tubes were preferred over horns for recording speech.[77]

Another variation on segmentary recording took place when end users added new material to existing phonograms to customize them for particular uses. For instance, a *Phonoscope* correspondent suggested that businesses add sales pitches at the ends of commercially recorded cylinders for use during free in-store phonograph concerts:

I have noticed that there is a short space on the end of each cylinder, and it can be easily used to great advantage by putting a record on the machine and moving the recorder to the right end of the cylinder to the space that is left. Then record anything you wish. Make mention of any line of goods you wish, or call attention to your different departments. For example, "Notice Our Stylish Headwear for Men," or "Do You Need a Pair of Shoes? If so, You Can Buy Them Here," etc.[78]

One collector has reported finding an Edison cylinder of *Turkey in the Straw* by Arthur Collins with an advertisement recorded in the leftover space at the end: "The place to buy records is at Manfield's Music Store, 33 North 8th Street, Lebanon, PA."[79] In another instance, a consumer recorded a custom segment at the start of the first cylinder of the *U. S. Army Lancers*, a five-cylinder set containing music with dance calls: "Hello, Bert, you and your wife walk in the other room and lay off your wraps, come in and join the dance with the rest of us; think I'll call this set."[80] Presumably the idea was to have the phonograph greet a specific pair of guests at the door before launching into the dance itself. In such cases, different parts of a phonogram were recorded not only at different times, but by different parties.

Much as it was possible to add material to an existing phonogram, it was also possible to remove material by physically cutting it away, a practice recommended for phonographic business dictation:

A simple attachment can be placed on the Phonograph, which serves to raise the recorder slightly out of the record so that it will act as a reproducer, which it does perfectly, without hurting the record. The person having made a wrong dictation can raise the jig back and move the recorder back a little and then listen with the speaking-tube, and when he

comes to the commencement of the wrongly dictated sentence, the attachment device is worked, the recorder drops to its normal depth and practically cuts out the wrong sentence, dictation recommencing as soon as the sentence is passed over. This is also ascertained by listening with the speaking-tube. This method permits of every kind of correction being made, and whole sentences can be cut away.[81]

Spoken announcements were similarly effaced from commercial phonograms during the early twentieth century, generally in order to remove an inconvenient company name. When originating companies reused masters announced "Columbia Record" or "Zono-phone Record" to press client-label discs such as the Oxford Record manufactured for Sears, Roebuck, and Company, they sometimes tooled the original announcements physically off the stampers.[82] Early phonogram pirates did something similar in order to obscure the source of their material; when an industrial spy infiltrated a ring of unauthorized cylinder duplicators in 1901, for example, he reported that they had proposed to teach him "how to obliterate announcements for any masters we might buy."[83] Sometimes the pirates went even further, substituting announcements of their own in place of those they obliterated – a practice that seems to have been more common in Great Britain than in the United States.[84] The principle of erasing material and then replacing it with something else was also tapped for the following trick recommended to home phonograph enthusiasts:

This will call for two records, preferably talking selections, which are exact duplicates. One of these is "doctored" by cleaning off the latter half [using a rag and some kerosene]*, the rest being protected by a piece of writing paper wrapped around and secured by an elastic band. On this blank space various remarks should be recorded, which should be very different from those originally there. The good record is to be played through first. While saying that you will repeat it, the second one is quickly substituted in the machine, and of course starts off exactly like the first one. When the "doctored" portion is reached, however, a change will be noticed, but cannot be accounted for by the hearers*.[85]

Even in the absence of cutting and splicing, then, the stuff of early phonography was more malleable in practice than is generally recognized.

Preexisting phonograms could also be assembled together into new phonograms through sequential dubbing. Thus, Orlando Kellum's patent describing a sound-on-disc system for cinema, initially filed in 1914, includes an apparatus for dubbing recorded content selectively from source cylinders onto a composite master disc: "I provide for accurately assembling the parts of sound records in continuity on a master record in any sequence desired; and I make a final assembled master record which has just the parts desired from the original records, and no more; and I make a final master record in which perfect continuity is assured."[86] Conceptually, Kellum's approach to audio postproduction closely resembles well-known practices of later date.

Moreover, cutting and splicing in the most literal sense were themselves not entirely absent from early phonography. In 1878, Eli Whitney Blake, Jr. recorded the test phrases "How do you do?" and "Brown University" several times as waveforms on photographic plates using an innovative technique of his own design. A comparison of an original print with the images published in journals at the time reveals that the latter were

significantly edited, with silent portions spliced out (Fig. 3) and one version of "How do you do?" assembled from pieces of two different takes.[87] As in the case of Scott phonautograms, Blake's plates were intended for visual rather than aural apprehension; what he was doing arguably resembled photomanipulation more than it did phonomanipulation. However, consider the following experiment suggested in Allis's "Fun With the Phonograph" article of 1905: "By taking two records of entirely different character, cutting each in two, and putting on a half of one and a half of the other, we can often jump from the sublime to the ridiculous by quickly flipping the reproducer across the gap, from one to the other."[88] This trick involved physically cutting and juxtaposing two cylinders to create an incongruous effect during eduction. Granted, the idea seems to have been for the user to keep flipping back and forth manually between the two pieces rather than simply educing them sequentially, one after the other – after all, the writer mentions a "gap" being left between the parts. Still, the proposed technique reveals a degree of physical malleability that critics have not generally supposed was even possible in the phonography of this period.

Mixing

Yet another early phonomanipulative principle was mixing, in which sounds recorded at different times were combined or retroduced simultaneously. Several different approaches were used to accomplish this.

One method was *superimposition* – that is, recording multiple times over the same groove and physically overlaying the successive patterns of vibration onto one another. "When a sentence has been spoken to the phonograph, a subsequent record may be made over the first," a writer explained in 1878, "and the two utterances will be reproduced at the same time, although there is some confusion and a slight indistinctness."[89] Charles Batchelor, the same Edison assistant who used reverse eduction to turn "mad dog" into "god damn," also effected a number of phonographic superimpositions, including the following (consisting of two and three passes, respectively):

Mr. B. started it again with a new sheet of foil, and made the little point on the diaphragm print the indentations of the song sung into the hole in the wooden dish, "Old Uncle Ned." This he reproduced, and then set the point against the foil in the same indentations, and started the machine again, this time singing, "Mary had a little lamb," &c. Running the cylinder back and arranging his point and line, both songs were trolled out by the machine. The effect was ludicrous.[90]

Among the experiments tried was the reproduction of three different kinds of sound on the same sheet of tinfoil. Over "Mary and the Lamb" he spoke "Jack and Gill," and over both he whistled a lively air. The turning of the cylinder, strange to say, brought all three out distinctly, so that the hearer might follow any one to the exclusion of the others.[91]

The retroduction of multiple recitations or pieces of music at once may have sounded gratifyingly "ludicrous," but the same technique was also used to construct more or less significant fictional "scenes," as in the following case reported from an exhibition in Kansas:

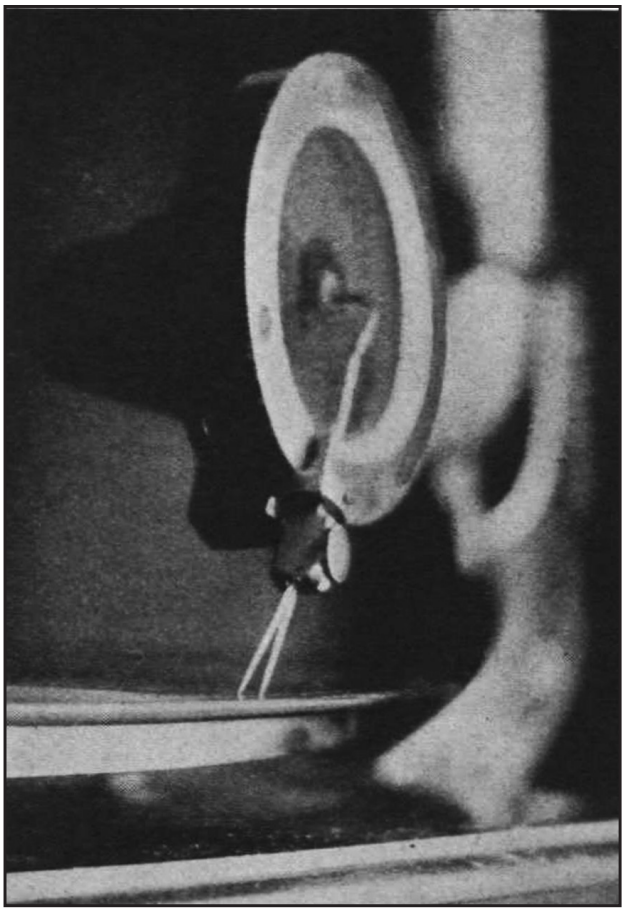

Figure 5. A technique for mixing content from a single phonogram, originally captioned "Using a Double Pin Produces a Remarkable Effect." Strand Magazine, 1915;49:359.

