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BAKING, MINERAL OIL, AND WINDEX: A LOOK AT THE SORRY STATE OF PRE-DIGITIZATION CONSERVATION TREATMENT FOR AUDIOVISUAL MEDIA

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ABSTRACT

Playing old sound recordings is part art and part science. Pre-playback conservation treatment, however, is almost entirely an "art." Very little scientific research has been published in peer review journals on the actions practitioners apply to playing old (and not so old) electronic media. Many conservation methods are used without sufficient data. In a 1982 article in the journal *IEEE Transactions of Magnetics*, the problem now known as sticky-shed syndrome was shown to be an issue of humidity, not temperature (Bertram and Cuddihy 1982). In 2006, the National Endowment for the Humanities funded a study at the Image Permanence Institute, Rochester, New York, that concluded that there was no linear correlation between baking and improved playback parameters (Bigourdan et al. 2006). So, why are so many of us still baking sticky tapes? Lacquer or acetate instantaneous recording discs leach their plasticizer and become coated in palmitic acid. It is nearly impervious to soap and water. One specialist uses mineral oil to dissolve the palmitic acid deposits then dishwashing liquid to clean off the mineral oil. The Library of Congress, Washington, D.C., published a cleaning solution (subsequently withdrawn) that made short work of the palmitic acid deposits. It also ate through the plastic tubing of their cleaning machines. Many audio engineers play 78 RPM discs with a bead of water under the playback cartridge. Why does this sound better? Do we give up accuracy of performance for a more pleasant sound? We don't know. This paper will look at the sad lack of hard science in the conservation of sound recordings.

Thirty years ago, as I was becoming aware of sound through home stereo equipment, there was a big market in gadgets to improve the quality of sound. Discwasher's hand-held vinyl LP cleaners were *de rigueur* unless you could afford $4,000 for a Keith Monks Record Cleaning Machine. Discwasher also sold interconnect cables with gold plated connects amongst many other grand ways to improve your system. You could also buy special bricks to put on top of amplifiers to make them sound better, and little contraptions to lift speaker wires off the floor to improve the sound.

If you remember LPs, you'll remember they were prone to static electric buildup. Sometimes this came from the plastic liners inside the inner sleeves of the jackets, the weather, or the friction of the stylus during playback. The Milty Zerostat Gun has a mechanism that produces positively charged ions when you pull the trigger, and an equal number of negatively charged ions when the trigger is released. Therefore, the theory and marketing materials said it didn't matter whether your disc suffered from positive or negative ions. There was plenty of each from the Zerostat gun. If you had the gumption to question how an equal number of positive and negative ions in the pull and release cycle could cause a net change on a disc then you clearly didn't understand how it worked. The struggle with this devise is that it did indeed "work." Just not as advertised. This is a case where the device does have a scientific basis, just the marketing materials do not.

Static electricity, like all electricity, stays put until there is a reason (a difference in electrical potential between two points), and a path (such as a wire or the finger of your little brother). The static electric potential can be quite high, and when it finds a path, off it goes——zap. Let's say your LP has net negatively charged ions. When you pull the trigger, positive ions are attracted to the negative ions and the charge is dissipated. If there are more positive ions than needed to dissipate the charge on the disc, they just float away into the air. When the trigger is released, the spray of negative ions either finds the floating positive ions or just otherwise dissipates in the air. There's no reason for the "extra ions" to be attracted to the LP because there is no remaining electrical potential. With LPs going the way of the horse and buggy, the Zerostat is a veritable buggy whip. A new market had to be found. From this is born the idea of using the same tool on the LP's replacement, the CD.

This all sounds well and good until someone realizes that CD playback is an entirely optical phenomenon. If the Zerostat gun is making a difference in the sound, then you have a very interesting situation, indeed. Furthermore, there are other, simpler ways to dissipate the static electricity. A light spray of water does just fine as water is highly conductive. A carbon-fiber anti-static brush is what we use at George Blood Audio and Video. Of course, the Zerostat has found applications outside audio where it has a stronger basis in laboratories and photographic finishing, where water might damage an objects surface.

Many people swear by this technique: put a bead of water on the disc where the stylus is touching, and the surface tension of the water will draw the bead along, keeping the stylus immersed continuously. Playback sounds better but there is no quantitative measurement or description, just "better." If it *is* better, then it should be possible to measure it. It is easy to see how this water method would reduce the noise from static electric pops but does it affect the frequency response? Is the water dampening the motion of the stylus and cantilever to reduce the velocity of the stylus? This reduction in velocity will have a measurably negative affect on the frequency response even if it does yield a better sound. If it discharges the static electricity, but does *not* affect the mechanical-electrical transduction, then it is a good thing. But if there is a price paid in accuracy of playback, should the process be prohibited in preservation?

