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## Phonograph Records: History, Materials, and Preservation

### Introduction and History

According to the *Gale Encyclopedia of Science*, in 1877, Thomas Edison conceptualized the first machine capable of recording and reproducing sound (3042). This machine was the phonograph, and it operated chiefly through the use of mechanically made impressions on the cylinders he had designed for recording. While other inventions that could record sound preceded it, no other had been capable of reproducing the sounds. Though to be fair, another conceived the same idea slightly earlier than Edison, but that man, French national Charles Cros, could not get anyone to back his ideas in any substantial way (Osborne, 9). Also, it should be noted that Cros's paper detailing his ideas was not published until a month after Edison first began telling others of his experiments with recorded sound (Osborne, 10).

On this day, December third, in 1877, Edison and his assistants began designing the groove for recording sound (Osborne, 11). They began with three ideas: a single, continuous strip, a disc, or a cylinder, and despite what readers might initially think, Edison chose to bet on the cylinder. This cylinder was wrapped in tinfoil, and one "diaphragm-and-needle unit" would record sound onto the cylinder by engraving the groove into the foil using a hand crank, while the other needle unit was for playback (Osborne, 11). By the very next day, Edison and his cohorts were able to put this invention to the test by recording "Mary Had a Little Lamb." His own testimony later demonstrated his apparent shock at this initial success (Osborne, 11).

Edison's initial concepts were not ideal for commercial production, and he knew this. However, others, including Alexander Graham Bell, were able to take those ideas and contribute their own, such as the floating stylus (Ord-Hume et al.) in their production of the Graphophone (Osborne, 12). Another of the changes they made was exchanging tinfoil for cardboard coated in wax for increased durability (Osborne, 12). Lastly, rather than simply engraving or "indenting" the material's surface, their machine incised the grooves (Osborne, 13).

It was not until 1894 that Emil Berliner introduced the laterally cut, flat discs we know as records that were played on his gramophone. Another difference was the intended content of his discs. Up to this point, the phonograph and graphophone had been intended for office work, while Berliner wanted to put music on his discs, and pre-recorded music was non-existent up to this point (Osborne, 13). Interestingly though, "the disc itself was not a patentable device, [so] Berliner's gramophone patents instead focused on his development of the groove" (Osborne, 13). Rather than the up-and-down movement utilized in the cylinders, his were incised laterally and

had a better sound quality as a result. This was the standard for discs until the forty-five-degree groove took over in the mid-twentieth century with an even better quality of sound (Osborne, 13). Berliner's discs had a further advantage over Edison's cylinders, however, because they were more conducive to mass production through the use of pressings (Lerner et al. 3042). Those cylinders were not easily forgotten, however. For a century, the cylinders and discs competed with each other for greater popularity; however, in 1902, two major recording companies combined their resources and knowledge, and with that, the flat discs quickly began to outpace the cylinders (Ord-Hume et al.).

For the first several years of their production, these discs were composed of a stiff rubber material before, in 1897, a shellac-based medium began to quickly replace it (Ord-Hume et al.). However, Berliner initially worked with "plate glass discs coated in lamp-black, the substance in which the groove would be engraved" (Osborne, 29). Shellac itself is a resin, a gummy and sticky substance found in nature. In this case, a bug native to the Malay Peninsula and French Indochina (Osborne, 67). Various manufacturers across Britain had differing formulas for their shellac records, and those also changed over time, but generally, they were "about one-third shellac and two-thirds mineral filler (finely pulverized slate or limestone), with cotton fibers to add tensile strength, carbon black for color (without which it tended to be an unattractive "dirty" gray or brown color), and a small amount of a lubricant to facilitate release from the manufacturing press" (Wikipedia, Phonograph Record). In 1945, after the end of World War II, the shellac disc was replaced by vinyl.

More specifically, it was polyvinyl chloride or PVC, and it was a big step forward for phonographic discs in several ways. It was much more durable than the delicate, easily broken shellac discs and could be transported to troops serving overseas. Shellac also had to be imported into the U.S., and during World War II, Japan occupied the areas where the "shellac beetle" resided, while vinyl is petroleum-based and could be produced locally (Osborne, 67). While it was initially more expensive to produce, it became the only option once the blockades began, and thus the cost differential was less of a factor (Osborne, 67). Vinyl could also be etched with narrower grooves, meaning more lines could be etched onto each disc. That, coupled with the introduction of a slower playback speed of 33 1/3 r.p.m. was the birth of the L.P. or Long Play record (Ord-Hume et al.). It also produced a clearer sound with less popping and buzzing and could reproduce a greater span of sound frequencies (Mumma et al.).