By whistling "Oh, no, we'll never get drunk any more," and yelling "Shut up," "Go soak your head," "G'way," into it on the same piece of foil, we produced a very natural scene, all the sounds coming out at once, and in a very boisterous manner. It was so natural that we could smell its breath.[92]

The scenes created through phonographic superimposition in 1878 most typically combined a representation of a performer with that of an imaginary heckler. In the specific fiction just cited, the performer was whistling "We'll Never Get Drunk Any More," and the heckler was trying to get him to shut up; the remark about smelling breath implies that the fictional whistler was understood to be intoxicated and causing a disturbance. Edison himself reportedly built up a similar but more technically elaborate scene, starting with a single-voice harmony:

Singing first the air of "John Brown's body," etc., and afterward the bass over the same matrix while listening to the air as reproduced by the instrument, he produces a matrix which will sing both treble and bass. Not satisfied with this, he whistles Yankee Doodle, and finally, over the same matrix, talks in a loud voice, so that when the whole is reproduced, we have a firstclass street corner bawl, which is like this: Two fellows singing John Brown, another whistling Yankee Doodle, and a perturbed citizen crying from an upper window, "O shut up! Go away! If you can't sing better than that the police will arrest you! Police! police!"[93]

A journalist once quoted Edison's explanation of what he was trying to achieve with another, similar routine: "'Sometimes, you know,' said the inventor, with a merry laugh, 'rude people will talk at concerts; suppose we see if we can produce that effect.'" The result in that instance "was as if a riot had broken out in a concert room."[94] On a different occasion, Batchelor began with a speech and then superimposed heckling on it, the idea being to show that the phonograph could educe complex scenes in principle, even if it could not yet retroduce them successfully from life:

Rewinding back the cylinder again the phonograph spoke as follows, reproducing all the variations of tone:—"The sacredness of the (oh, dry up) family tie is the (what are you givin' us?) condition, both of the (music) physical soundness and the (go hire a hall) moral vigor of (miaeow, miaeow) nations. The family is (git eout) the miniature (bow wow-wow) commonwealth upon whose (ki yi, ki yi, yow, yow) integrity the safety of the (took, took, tooky, took, took) larger commonwealth depends. It is the seed (hur-r-r-r-r-oo-o-o) plot of all (give us a rest) morality, in the child's (sah [sic], sshh), intercourse with its (I want to go home) parents the sentiment of (oh, Chawlie!) reverence is instilled (boo, hoo-oo); the essence of all (rr-r-r-R-R-r-rrrr) piety, all idealism; also (let go my hair) the habit of obedience (phit, miaeow) to rightful (police, po-o-ole-e-e-ce) authority which forms so (fire! fire!! fire!!!) invaluable a feature (look at his nose) in the character of the (tooral-looral-loo) loyal citizen." It is difficult, indeed, to describe the effect of the combined sounds issuing from the phonograph. If the reader can imagine the interruptions as above given being sounded or uttered at the same time with the measured sentences of the speaker, and that they do not impair in the least the distinctness of the words spoken, he can understand in some degree the capacity of the phonograph.[95]

The performance described here was successfully recreated on a reproduction 1878 tinfoil phonograph at the 2008 conference of the Association for Recorded Sound Collections, where I had the privilege of voicing the roles of both orator and heckler. To line up the oratory and heckling as indicated, recordist René Rondeau and I found it helpful to record the heckling underspeed, so that it was retroduced at higher pitch during eduction, enhancing the contrast between the two "voices" and adding to the comic effect.[96] Alternatively, the heckling could be recorded first, and an unwitting subject could later be invited to superimpose the "serious" part:

One of his [Edison's] *assistants told a story concerning a trap laid for a well-known divine, who was skeptical regarding the capabilities of the instrument, and evidently had a suspicion that the Professor was a ventriloquist. He wanted to talk into the mouthpiece himself, and see if his own words would be recorded and repeated. A matrix was put on*

the cylinder that had been used once before. The Doctor repeated a Scripture quotation, and, to his great astonishment, it came out as follows:

He that cometh from above is above all ("Who are you?"); he that is of the earth (["]Oh, you can't preach!") is earthly, and speaketh of the ("I think you're a fraud!") earth; he that cometh from heaven is above all. And what he has seen and heard ("Louder, old pudding head!") that he testifieth; and no man receiveth his testimony ("Oh, go and see Beecher!")[97]

These phonographic montages of 1878 plainly exceeded the sum of their constituent parts: the listener did not hear just discrete superimposed sounds, but scenes in which the combined elements gained meaning relative to each other. Thus, we are already dealing here with montages that functioned like later ones not just in a technical sense, but in a cultural sense as well.

The Edison wax cylinder phonograph allowed for superimposition as well, and one of the first demonstrations of it – given privately in late 1887 – featured the same kind of "trick" that had been carried out during the tinfoil era:

after reading over a few lines from a newspaper, one of Edison's assistants turned the phonograph back and sang a few lines of doggerel into it, then turned it back again and whistled "Hail Columbia," the three communications being superimposed. The result was a curious mixture, the speaking, the singing and the whistling being perfectly distinguished, and yet blended together. This shows the ease with which the phonograph can reproduce the music of an orchestra, each of the instruments coming out distinctly, and the voice of the singers, if there is also singing.[98]

In May 1888, music played by an ensemble was successfully retroduced from life,[99] so superimposition lost some of its rhetorical value. Still, it continued to have its uses. In the business dictation sphere, for example, it was one of the methods an official Edison handbook recommended for making corrections: "use the return screw, and by talking louder drown out the sentence wrongfully dictated."[100] Edison's secretary described the technique in more detail elsewhere:

Should it be desired to omit from a letter something already recorded on a phonogram, we find that a good plan is to move back the spectacle arm to that part of the cylinder containing the words which we desire omitted, then to adjust the recording stylus and speaking tube and say into the phonograph, in a loud voice, 'don't write this,' or words of similar import, which expression will be recorded on the cylinder over the sounds already there and will be reproduced more distinctly than the latter. Should we desire to substitute something else for the passage omitted, we record it on another phonogram and direct the operator's attention to it.[101]

This technique differed from the total cutting out of mistakes described earlier in that the original wording was still faintly audible.

Meanwhile, the principle of the single-voice harmony which Edison had demonstrated back in 1878 was revived as well, for instance in the offices of the journal *Club Life*, which was distinctive in 1891 for being typeset directly from phonographic dictation:

A new way of singing into the phonograph, in which manner a quartet is readily heard, has been discovered in the use of one of the Club Life *machines. The several parts of a quartet are sung into the machine separately, and when finished the harmony is perfect, the sound being as though sung by four different persons, though in reality one singer has done the whole work. This is also an innovation, and will in the future produce remarkable results.*[102]

Ten years later, when phonographs were becoming common household entertainment devices, a home recording enthusiast reported doing much the same thing, albeit with three rather than four passes:

You might like to know about an experiment that I recently tried, with my Home Phonograph. I played it Sunday morning, as is my custom, and while making a singing record, it occurred to me to sing a second part directly over what I had sung already. After singing the air of "Sweet and Low" I brushed the record and started the recorder back at the beginning. The moment I heard the first note faintly sounded by the sapphire point, I sang the tenor part, and having completed this, I again brushed the record and started the recorder again at the beginning, and sang the bass part over the previous records. I then changed the recorder to the reproducer and listened for the result.