One highly respected member of the audio preservation community swears by his technique of playing LPs with Windex window cleaner. He is convinced there is a chemical in Windex that replaces part of the PVC molecule that deteriorates over time. He cautions, however, that this does *not* work for 78 RPM discs, which are made from shellac. Not only is there no PVC in the shellac to be "repaired" but the alcohol in Windex dissolves shellac! No, it is not possible that the improvement in sound is due to the liquid dissipating the static electric charge and, no, it is not the glycerin lubricating the disc. He tried straight glycerin and it sounded terrible.

Apart from the issues of static and PVC molecule deterioration, there are various other issues associated with discs. Lacquer discs were a means of recording before tape was practical, and they coexisted for decades. In their most common form they consist of a metal base coated with cellulose nitrate. Etched or not, these are not stone tablets. But they are capable of pretty high quality sound if properly recorded. Unfortunately they deteriorate over time. They have two modes of failure, delamination, and plasticizer leaching.

Theoretically, it is possible to repair a delaminated disc. As a practical matter it is considered a complete loss. The residue, however, is fairly well understood. Palmitic acid is a saturated fatty acid. As the length of the carbon chain in the acid increases, the solubility in water decreases rapidly. Palmitic acid has 16 carbon atoms (stearic acid, by comparison, has 18). Since the palmitic acid originates in the cellulose nitrate plasticizer, it has a high affinity for the disc surface. It cannot be removed with water. There are plenty of options, though, for getting palmitic acid off the disc. The disc specialist at George Blood Audio and Video swears by DiscDoctor Cleaning Solution. The formulation is not published, but it has been tested and there is plenty of field experience with it. Tergitol is the reagent of choice at the Packard Campus of the Library of Congress in Culpeper, Virginia. It is a "readily biodegradable" surfactant made by The Dow Chemical Company. Years ago, the Library of Congress whipped up an in-house cleaning concoction. They stopped using it because it had a tendency to eat the plastic tubing in their Keith Monks Record Cleaning Machines.

Other audio preservationists insist that home remedies are the best palmitic acid removers. Mineral oil has been tossed around as a cleaner for at least 30 years. While its practitioners swear that it works, not too many other people have picked it up. The process involves using a coat of mineral oil to dissolve the palmitic acid. Afterwards your disc is a mess, it's coated with baby oil. How do you get the mineral oil off?—Scary amounts of Ivory Dishwashing liquid.

Rubber cement has also been heralded as a palimitic acid avenger. This method was discovered by Ed Wilkinson while trying to re-glue a label to a lacquer disc. How does it work? Ed's theory is that the glue attaches itself to the residue and it peels off with the dried glue.

> I looked up the MSDS for rubber cement. Various solvents are used in the making of rubber cement and these chemicals vary by manufacturer. I experimented with a can of rubber cement. I applied it to a test disc then washed it off. This resulted in no Palmitic Acid without any drying or peeling of the glue required. Despite this "success" I am concerned about the long-term effects on the rubber cement on the lacquer.

Furthermore, how sure are we that the bonding strength of the cellulose nitrate to the aluminum or glass base in a lacquer disc is higher than the bonding strength of the rubber cement? In other words: DO NOT TRY THIS AT HOME.

The most talked about AV conservation myths revolve around sticky-shed syndrome. The idea of baking tapes is spoken about in almost hushed reverent tones. Many practitioners have gone as far as to make their own baking devices consisting of a cardboard box, thermostat and a hairdryer. Fancier setups include laboratory incubators, food dehydrators and the ever-popular countertop convection oven. The hard science behind sticky-shed syndrome tells us that baking is quite unnecessary and in the hands of the inexperienced, detrimental to the tape. Tests indicate the chemical reaction of binder hydrolysis is reversible (Bertram and Cuddihy 1982). No matter what the temperature, in dry air, the process always reverses. Near normal room temperature conditions (65°F, 40%RH) are on the curve of ideal storage conditions. Depending on which side of the curve, the binder will either develop sticky-shed syndrome or reconstruct its former properties. Polyester tape will deform and melt at high temperatures. Even if you manage to not destroy your tape, the tape is still at a high risk for accelerated print-through and accelerated aging of the materials. This occurs due to the stress that the heating and cooling process places on the layered structure of the medium.

As demonstrated in the conservation of tapes suffering from sticky-shed syndrome, many audiovisual conservation techniques—or rather myths—have their roots in sound science. There is no question that the practitioners of these methods have their heart in the right place; however, many of these myths at best do not work (or work on a lark) or at worst will ruin collection materials. Book and paper conservation relies on tested methodologies that are constantly being questioned and improved. Why should this be any different in the audiovisual world? Why must we settle for conservation myths, half truths, and gossip? Let's stop using Windex and let the technology and structure of the materials tell us what they need.

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