The fact is that the music industry as we know it today would not be the same without the development of these machines and recording techniques. In the span of half a century, the world changed from one where live music was just about all that was available to a massive market for pre-recorded entertainment of many kinds. Records and vinyl ones especially are a huge part of that. Once vinyl made longer recordings feasible, the label companies that had emerged began producing longer classical works and releasing them in sets for purchasing so that listeners could enjoy the entirety of the *Nutcracker Suite* within the comfort of their home (Osborne, 88-89).

## Vinyl Revival

Unlike compact discs, vinyl records have experienced a resurgence. “Vinyl sales have long been propelled by a fanboy culture and a collector ethos” (Palm 5). More people are buying and collecting older and possibly original records, while today’s artists produce and sell their new releases as L.P.s. Some have stated that this is because of a “peculiar yearning for the recreation of audio quality as it was first perceived,” and for some generations, this “vinyl nostalgia” might be the answer, but it does not entirely account for this resurgence (Bijsterveld et al. 102). And what a resurgence it has been; by the mid-1990s, sales had lagged to only a few hundred records per year (Palm 3). Two decades later, the trend had been entirely reversed, and now sales are only going up, both for new and original or used records (Palm 4).

One thing that seems to have contributed to this is the creation of a new holiday. The third Saturday in April has been declared Record Store Day or RSD. The first Record Store Day took place in 2008 and was celebrated across the world, with frigid Antarctica being the sole exception (Record Store Day). “The effect of RSD on vinyl rivals Valentine's Day for flowers and Halloween for candy...RSD has done more than any other event, organization, or individual to elevate the sales and profile of vinyl records” (Palm 7). Apart from all the stores that offer deals and specials that day, the event spotlights vinyl as a desirable form of music media.

C.D.s will likely not see a similar revival. In my opinion, this is partly because they lack the novelty of vinyl records. Additionally, the initial attraction of C.D.s was their ease of use and playback, and their mobility. Vinyl is less travel-friendly and requires larger and less simplistic playback equipment. It takes more effort on the listener's part than streaming, which seems counterintuitive to vinyl's resurgence. However, it actually contributes to the novelty of it for those who did not grow up in the original age of vinyl albums. In their 2015 paper, Bartmanski and Woodward call vinyl records iconic objects and say that they “become meaningful via a dual process. First, they offer immersive engagements which structure user interpretations through various material experiences of handling, use, and extension. Second, they always work via entanglements with related material ecologies such as turntables, speakers, mixers, and rituals of object care” (171). People who continue to collect vinyl albums are investing in more than the album's music. They want that experience and engagement that they offer.

## Threats Facing Vinyl Records

Whatever the age of the disc, “all grooved disc media is susceptible to warpage, breakage, groove wear, and surface contamination” (PSAP). In other words, the most prominent threats are dust, excessive heat, overplaying, mishandling/abuse, and material degradation. Truthfully, the concept of overplaying had never occurred to me before. However, as a record is played more, the grooves suffer more wear. And since the speed does not change through playback, as the turns become tighter, the needle makes less contact with the disc per second (Wikipedia, Phonograph Record). Another way to phrase it is that towards the outer edge of the disc, there is more room to hold information than towards the center. This can result in some

sound distortion, which will only worsen as the record is played more and the needle wears the grooves.

Another agent that can affect playback quality is dust, and in this scenario, I tend to think of dust as a more gentle version of sand. It gets everywhere and is hard to eradicate, especially since vinyl is a dust magnet due to its tendency to hold an electrostatic charge (IASA). Dust gets in the grooves and causes problems, kind of like getting sand in your swimsuit. The dust interferes with the needle's contact with the vinyl, creating a popping or, in some cases, a clicking noise during playback (Victrola). Oils and sweat from frequent touching can worsen this problem by allowing the dust to cling to the disc, or even worse, encourage mold to form (IASA). If the dust is thick enough, it can cause the needle to fall out of one groove and into another.

If the needle skips roughly, it can result in physical damage. While vinyl is not as vulnerable to breaking as the older shellac discs, it is still relatively malleable and soft enough to be scratched. Some scratches are shallow enough to cause only slight variances in the playback, but more severe ones can cause large sections of the song or other media to be skipped. In some cases, the needle continuously runs through the same groove, repeating a section of the recording repeatedly. The direction of the scratch has a lot to do with its effect on the sounds. They are, of course, still breakable if put under enough pressure, but proper storage and care should eliminate that threat.