To say that I was astonished is to draw it mild; for surely enough my own voice came back to me, clear and distinct, singing three parts. The harmony was remarkable and there was very little blasting. I tried the experiment over again, paying particular attention to the time, and also corrected the blasting by singing the air quite close to the horn; and the tenor, which is higher and shriller, through a handkerchief which I had thrown over the horn. Not only was it very interesting to me, but to all my friends who have since heard it, and I intend to work at it until I get a perfect record of the three parts with my own voice.

I would suggest to anyone who tries this, to hold the first note rather long, to enable the singer to start the second and third parts in perfect time, as of course the start is the most important.[103]

The writer in this case had not only experimented with superimposition but had also fine-tuned his methods in an ongoing quest to produce "a perfect record," for instance by recording the tenor part through a handkerchief. A two-pass version of the same technique was spelled out in Allis's 1905 article on "Fun With the Phonograph":

"A Whistling Duet by John Smith." This startling announcement through the horn would create much surprise.

Put on a blank; and, after the speed is about 160 revolutions, whistle some popular piece of which you know the second part. When the record is full, set the recorder back to the beginning again without stopping the machine. When the recording point gets to the commencement of the piece, the first part will sound faintly in the recorder, thus giving the cue and the pitch for the second, which should be recorded not quite so loudly as the first.[104]

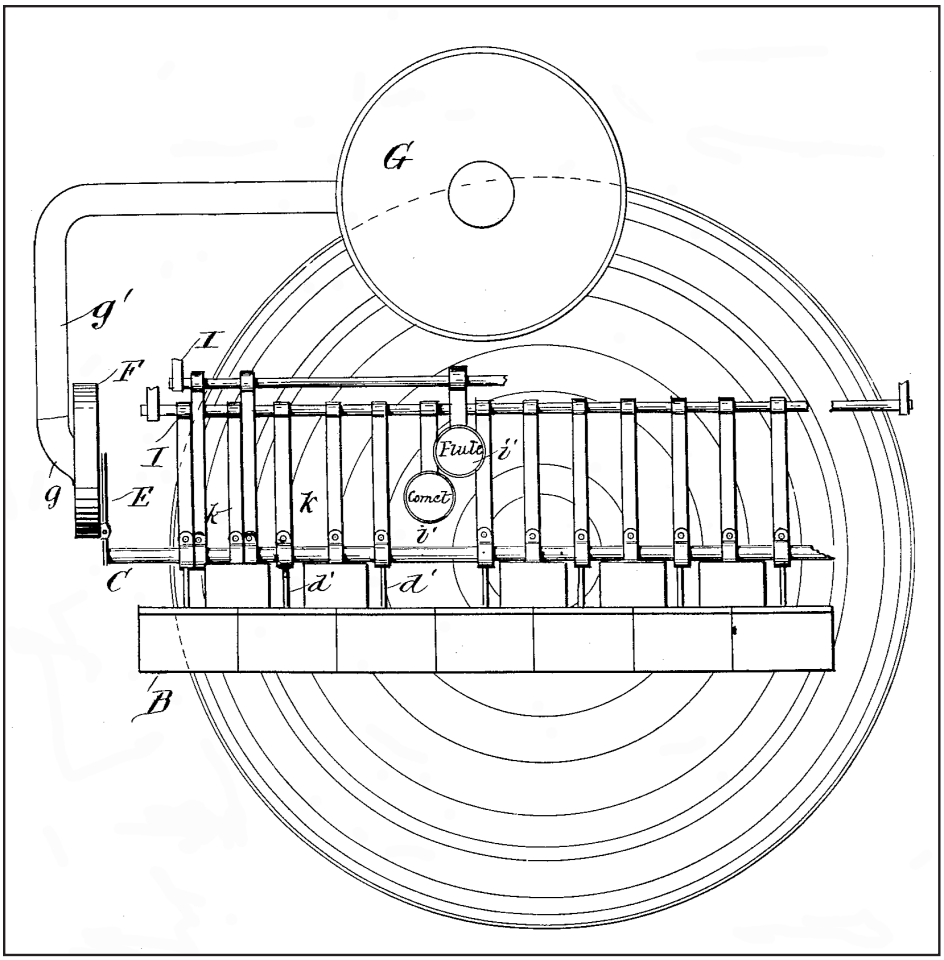

Figure 6. A phonographic sampler with looped "Flute" and "Cornet" grooves. Thomas A. Connolly and Joseph B. Connolly, "Musical Instrument," U. S. Patent 851,634, filed 28 Jan. 1907, issued 23 Apr. 1907.

The first part was to be sung louder than the second because its trace would be degraded somewhat in the process of superimposition, reducing its volume; the goal was to produce a "duet" in which the volume of both parts was more or less equal.

I know several people who have successfully made composite phonograms of this kind in recent years, including single-voice harmonies, using wax cylinder phonographs to record multiple times over the same groove. It is more difficult to find specimens actually recorded in the late nineteenth or early twentieth century. One possible candidate is a brown wax cylinder in the collection of the University of California, Santa Barbara, identified in the cataloging record as "Noisy crowd scene, with various choirs

and solo singers entering and exiting at random. Near the end, male sings 'Put on your Old Grey Bonnet.'" This phonogram sounds as though it originated with a sentimental male-female duet with violin accompaniment over which someone has superimposed imitations of animal noises, whistling, and other sounds reminiscent of the heckling of the tinfoil-era montages. Further details support this interpretation: sometimes the heckling sounds are heard twice in a row one revolution apart, as would be expected if the recording stylus hadn't been correctly lined up with the original groove during a subsequent pass; and when the heckling sounds themselves double up, the underlying music becomes especially faint, as would be expected if it had been degraded by multiple superimpositions. Unfortunately, it is unclear when this particular phonogram was created.[105] Other contenders – in private hands – include an intriguing set of commercial brown wax cylinders of band music onto which a past owner apparently superimposed his own voice singing along.

Another compositing technique was *multitracking*, in which a phonogram was made with multiple discrete traces intended to be educed simultaneously. The "multiple graphophone" of 1898 (Fig. 4) was designed to record and educe several parallel helical traces on the same cylinder, the idea being to devote a separate membrane to each of several voices or instruments.[106] A vocal quartet could produce such a phonogram all at once with four distinct traces on it that would yield a stereo effect when educed through four separate horns. "By using the separate records a clearness and distinctness of each voice is obtained, much like that heard when the voices themselves fall on the ear," it was observed at the time. But the multiple traces didn't need to be recorded simultaneously:

With this same contrivance another novelty has been produced. One voice is employed for making all four of the records in a quartet. In the first place it is necessary to have a voice which is capable of singing any and all of the four parts – first bass, second bass, first tenor and second tenor. There are, of course, few voices of that kind in the entire country. But the graphophone people have succeeded in getting hold of several in New York and Chicago.

Silas Leachman, the twenty-fourth ward politician, is the fortunate possessor of such a voice, and he has made a number of quartet records in Chicago. The singer puts on the cylinder first whichever part it is easiest for him to sing. In putting it on only the one horn and recorder are in place. After he has put the one part on, the reproducing instrument is put on the part. The singer listens and as he hears his voice begin on the part recorded he chimes in, singing a second part in the quartet. Then he listens to both of these parts and joins in with a third part in the quartet. Lastly he listens to the three parts and sings the fourth. The quartet is then complete and four reproducers can be put upon the cylinder and the listener will hear a quartet, which has been made by only one voice.[107]

In the production of single-voice harmonies, multitracking had an advantage over superimposition in that the addition of the later parts did not degrade the earlier ones. However, very few machines of this type were built, and the technique remained accordingly rare.

It was also possible to educe multiple parts of an ordinary phonogram simultaneously. The "polyphone" of Leon Douglass was designed to educe a cylinder phonogram using two styli, the one positioned in the groove a short distance behind the other, in order to increase the overall volume. The *Scientific American* explained:

At first blush it might appear that one diaphragm would reproduce one word and the second another word. But when it is considered that the cylinder makes two revolutions in a single second, it is evident that the interval between the two sounds is so small that the repetition and the original practically coincide.[108]

On the other hand, if the length of groove separating the two styli were increased, the two eductions would no longer "practically coincide," and the listener would perceive different parts of the phonogram being educed at once. Colborne described one means of accomplishing this in his 1915 article on "Gramophone Tricks" (Fig. 5):

A very remarkable effect can be obtained by manufacturing a double pin. Cut the heads off two ordinary pins, and carefully adjust them in the holder...so that they run parallel to each other but in different grooves of the record. The effect is as if two bands were playing simultaneously the same tune, only one band a few bars ahead of the other; although the tunes are separate and quite distinct, yet there is that delightfully confusing "clash" which reminds one of the characteristic grandeur of Coronation processions or Empire Days.[109]

Two years later, Slosson mentioned a similar "trick" as a corollary to the use of photographic negatives or postcards as makeshift gramophone styli: "Three or four films can be held between the fingers or fixt [*sic*] on a stick so as to run in different grooves. This multiplies the volume of sound and makes a medley of it."[110]

A related technique consisted of educing multiple phonograms simultaneously on different machines. In 1903, a store manager in New Albany, Indiana, produced a montage in this way as a publicity stunt and passed a set of instructions along to fellow Edison retailers who he thought might want to duplicate it:

Arrange seven Phonographs on the counters or tables in the display room so as to be distinctly heard from the street by passers by, select the following Records and place one on each machine: Nos. 7885, 607, 8355, 8293, 2226, 3877, 8335. Place a 24 or 30-inch horn on each machine, personally announce that there will be a street fair or Midway in the store within a few minutes, start all of the machines as near one time as possible and listen to the result, which will be an exact reproduction of one of those famous Midways that almost every one is so familiar with.

You may also arrange the seven machines in a half circle and use another machine with a blank Record and preserve your experiment, which I have done. This will satisfy some inquisitive customer who has not heard the original and will save you time in arranging the machines for his special benefit.[111]

By consulting the Edison catalog, we can identify the ingredients of this composite Midway scene. *American Eagle March* by the Edison Grand Concert Band (7885) and *Santiago Waltz* by the Edison Symphony Orchestra (607) were by instrumental ensembles, while *Pearl of the Harem* by Vess Ossman on banjo (8355) and *Turkish Patrol*

by J. Frank Hopkins on xylophone (8335) were instrumental solos. *Turkey in the Straw* by Billy Golden (8293) and *Camp Meeting Jubilee* by the Edison Male Quartette (2226) were both sung pieces, while *Uncle Josh at the Opera* by Cal Stewart (3877) was a monolog. The dealer had also recorded the composite results on an eighth cylinder, but the emphasis was on live juxtaposition, during which the sounds coming from different directions would have yielded a stereophonic effect. Three years later, it was reported that the members of a Chicago women's club had recorded the barking of their pet dogs on cylinder and then, during a meeting, "set half a dozen machines going at once, making a tremendous racket."[112] This would have produced the effect of several dogs barking at once from different directions, so perhaps we can interpret it as a "dogfight" simulated through montage. A piece entitled "Music in the Future," published in the *Musical Times* in 1890 but purportedly a "spirit-writing" sent back in time from the distant future, described yet another scenario of this type:

Only last week a dear friend of mine was found to have contracted a morbid tendency to put in his cylinders the reverse way and, locking himself in his study, set the instrument going for hours together. His wife found him at last with two phonographs, one at each ear, both playing different symphonic poems by Liszt, and both backwards, she says; but as to that she might easily be mistaken. The poor fellow is now undergoing painful and tedious treatment in the hospital.

This last case was cited as an example of "too immoderate an indulgence in the pleasures of the phonograph,"[113] anticipating a future in which phonomanipulation would be not only rampant, but psychologically dangerous.

Yet another technique consisted of recording a sequence of live sounds while simultaneously educing a phonogram on a second machine to produce a new, composite phonogram from the two sound sources. The prerecorded element can be identified today by its unusually "tinny" quality relative to the content recorded live. Sometimes this technique was used to represent the phonograph itself as a sound-generating device within a fictional setting. A prime example of this is Russell Hunting's *Casey Listening to the Phonograph*, which centers on the eponymous character's humorous remarks as he listens to a cylinder of a song on a coin-in-the-slot phonograph, complete with a distinctive speed-shift when the motor runs down prematurely (playfully interpreted as the singer "dying").[114] In other cases, the technique was used to introduce retroduced subjects into a fictional setting, as in *A Trip to the Circus: A Story for Little Folks*, which superimposes its live-recorded action on a brass band phonogram of *The Stars and Stripes Forever*.[115] Since phonographic music wasn't ordinarily used in circuses in 1901, when this phonogram was made, the band phonogram was presumably intended to represent the sound of a live band playing at the fictional circus.

Sampling

The practice known today as "sampling" consists of the use of short phonograms (or excerpts of longer phonograms) as compositional elements (loops, musical instruments, and so forth), often in conjunction with speed-shifting. There isn't a clear-cut boundary between

sampling and other techniques considered above, except that sampling generally involves working with smaller pieces, such as phonograms of individual words or notes.

Thomas Edison himself appears first to have recorded speech sounds in July 1877 as part of an effort to devise a "keyboard talking telegraph," an instrument that would have enabled a user to "play" individual letters on a keyboard, setting successive wheels in motion to generate the patterns of impulses necessary to educe audible words at the other end of a telephone line. He abandoned this plan when phonograms of the "same" letter failed to display consistent patterns for transfer to the rims of the wheels.[116] Nevertheless, the concept of sampling plainly dates back to the moment of the invention itself.

Edison wasn't alone in his vision of phonographic sampling. In late 1877, John Cammack wrote a letter to the *English Mechanic* claiming that he had just been contemplating a similar project when the news of Edison's invention had broken. Cammack's idea had been, first, to record on a blackened paper or a thin metal sheet the "essential characteristics" of the "elementary phonetic sounds" of any language; then,

from these a set of corresponding types in hard metal could be made, which could then be set up as in ordinary print for any lecture or speech when desired. On account of the permanent character of the type the original sounds could be reproduced, and even considerably augmented so as to be heard by a large audience or at a great distance. Suitable expression might be given as desired by separate lines of type modifying the amplitude of the vibrations for loudness or softness of the voice, and regulating speed of apparatus for rate of utterance. It will be easily understood that the instrument for reproducing the sound, or phonomotor as it might be called, would be merely a modification of the original phonograph acting in a reverse manner.

For music a set of type could be made for the scale of each instrument, and by a combination of such it would be possible to reproduce the effects of a complete orchestra, either for parlour use or public demonstration.[117]

Cammack's mechanical oratory would have been set from uniform type rather than recorded from connected live speech, invested with "expression" by variations in volume and rapidity analogous to different fonts rather than by the intonations of a live speaker. Such speculation continued into the era of the wax cylinder phonograph: "Eventually we may be able to copy its curves in a larger size, like type, and use them for a stentorian talking machine."[118] Again, once specific recorded waveforms had been identified with particular sounds, "it might be possible to cut the curves on the margin of a wheel, or other appropriate device, and thus construct a speaking or singing machine. Speech and song and orchestral effects might be multiplied mechanically."[119] Among other use scenarios, it was proposed that the deaf-mute could be furnished with "a storehouse of syllables, manipulated as one would manipulate the characters in a type writer. One key may supply him with a rippling laughter for frivolous occasions, while another enables him to furnish with condoling, sympathetic signs, a weeping mourner."[120]

In 1891, William M. Jewell of Chicago, who worked primarily in the water purification industry, received an actual patent on a phonographic sampler. In this new "musical instrument," a keyboard was to control a bank of phonograms representing various

prerecorded "notes" whose volume could be varied by a lever that adjusted the tracking weight. Although Jewell didn't consider the preparation of the phonograms to be part of his patent, he suggested the method of recording a sound wave phonautographically with a pencil on the side of a disc and then cutting at the line so that the undulating edge would educe the sound when pressed against a stylus. He supposed that the wavy pattern cut into this first disc might then be retraced onto other discs at different speed ratios, enabling him to educe sounds of the same "quality," but transposed to higher or lower pitches. Finally, he thought his instrument might be applied to spoken language as well as music:

I wish also to mention that this apparatus may be made to sound the alphabetical letters and figures or any other characters in the same manner as notes or tones, thus enabling any character, or two or more of them, to be sounded simultaneously, and thus form a symbolical chord or word.[121]

Another patent along similar lines followed in 1907, this one granted to Thomas A. Connolly and Joseph B. Connolly, two brothers who worked together as patent lawyers in Washington, D. C. They laid claim to

an instrument, embodying the principles of the phonograph or graphophone, whereby the tones of different kinds of musical instruments may be reproduced in any desired sequence or combination to produce melodies, airs, chords, harmonies or other musical effects, by manual performance on a key board or by devices, similar to those in use for the automatic playing of music on pianos, organs, and other key board instruments.