The subject of storage is essential in caring for vinyl records as well. Severe temperatures can do much damage to the materials. Too much heat exposure can soften the vinyl and cause the record to become warped. This would make playback difficult, if not impossible. Additionally, records that are stacked, one on top of the other or angled without proper support, can warp simply by being left in that position for too long (Victrola). Even if they do not suffer warp, stacked records exposed to heat can press into each other, damaging the groove impressions. One record store that I recently visited had an example of a severely warped record on display next to the register, with a written warning about Texas summers.

Sunlight exposure can, of course, exacerbate this problem. Heat is also an issue if the album or the sleeve is covered in shrink-wrap. The plastic wrapping can adhere to the sleeve or to the vinyl itself, but it can also increase the chances of warp damage. Due to the plastic nature of the records, fluctuating humidity levels are not as dangerous to the materials as they would be to a paper collection. However, it does contribute to the static charge mentioned above (Victrola). As the humidity rises, it becomes easier for the vinyl to hold a positive charge and attract more dust. So, as usual, here in the South, we will constantly be battling against humidity variances.

While polyvinyl chloride (PVC) is theoretically susceptible to degradation over time, it is relatively stable compared to many other materials. According to the Canadian Conservation Institute, PVC is categorized as being at low risk of ill effects from just about every agent of

deterioration. It seems that it is less stable when combined with or exposed to other materials. “Vinyl-type 45s and L.P.s are not presently considered especially vulnerable to age-related deterioration or inherent vice. They are generally chemically stable and have a relatively long lifespan when stored properly. Playback equipment is still being manufactured. Therefore, discs of this type are generally a low preservation priority” (PSAP). What is more, proper care, handling, and storage go a long way to staving off most threats of potential harm, which should come as no surprise.

### **Preservation: Storage, Care, and Cleaning**

The preservation of vinyl records is reasonably straightforward, and I might even say easy. There are several recommended best practices regarding cleaning, handling, storage, and even playing. The grooves themselves are vital and must be treated as such. One way to combat the wear from overplaying is using a counterweight on the tonearm of the record player. Not all players have this option; however, a counterweight “allows the user to set the pressure the needle sits and...[can] take the pressure off and make the record last longer” (Parmenter, 2021). When handling the discs, it is important to try and touch the grooves as little as possible or even wear clean, lint-free cotton gloves (IASA). This will prevent the oils on your skin from adversely affecting the record. It is also wise to only make contact with the outside edge and the label area when transferring the record back and forth between the player and the protective sleeve or sleeves.

Sleeves are an essential buffer against unnecessary deterioration, and records should be returned to their sleeves when not in use. Using both an inner and outer sleeve can also help prevent dust from collecting. It is important that the opening of the inner sleeve does not line up with the opening of the outer sleeve (Wikipedia, Conservation). While paper sleeves are popular, they should be replaced regularly to prevent any oil or residue that could be produced as the paper deteriorates; also, they could pose a scratch threat to the record. “Commercial vinyl records may be stored in their original sleeve, but they should also be placed in a static-free polyethylene liner to avoid print-through from the original sleeve” (Williams). Furthermore, stay away from PVC-based sleeves as they may fuse to the record (Wikipedia, Conservation). The only times that records should be allowed out of their sleeves are when played and shipped. This last bit may come as a shock, but it is because “impacts can often cause the vinyl to knock, burst-through and generally degrade those all-important sleeves” (Lil Packaging USA).

Again, temperature and sunlight can have severe effects on the materials, and while it typically takes roughly 140 degrees Fahrenheit to do real damage, collections should be stored in much more moderate conditions (Victrola). They should also be stored as close to an upright position as possible to maintain their original shape. It is also recommended that they are not stored with records of different sizes, such as mixing L.P.s with 45 r.p.m. discs because the different shapes could press against each other and eventually cause warp damage. Warp can be

corrected, but the flattening process must be carefully controlled and monitored. Additionally, it requires access to a thermostatic oven.

As expected, keeping the records clean will increase the length of their potential lifespan. The International Association of Sound and Audiovisual Archives (IASA) has a notable amount of helpful information on the subject. There are commercial cleaning machines, and many records stores sell safe, alternative methods that can be done at a residence. My focus will primarily be on the cleaning methods available to the average collector rather than those with access to large-scale cleaning methods.