The Connolly brothers' patent described a single cylinder or disc with a series of looped, laterally modulated grooves corresponding to the notes of the scale and voices of different instruments that could controlled by organ-like stops; melodies could be transposed into different keys simply by changing the rotational speed of the disc or cylinder. Accompanying drawings show a cylinder with four traces per note labeled "Piano," "Cornet," "Clarinette," and "Bass Viol," and a disc associated with two stops labeled "Cornet" and "Flute" (Fig. 6). The device was represented in part as a convenient substitute for existing musical instruments; thus, "if the sound grooves in the cylinder are all records of the same instrument, as for instance, a piano, the playing of the instrument as in playing a piano will produce the same tones as the piano." However, the Connolly brothers observed that it could generate new kinds of sound as well:

Very unique and strikingly novel musical effects…will be produced by prolonging the tones of certain instruments, hitherto unappreciable and in fact impossible, except as staccato tones, and when this prolongation of tones is desired the cylinder will bear sound grooves produced from the tones of percussion or plucked instruments, and stops will be provided which will prolong such tones as long as a key is held down.[122]

Two more patent applications were filed in 1916, one by Thomas Allen Cleaver for a phonographic "vox humana" to be used in organs,[123] and one by Ralph Colling for a device that produced different pitches by varying the rotational speed of a disc bearing a looped pho-

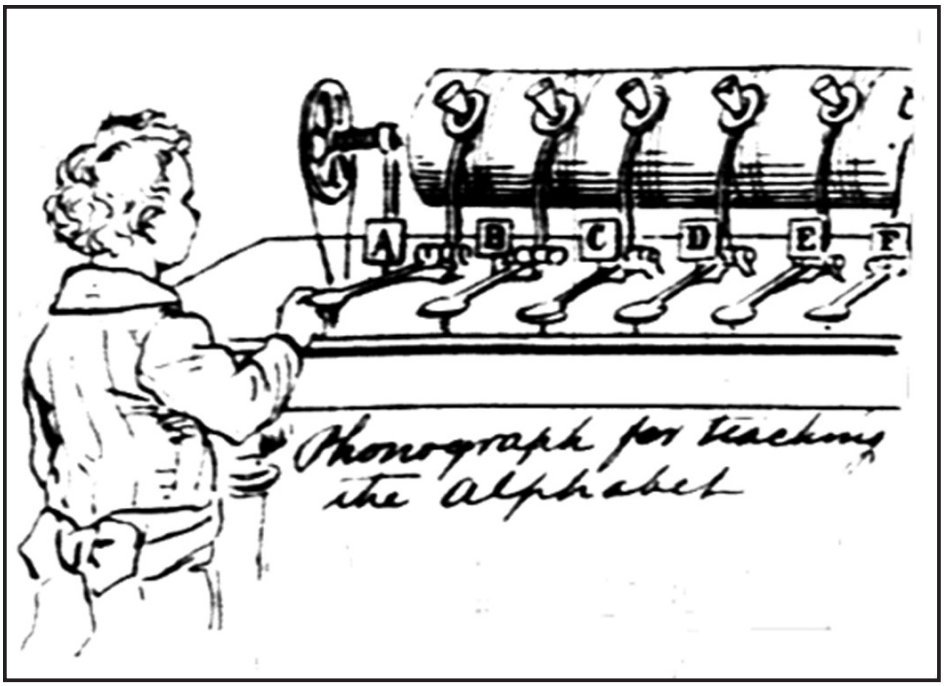

Figure 7. Phonographic samples at the push of a button, as shown in the New York Daily Graphic*, 2 Apr. 1878.*

nogram of a single vocal or instrumental note, enabling it "to produce a pure legato or glide between different pitches of tones recorded from instruments whose nature does not permit such glide to be produced from them."[124] The latter instrument anticipated the pitch wheel and would have enabled users to pitch-bend the notes of, say, a pianoforte.

It isn't clear that any of the phonographic samplers described in these patents were ever actually built, although the sheer fact that people went to the trouble of obtaining the patents suggests these were more than idle fancies. Still, the proposals were not mechanically dissimilar from other devices that were in fact put on the market, such as one patented in 1902 by George A. Moore

whereby to automatically and vocally announce any one of a series of predetermined words or sentences – such as the weight of a person standing upon the platform of a weighing-machine, the height of some one standing beneath the bracket of a measuring apparatus, the "fortune" of any one touching any of a series of points upon a fortune-telling device, the want of a hotel guest, the different floors passed by an elevator, etc.

Although the patent listed several possible uses, its focus was clearly the talking scale, since it was assigned to the Moore Talking Scale Company of Boston and eventually marketed in that form by the United Vending Machine Company. The talking-scale pho-

nogram consisted of a vertically-mounted disc with separate concentric grooves prepared to announce different weight measurements. An increase of weight on the scale moved a reproducer downwards, such that the heavier the person, the further the reproducer would descend from the center of the disc towards the edge, from the shorter inner grooves to the longer outer ones: "Inasmuch as the names of the larger weights are expressed in more numerous words than the lighter – as 'fifty,' 'one hundred and ten,' 'one hundred and seventy-five,' &c. – the record-grooves of greatest length are thereby appropriated for the weight-names of corresponding length."[125] Placing a given weight on the scale effectively selected a corresponding phonographic sample for eduction.

Other devices were envisioned by which any one of an assortment of phonographic samples could be educed at the push of a button. In April 1878, the *New York Daily Graphic* printed an illustration of a "phonograph for teaching the alphabet" on which Edison was said to be working, consisting of a long cylinder with a separate lever and reproducer for each letter. A child in the picture is about to press the key for the letter A (Fig. 7).[126] Sometimes devices of this type were even designed to piece together phrases from multiple phonograms. In 1891, for example, a patent was issued on a phonographic cash register designed to educe spoken announcements in lieu of a visual display. The specially-prepared phonogram inside was to consist of three segments: one devoted to cents, one to dollars, and one to the word "and." In combination with the workings of the cash register, this design was supposed to enable the machinery to generate phrases such as "Three dollars – and – fifty cents."[127] The operation of an articulating cash register of this type closely resembled the use of a keyboard-operated phonographic sampler, both mechanically and conceptually: one hit certain keys, and out came the corresponding sounds, assembled from prerecorded elements.

Sample-looping was put to various uses apart from the more elaborate samplers we have considered so far. In the dictation sphere, a foot-pedal attachment allowed secretaries to repeat short segments of phonogram at will: "the arm of the diaphragm is thrown back in position to catch the last words of the preceding sentence."[128] Another type of repeater was designed for language instruction "to fix certain foreign phrases in the memory of the scholars by constant repetition"; this was also applied successfully to the training of parrots.[129] In 1885, Chauncey Smith of the Bell Telephone Company wrote to Edison asking him to supply "a brass wheel which would say 'Hello'" for use in telephone experiments. In this period, callers generally repeated "hello" over and over again until a respondent answered, so the wheel was presumably intended to educe the word repeatedly rather than just once. Nevertheless, Edison wasn't willing to cooperate, arguing that "it would take a big lot of my time to get a perfect record to make a wheel by."[130] Early phonographic busy signals for telephones must have applied some kind of looping mechanism to the message "Busy, call again – busy, call again – busy, call again," though at least one listener heard "Lizzie, call again – Lizzie, call again," probably due to excessive wear.[131] It was even possible to produce a sample-looping effect without any special equipment. In his 1917 article, Slosson describes connecting the tonearm of a gramophone to his finger with a cord as "a device for retarding, graduating and repeating" – that is, for keeping the stylus locked in a single rotation of the spiral and creating an artificial hung groove.

Now it goes like this: "Oh my, oh my, Oh my, p-p-poor Nellie G-G-Gray, they have t-t-taken you away and I'll never, never, never see my d-d-darling any mo-o-o-o-ore." This is the true vox humana, the voice broken by sobs, wailings and stuttering. Everybody hearing it shakes with uncontrollable emotion.[132]

Of course, the "uncontrollable emotion" was probably laughter. Even so, I believe Slosson's article predates any other known instance of a turntable operator manually interfering with the path of a stylus on a gramophone disc with the intention of producing novel aural effects.

Discussion

The examples cited in this essay should dispel three common misperceptions: (1) that phonography was at first understood and used exclusively as a means of "reproducing" sound sequences as transparently as possible; (2) that the basic palette of phonomanipulative techniques originated with recognized composers and avant-garde figures between the mid-1910s and the 1940s; and (3) that the physical limitations of early phonographic media posed an insurmountable practical obstacle to phonomanipulation until the advent of sound-on-film and audiotape. In fact, phonography has involved phonomanipulation from its very beginnings, incorporating it not only into programs of creative experimentation, but also into everyday uses.

My examples represent only a small subset of early phonographic theory and practice, but this should not be taken as diminishing their importance. In terms of sheer prevalence, I strongly suspect that a higher fraction of total phonographic activity worldwide was phonomanipulative in 1878, during the heyday of the tinfoil phonograph exhibition with its numerous tricks, than it was in 1948 with the birth of *musique concrète*. Moreover, the concepts of speed-shifting and sampling seem to have informed Edison's own path to the phonograph on such a fundamental level that the genesis of the invention itself can't be well understood without them. We have seen motivations for phonomanipulation ranging from the practical needs of business dictation and scientific inquiry to the pursuit of entertainment and aesthetic experience. In the latter spirit, it was claimed (if I may cobble together a few earlier quotations) that phonomanipulation "introduces us into a new world" of "unique and strikingly novel musical effects," "pathetic and beautiful," "charming beyond description," a "Futuristic music" or "music of the future" anchored in "machine composing" that would embrace the phonograph not for "how you can play on it," but for "how you can play *with* it." The better-known electroacoustic pioneers of later times were not the first to articulate such ambitions, nor were they the first to discover many of the relevant techniques that are often credited to them. Their contribution lies rather in their further development and refinement of phonomanipulation and in the aura of artistic legitimacy their works and programmatic statements brought to it.

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Endnotes

1. Douglas Kahn, *Noise, Water, Meat: A History of Sound in the Arts* (Cambridge: MIT Press, 1999), pp.123-156; Mark Katz, *Capturing Sound: How Technology Has Changed Music* (Berkeley: University of California Press, 2004), pp.99-113; Reynold Henry Weidenaar, *Magic Music from the Telharmonium* (Metuchen: Scarecrow Press, 1995); Thomas Y. Levin, "'Tones from out of Nowhere': Rudolf Pfenninger and the Archaeology of Synthetic Sound," *The Grey Room* 2003;12(Summer):32-79; Emily D. Robertson, "'It Looks Like Sound!': Drawing a History of 'Animated Music' in the Early Twentieth Century," M.A. thesis, University of Maryland, 2010.

2. A notable exception is Leah Biel and Mike Biel, "Strange To Your Ears – A History of Manipulating Pitch, Timbre, and Time in Sound Recordings," Association for Recorded Sound Collections annual conference, Seattle, Washington, 20 May 2006, which correctly acknowledged that the principle of speed-shifting was already recognized in the 1870s.

3. See e.g., Eric W. Rothenbuhler and John Durham Peters, "Defining Phonography: An Experiment in Theory," *Musical Quarterly,* 1997;81:242-264.

4. J. A. Simpson and E.S.C. Weiner, eds. *The Oxford English Dictionary,* 2nd ed. Oxford: Clarendon Press, 1989 (5:75).

5. Alan Williams, "Is Sound Recording Like a Language?" *Yale French Studies,* 1980;60:61. Objections to the term "reproduction" in the context of sound transduction date back quite some time; see e.g., Edward T. O'Dwyer, "The Telephone in Relation to the Sacrament of Penance," *Irish Ecclesiastical Record,* 1883;3ser.4(Mar.):168-172.

6. See e.g. Norman Foster, "Sh! – They're Filming 'Talkies'," *Popular Science* 1929;114.4(Apr.):21. I originally used *retroduction* in a similarly limited sense, and in contrast to *cold eduction*; see Patrick Feaster, "'The Following Record: Making Sense of Phonographic Performance, 1877-1908," Ph.D. thesis, Indiana University, 2007, pp.76-77. In retrospect, I would now substitute the terms *hot retroduction* and *cold retroduction*.

7. Technical note, 17 July 1877, in *Thomas A. Edison Papers: A Selective Microfilm Edition*, henceforth TAEM, ed. Thomas E. Jeffrey, microfilm (Frederick, Maryland: University Publications of America, 1985-__), 4:8; or the digital edition, henceforth TAED, http://edison.rutgers.edu (accessed 18 July 2010), NV12016. On this document, see also Patrick Feaster, "'Perfectly Reproduced Slow or Fast': A New Take on Edison's First Playback of Sound," *The Sound Box: The Journal of the California Antique Phonograph Society,* 2011;29.1(Mar.):3-7.

8. Paul Israel, *Edison: A Life of Invention* (New York: John Wiley and Sons, 1998), pp.26-28.

9. "Washington… Wonders of Edison's Inventions," *New York Herald,* 24 Apr. 1878, TAEM 25:171, TAED NV12016.

10. "That Wonderful Edison," *New York World,* 29 Mar. 1878, TAEM 94:147, TAED MBSB10463.

11. "Marvellous Discovery," *New York Sun,* 22 Feb. 1878, TAEM 94:115, TAED MBSB10378.

12. Edward Bellamy, "With the Eyes Shut." *Harper's New Monthly Magazine,* 1889;79(Oct.):739.

13. *Proceedings of the Fourth Annual Convention of the National Phonograph Association of the United States, Held at Chicago, Sept. 20, 21, and 22, 1893* (Milwaukee, Wisconsin: Houtkamp & Cannon, [1893]), pp.98-99.

14. H. D. Goodwin, "Stenographic Speed," *National Stenographer* 1893;4(June):206.

15. The results reported by different researchers proved contradictory; see Fleeming Jenkin and J. A. Ewing, "Helmholtz's Vowel Theory and the Phonograph," *Nature,* 1878;17(14 Mar.):384; Chas. R. Cross, "Helmholtz's Vowel Theory and the Phonograph," *Nature,* 1878;17(29 Apr.):384.

16. J. Comfort Fillmore to [Franz Boas], 24 Dec. 1893, in *The Professional Correspondence of Franz Boas,* microfilm (Wilmington: Scholarly Resources, 1972).

17. Percy Grainger, "Collecting With the Phonograph," *Journal of the Folk-Song Society,* 1908;3(May):148.

18. "Mr. Garner and the Monkeys," *New York Times,* 17 Feb. 1892.

19. R.L. Garner, "Phonographic Studies of Speech," *The Forum,* 1892;13(Aug.):782.

20. "Phonograph in Medicine," *New York Times,* 5 Mar. 1889.

21. "Uses of the Phonograph," *New York Sun,* 3 May 1891, TAEM 146:687, TAED SC91027A; he had no progress to report in Allen L. Benson, "Edison's Dream of New Music," *Cosmopolitan,* 1913;54:800.

22. Count du Moncel, *The Telephone, the Microphone and the Phonograph* (New York: Harper & Brothers, 1879), p.251.

23. "The Phonograph," *Bucks County Gazette* (Bristol, Pa.), 3 Jan. 1878.

24. "The Phonograph Exhibited," *New York Times,* 24 Mar. 1878.

25. "The Phonograph Wins a Victory," *Scientific American,* 1878;n.s.38(22 June):384.

26. "An Evening with Edison," *New York Times,* 4 June 1878.