There are various steps you can take to keep records clean. One way to combat dust aside from the proper use of sleeves is to use a brush on the albums. “Using a carbon fiber brush to wipe down your records before and after use is a great way to take care of your records and steer clear of unwanted particles” (Victrola). Some of the brushes are carbon fiber, which are typically used when the record is dry, and others are made of camel hair and are used in conjunction with a cleaning solution (IASA). Similarly, collectors can use micro-fiber cloths in the same way, which are non-static and readily available at many stores (Parmenter, 2017). Another dry-cleaning option that I have seen sold in stores is a substance called “Groove Goo,” and this can be gently rolled across the records’ surface to pull various debris out of the grooves.

Washing is considered the most effective, and there are different cleaning solutions and methods to use (IASA). At the most basic level is soapy water. “Make sure you use something like a sensitive washing-up liquid with no perfumes, dyes or acids, and also use distilled water – not the stuff straight from the tap” (Parmenter, 2017). Additionally, only a tiny amount of soap should be added to the warm water, and the micro-fiber cloths mentioned earlier work well in this process (Parmenter, 2017). However, the records should never be soaking wet and should be dried well.

A quick Google search demonstrates the multitude of purchasable cleaning solutions that are available to the public, as well as do-it-yourself formulas. Many commercial options include ingredients that help fight the dust-attracting static charge. From the various solutions that I found on Amazon and the home formulas listed on Google, there seems to be some controversy over the use of isopropyl alcohol as a cleaning agent. Many DIY recipes include alcohol as well as soap, while some commercial products claim that they do not contain alcohol as it can weaken the plasticizers in the vinyl. Many collectors share this opinion, and as such, alcohol should probably be avoided as a cleaning agent.

One way to keep the discs clean that I found during my research may come as a surprise and should be taken with a grain of salt, and that is to play the records while they are wet. The idea is that the cleaning solution works while the stylus runs through the grooves (IASA). While this will create a much clearer sound at the time, it can cause a decline in sound quality when the record is later played dry. It should also be stated that collectors should not “expect miracles for

very old/damaged records. Cleaning may improve the sound but will not get rid of wear and tear or scratches” (Parmenter, 2017).

### **Preservation: The Digitization Effort**

Groups such as the IASA have developed protocols for digitizing records to lengthen the life of the media that they contain. Much work goes into the process. First, they try to locate the copy with the highest sound quality and clean it up the best they can. Furthermore, they say that “if two copies only exist, and they display different wear characteristics, then retain both and transfer both” (IASA). Another type of restoration that they encounter is flattening, which I briefly mentioned earlier. It is possible to correct warp damage; however, it is a delicate process with multiple possibilities for failure or further damage. It is recommended that this process be performed only if you possess the correct equipment.

They also take care to use the most accurate replay equipment for each L.P. and take care to use good quality equipment to ensure a good sound production. With each piece of machinery that is used, more variables are introduced that could affect the sound quality, “Pick-up arm, cartridge, stylus, tracking force, previous groove deformation or wear all contribute to the variability in replay” (IASA). It is important that they stick to the playback speed standards and perform any necessary equalization while also accounting for industry standards. The number of factors outlined in the IASA guidelines is impressive, and they are detail-oriented in their quest to capture the most accurate audio for preservation. It is a bit beyond the scope of this paper to dive into all of that minutiae, as the amount of information could constitute its own paper.

### **Conclusion**

While I think these digital preservation efforts are worthwhile, I would infinitely prefer that vinyl records be cared for in ways that ensure they last for as long as possible. Vinyl records are an essential piece of auditory history and culture that is currently being embraced by a generation that has easy and nearly constant access to online streaming of countless songs. As discussed earlier in this paper, despite the ever-increasing technological advances that are being made vinyl album sales continue to show high levels of interest across today’s generations. Hopefully, this means that this form of media will be around for many more years, and it serves to emphasize the need for people to educate themselves about how to care for vinyl records.

I know I will treat my collection differently with the knowledge I gained during this assignment. And I know just where to start. Last year I was gifted an old suitcase full of 45 r.p.m. vinyl records that were carelessly stored. There were more than fifty, maybe twenty had paper sleeves on them, while the others were resting on top of empty sleeves. Many of the discs were cracked, even more showed signs of scratches and scrapes. Some of the sleeves had signs of mouse damage and all were brittle and cracking. The broken seal on the suitcase allowed dirt and dust to collect as well. Overall, maybe half were salvageable for playing; or so I thought at the time, but maybe I should reevaluate them in light of my new knowledge.

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