27. "Useful Information Regarding the Care and Operation of the Phonograph," *Phonoscope* 1898;2.2(Feb.):5.

28. "Phonographic Toys," *Weekly Courier-Journal* (Louisville, Ky.), 15 Apr. 1889.

29. "Not a Mistake," *Edison Phonograph Monthly,* 1905;3.10(Dec.):3.

30. H.C.S. Colborne, "Gramophone Tricks," *Strand Magazine,* 1915;49:358.

31. Edwin E. Slosson, "A Number of Things," *The Independent,* 1917;92(3 Nov.):200.

32. Emily Thompson, "Machines, Music, and the Quest for Fidelity: Marketing the Edison Phonograph in America, 1877-1925," *Musical Quarterly,* 1995;79(Spring):131-171.

33. Research by George Brock-Nannestad cited in Peter Copeland, *Manual of Analogue Sound Restoration Techniques* (London: British Library, 2008), p.88.

34. Dexter W. Allis, "Fun With the Phonograph," *Scientific American,* 1905;n.s.93(25 Nov.):415.

35. Raymond R. Wile, "Etching the Human Voice: The Berliner Invention of the Gramophone," *ARSC Journal* 1990;21(1):13. The position of the "50" immediately below the date is consistent with the layout of other early experimental Berliner discs that specify the same speed, e.g., NMAH 271,729 ("Marching thru | Georgia | E. Berliner | Aug 2 / 88 | 50") and 271,724 ("Selections | Nov 13 / 88 | 50").

36. "Grammophon, Phonograph und ihre Zukunft," *Prometheus* 1890;1:213; Patrick Feaster and Stephan Puille, "E. Berliner's Grammophon: The Beginning of the German Talking Machine Industry (Part Two)," *The Sound Box: The Journal of the California Antique Phonograph Society,* 2010;28.3(Sept.):3-7.

37. Slosson, "A Number of Things."

38. George B. Prescott, "The Telephone and the Phonograph," *Scribner's Monthly,* 1878;15(Apr.):858.

39. Edison to William Henry Preece, 19 Feb. 1878, TAED Z005AP.

40. "Rapid Transit's Clatter," *New York Daily Graphic,* 9 July 1878, TAEM 94:268, TAED MBSB10752.

41. "The Morning's News: Edison's Laboratory," *Boston Evening Transcript,* 23 May 1878, TAEM 25:208, TAED SM029086B.

42. "The Phonograph," *New York Herald,* 27 June 1878, TAEM 94:241, TAED MBSB10699.

43. "The Phonograph," *Engineering,* 8 Mar. 1878, TAEM 94:141, TAED MBSB10449X.

44. *Van Nostrand's Engineering Magazine,* 1883;29(Sept.):264.

45. *Zeitung für das höhere Unterrichtswesen Deutschlands,* 1883;12(10 Aug.):255.

46. "The Phonograph, Etc.," *Daily Evening Traveller,* 23 May 1878, TAEM 25:218, TAED SM029106A.

47. Fleeming Jenkin and J. A. Ewing, "The Phonograph," *Nature,* 1878;17(28 Mar.):423; Edison himself disputed this finding in a letter to Clarence Blake, 1 May 1878, TAED X011AC.

48. "Singing and Talking by Machinery," *New York Daily Graphic*, 15 Mar. 1878, TAEM 94:124, TAED SB031039C.

49. "Monkeys Talked Backward," *Washington Post,* 26 Jan. 1902.

50. "Editorial Comment," *Atlanta Constitution,* 18 Jan. 1896.

51. Garner, "Phonographic Studies of Speech," 782.

52. Richard Lynch Garner to Edison, 27 July 1891, TAEM 131:851-2, TAED D9143AAY. The mandrel was tapered specifically "to prevent the reproducing-cylinder from being placed upon it in a reversed position and giving the record 'backwards,'" according to James L. Andem, *A Practical Guide to the Use of the Edison Phonograph* (Cincinnati: C. J. Krehbiel & Co., 1892), p.43.

53. Letter from "Selah," *Phonoscope,* 1897;1.8(July):13.

54. John G. McKendrick, "Observations on the Phonograph," *Transactions of the Royal Society of Edinburgh,* 1895-96;38:777-778.

55. Francis Arthur Jones, *Thomas Alva Edison: Sixty Years of an Inventor's Life* (New York: Thomas Y. Crowell and Co., 1907-8), pp.152-153.

56. "Reversing the Phonograph," *Literary Digest,* 1899;19(29 July):136.

57. Aleister Crowley, *Magick: Liber ABA, Book Four*, 2nd rev. ed. (York Beach, Maine: Red Wheel/Weiser, 1997), p.648.

58. Allis, "Fun."

59. "From Milwaukee," *Columbia Record,* 1904;2.9(Oct.); page hand-numbered 84 in the copy in the Jim Walsh Collection at the Library of Congress.

60. Colborne, "Gramophone Tricks," p.358.

61. See e.g. the description of the process in George List, "The Reproduction of Cylinder Recordings," *Folklore and Folk Music Archivist,* 1958;1.4(Dec.):2-3.

62. I recognized the mistake based on listening to transfers of the two copies in the Archives of Traditional Music at Indiana University, Bloomington, found in collections 59-002-F and 83-899-F. When the sound files are digitally reversed, the results sound correct.

63. E.M. von Hornbostel, "African Negro Music," *Africa: Journal of the International African Institute,* 1928;1.1(Jan.):47-48.

64. Thomas Edison, "The Phonograph and its Future," *North American Review,* 1878;262(May-June):532.

65. "Edison's Electric Light," *New York Sun,* 20 Oct. 1878, TAEM 94:383, TAED MBSB20963.

66. "Edison's Phonograph," *Journal,* (Quincy, Ill.), 4 Nov. 1890, TAEM 146:632, TAED SC90069A.

67. Transcript of phonograms, 5 Oct. 1888, TAEM 124:793-799, original order 793, 797-799, 794-796; TAED D8850ADW. Six cylinders had been prepared in advance, of which five survive at Thomas Edison National Historical Park in box E-2440: the first (post 11), "Gram No 2" (post 14), "Gram No 3" (post 13), "Gram No 4" (lost), "Gram No 5" (post 17), and Gouraud's own "After-Dinner Speech" in which he proposes a toast to Edison (post 16).

68. Samuel Warsawer, "A Twentieth Century Game," *Phonogram,* 1902;4(Feb.):60-61.

69. "That Wonderful Edison," *New York World,* 29 Mar. 1878, TAEM 94:147, TAED MBSB10463.

70. "Useful Information Regarding the Care and Operation of the Phonograph," *Phonoscope,* 1898;2.2(Feb.):7.

71. The term "home mode" is from Richard Chalfen, *Snapshot Versions of Life* (Bowling Green: University of Wisconsin Press, 1987). For a sense of what pitch asymptotes sound like under different circumstances, consult the "Cylinder Preservation and Digitization Project," University of California, Santa Barbara, http://cylinders.library.ucsb.edu (accessed 18 July 2010), henceforth UCSB, 5277 (at 1:52); 5287 (at 2:02); and 5232 (at 1:46).

72. SEIN 8/54-3; facsimile in Édouard-Léon Scott de Martinville, *M. Scott's Procedures for the Graphic Fixation of the Voice (1857)*, ed. David Giovannoni (FirstSounds.org, 2010), p.3. For an obvious example, see the upper trace of the ninth rotation from the top, two thirds of the way across.

73. SEIN 8/54-33; facsimile in Scott, *M. Scott's Procedures*, 42.

74. Édouard-Léon Scott de Martinville, *Inscription automatique des sons de l'air au moyen d'une oreille artificielle (1861)*, ed. David Giovannoni (FirstSounds.org, 2010), p.10, midway through the fourteenth rotation from the top.

75. Letter from W.H. Sedgewick in *Phonogram,* 1901;2(Feb.):158.

76. Rene Bache, "Do Monkeys Have Speech?" *Brooklyn Times*, 21 Sept. 1890, TAEM 146:608, TAED SC90045A.

77. "Charles Marshall, New York City," *Phonogram,* 1891;1(Mar.):63.

78. Letter from J.J.H., *Phonoscope,* 1899;3.7(July):13.

79. Brian Towne, "'Commercial' Discovered on Brown Wax Cylinder," *New Amberola Graphic,* 1990;71(Jan.):17; dealer's name corrected from "Benfield's (?)."

80. Peerless Orchestra, *U. S. Army Lancers, 1st Figure*, Edison 8247, UCSB 7041.

81. *Inspector's Handbook of the Phonograph, Issued by the Edison Phonograph Works, Orange, N. J., August 1889* (Newark, New Jersey: Ward and Tichenor, 1889; TAEM 147:274, TAED D9899AAS2), p.65.

82. Zon-o-phone based on examples in the author's collection; for Columbia, see Allan Sutton and Kurt Nauck, *American Record Labels and Companies: An Encyclopedia (1891-1943)* (Denver, Colorado: Mainspring Press, 2000), pp.98,155.

83. Ray Wile, "Record Piracy and Ivory Soap," *Antique Phonograph Monthly,* 1980;6.4:8.

84. Two examples were the International Indestructible Record Company, Ltd. of Liverpool, England, discussed on Phonolist@yahoogroups.com, 22 Mar. 2003; and Percy Henry Levy's Imperial Records, for which see Lisa Gitelman, *Scripts, Grooves, and Writing Machines: Representing Technology in the Edison Era* (Stanford, California: Stanford University Press, 1999), p.175.

85. Allis, "Fun."

86. Orlando E. Kellum, "Method of Producing Assembled Synchronous Kinetogrph and Phonograph Records," U. S. Patent 1,294,672, continuation of application filed 29 June 1914; filed 28 April 1915, issued 18 Feb. 1919.

87. E.W. Blake, "A method of recording Articulate Vibrations by means of Photography," *American Journal of Science,* 1878;116(July):54-59 and *Nature,* 1878;18(25 July):338-40; original print in Alexander Graham Bell family papers, Library of Congress, box 317.

88. Allis, "Fun."

89. George H. Bliss, "The Wonders of the Phonograph," *Chicago Tribune,* 16 May 1878.

90. "Visiting Mr. Edison," *Evening Journal* (Jersey City, N.J.), 9 May 1878, TAEM 25:191, TAED SM029061B.

91. "The Phonograph," *New York Herald,* 27 June 1878, TAEM 94:241, TAED MBSB10699.

92. *Globe* (Atchison, Kans.), 27 June 1878.

93. "An Hour With Edison," *Scientific American,* 1878;n.s.39(13 July):17.

94. "Inventor Edison's Last," *New York World*, 20 March 1878, TAEM 94:131, TAED MBSB10435.

95. "The Phonograph," *New York Herald,* 22 Apr. 1878, TAEM 94:174, TAED MBSB10541X.

96. René Rondeau, "Tinfoil Phonographs and Their Public Exhibition," annual conference of the Association for Recorded Sound Collections, Palo Alto, California, 28 Mar. 2008, audio available at http://www.arsc-audio.org/conference/audio2008/ (accessed 12 Aug. 2010).

97. "A Marvellous Discovery," *New York Sun,* 22 Feb. 1878, TAEM 94:115, TAED MBSB10378; original text uses square brackets instead of parentheses.

98. "The New Phonograph," *Mail and Express* (New York), 14 Dec. 1887, TAEM 146:321, TAED SC88093B.

99. "Edison's Perfected Phonograph," *Daily Inter Ocean* (Chicago, Illinois), 25 May 1888.

100. *Inspector's Handbook,* 64.

101. Tate to Duke of Marlborough, 11 Mar. 1891, TAEM 142:67-8, TAED LB048185.

102. "It is a Wonder," *Phonogram,* 1891;1(Aug.):171.

103. Letter from T. Frederick Krey, *Phonogram,* 1901;2(Mar.):189-90.

104. Allis, "Fun."

105. UCSB 5229.

106. Thomas H. Macdonald, "Multiple Graphophone," U. S. Patent 711,706, filed 11 June 1898, issued 21 Oct. 1902; on its implementation as the Columbia "Multiplex Grand," see Timothy C. Fabrizio and George F. Paul, *The Talking Machine: An Illustrated Compendium, 1877-1929* (Atglen, Pennsylvania: Schiffer Publishing Co., 1997), p.92.

107. "Quartet Produced by One Voice," *Phonoscope,* 1898;2.3(Mar.):12.

108. "The 'Polyphone' – Attachment for Phonographs," *Scientific American,* 1899;n.s.81(Aug.):100; see also Leon F. Douglass, "Talking-Machine," U. S. Patent 613,670, filed 14 Feb. 1898, issued 8 Nov. 1898.

109. Colborne, "Gramophone Tricks," p.359.

110. Slosson, "A Number of Things."

111. O.C. Thompson, "A Novel Suggestion," *Edison Phonograph Monthly,* 1903;1.6(Aug.):6.

112. "Phonograph Dinners," *Massillon (Ohio) Independent*, 5 Nov. 1906.

113. F.C., "Music in the Future," *Musical Times,* 1890;31(1 Sep.):528-529.

114. Russell Hunting, *Casey Listening to the Phonograph* (Edison Bell 6584); City of London Phonograph and Gramophone Society, http://www.clpgs.org.uk/Sound_lib_cylinder_page.htm (accessed 12 Aug. 2010).

115. Len Spencer and Gilbert Girard, *A Trip to the Circus – Story for Little Folks*, Victor M-3461-[?]; http://www.archive.org/details/LenSpencerGilbertGirard (accessed 12 Aug. 2010).

116. Patrick Feaster, "Speech Acoustics and the Keyboard Telephone: Rethinking Edison's Discovery of the Phonograph Principle," *ARSC Journal,* 2007;38(1):19-30.

117. Jno. Cammack, "Phonography," *English Mechanic,* 14 Dec. 1877, TAEM 94:96, TAED MBSB10317X. Cammack also claimed to have built a successful electric speaking telephone in 1860; see W. F. Barrett, "Early Electric Telephony," *Nature,* 1878;17(25 Apr.):512.

118. "What is the Difference in the Sounds of Voices and of Musical Instruments by Which We Distinguish Them," *Phonogram* 1892;2(Nov.):248; a similar passage appears in Schuyler S. Wheeler, "The Phonograph," *Harper's Weekly,* 9 June 1888, p.415.

119. "Science in 1894," *London Times,* 15 Jan. 1895.

120. "A Locomotive Phonograph," *Brooklyn Daily Eagle,* 22 Sept. 1889.

121. William M. Jewell, "Musical Instrument," U. S. Patent 460,688, filed 27 Apr. 1891, issued 6 Oct. 1891.

122. Thomas A. Connolly and Joseph B. Connolly, "Musical Instrument," U. S. Patent 851,634, filed 28 Jan. 1907, issued 23 Apr. 1907.

123. Thomas Allen Cleaver, "Phonographic Reproducing Instrument for Organs," U. S. Patent 1,317,127, filed 17 Mar. 1916, issued 23 Sept. 1919.

124. Ralph Colling, "Musical Instrument," U. S. Patent 1,246,055, filed 27 Dec. 1916, issued 13 Nov. 1917.

125. George A. Moore, "Phonographic Record," U. S. Patent 713,328, filed 8 Mar. 1902, issued 11 Nov. 1902; "Two Novel Vending Machines," *Electric Railway Journal,* 1909;33(27 Feb.):382-383.

126. "A Visit to the Inventor of the Phonograph," *New York Daily Graphic,* 2 Apr. 1878, TAEM 27:776, TAED SB031075B.

127. Austin B. Hayden, "Combined Cash-Register and Phonograph," U. S. Patent 460,492, filed 20 Aug. 1890, renewed 11 Sept. 1891, granted 29 Sept. 1891.

128. "A Novel and Useful Attachment to the Phonograph," *Phonogram,* 1 (May 1891):116.

129. "Teaching Parrots by Phonograph," *Phonogram,* 2 (Mar. 1901):179-80.

130. Chauncey Smith to Edison, 24 Apr. 1885, TAED X012F2H; and 5 May 1885, with marginalia, TAED X012F2J.

131. "The Man in the Street," *New York Times,* 24 Nov. 1901.

132. Slosson, "A Number of Things."

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