ELECTRICAL REPRODUCTION
OF
ACOUSTICALLY RECORDED CYLINDERS AND DISKS

by Tom Owen

By the turn of the century, when the phonograph was still somewhat of a novelty, Lionel S. Mapleson, the Librarian for the Metropolitan Opera Company, made an experimental recording of diva Marcella Sembrich. Encouraged by the results, Mapleson took his Edison "Home" Model A phonograph and installed himself in the prompter's box during the 1900-1901 season. He was able to record Nellie Melba and Jean de Reszke in Le Cid, Melba in Faust, J. de Reszke and Lillian Nordica in Huguenots, Sembrich, Joanna Gadski and others. By the 1901-2 season, Mapleson realized that working from the prompter's box severely limited his recording. In an effort to capture the entire ensemble he moved his apparatus to the catwalk some 40 feet above the stage. Mapleson experimented with various horns and diaphrams until he finally settled on the most appropriate one. Recordings by Calve in Faust, Gadski in Tannhauser, and Albert Alvarez, illustrate that Mapleson had mastered his machine by the end of the season.

By the 1902-3 season, we see Mapleson cutting over 60 waxes which have survived to this date. After 1903, Mapleson's recording seems to have come to a halt, but aural discoveries on the cylinders and comment by Lionel's son, Alfred, in a recent telephone conversation indicate that such was not altogether the case. Many reasons have been given for the abrupt cessation of known Mapleson recording, but I agree with David Hall's conjecture that in addition to things dropping onto the stage from the catwalk during performances that the start of commercial recording of these artists by Columbia and Victor may also have been a factor in the situation. Again the old axiom prevails, "Romance without finance has no chance."

The exact number of Mapleson cylinders recorded will probably never be known, for it is assumed that many were lost or perished at the hands of others. Alfred Mapleson has stated in the aforementioned phone conversation that several hundred cylinders were sent to Lionel's mother in London along with a phonograph given to Mapleson by Thomas Edison.

Not moved by lucrative offers from record companies to re-record the cylinders, Mapleson was finally persuaded by a letter from Geraldine Farrar to allow William H. Seltsam of Bridgeport, Conn. (1897-1968) to take two of the cylinders for experimental transfer purposes. This was in 1937 and before anything was accomplished concerning the transfers Mapleson died on December 21, 1937. After Mapleson's death, Seltsam negotiated with the Mapleson estate for the then-extant 122 cylinders on hand. Fortunately, Seltsam was aware of the value of these unique recordings and he, together with Ira Glackens, George Bishop, Glendon

Good, George Laviolette and, from 1942, John Raynor, labored from 1938 to 1968 to elicit intelligent representations in disk format of Mapleson's sonic documentation, first on 78 rpm, then on LP in 1956. All in all, there were about 60 items issued by Seltsam's International Record Collectors Club label.

In 1938 the initial playback and identification of the Seltsam collection of cylinders was notated by Ira Glackens and George Bishop into a notebook. This first documentation of "audition" of the cylinders is now at The New York Public Library's Rodgers and Hammerstein Archives of Recorded Sound, following its discovery by curator, David Hall, at the home of one of Seltsam's chief associates, George Laviolette, who generously donated it to the Archives.

Even in 1938 many of the cylinders are notated by Bishop and Glackens as being in hopelessly poor condition.

Glackens wrote an article in November of 1938 for The Gramophone (England) describing in detail the original audition and identifying the cylinders and artists. One major identification was incorrect, for the most part the article stands up. It does not, however, contain any technical information, except to say that the surface noise was terrible.

The involvement of The New York Public Library (of which Rodgers and Hammerstein is a Division) can be traced to 1939 when the late G. Lauder Greenway, a friend of the Library, arranged for the purchase of a dozen heretofore unknown Maplesons from a private collector. These cylinders were housed at 42nd Street until such time when they could be transferred to disk--this was before tape. In 1940-41 these cylinders were transferred to the Library of Congress audio facilities to 16" acetates by the now very famous Jerome Wiesner of MIT. Dr. Wiesner transferred the cylinders electrically by mounting a pickup on an acoustical reproducer and driving the feed screw mechanism with a servo-controlled motor. As far as the particulars go, there were no notes kept (as far as I know) and Dr. Wiesner is not sure anymore of the details.

In 1957, another 10 cylinders surfaced by way of Aida Favia-Artsay, a noted columnist for Hobbies Magazine. She allowed Herrold Records to record them on an LP then sold them to the Library in 1960. In May of 1962 Seltsam sold to the Library his collection of cylinders which by this time, due to accidents, numbered 98 out of the original 122. Thus from the original 144 Mapleson cylinders, the Library has the 119 survivors in whole or part.

From 1962 to 1981 these cylinders remained virtually untouched with the exception of some experimental transfers done in 1967 by Bob Carneal of the Library of Congress. Meanwhile, acoustical analysis of wax cylinder characteristics has been carried out by Wilfried Zahn of West Germany by recording pink noise on two shaved cylinders and plotting the playback spectrally. Zahn gave a demonstration of his

cylinder playback techniques to the Association of Recorded Sound Collections in 1978 in Washington, D.C. This resulted in letting Zahn try his hand with Mapleson cylinders from three different performances of the Faust final trio, two of which never had been previously transferred. Although Zahn's work was impressive, the idea of transporting all the cylinders to West Germany was considered too risky. Therefore the transfer work fell back on the Rodgers and Hammerstein Archives, the NYPL Audio Archive. This was the state of the Mapleson Cylinder Collection when I assumed the position of Sound Engineer in January of 1979.

The first order of business was that of designing a cylinder playback apparatus capable of accommodating all cylinders of all types, that was electrical, that imposed no mechanical vibration, that was linear, that had lightweight tracking, that could accommodate from 40 to 200 rpm, could be servo-driven, that had digital mandral readout in rpm, that could track vertically with no side angling at 100, 150 and 200 LPI. Obviously, this was no small order. Art Shifrin developed a machine which accomplished most of these goals, and with further modifications done at R&H, we had achieved what was needed.

Next was to research the existing literature on acoustical analysis and playback technology, though much to my chagrin, I found little in this area to guide me. There was, however, an article (this was before the AES printed their index) written by Hans Meulengracht-Madsen on The Transcription of Old Phonograph Wax Records, which appeared in Vol. 24 Number 1, 1976 of the AES Journal. The acoustical analysis methodology described in this paper is extremely thorough and should be required reading for anyone attempting such an endeavor. It was based on cylinders recorded from 1919 to 1923, twenty-three years after Mapleson did his recordings. We knew that in order to do a viable acoustical analysis cylinders had to be recorded methodically and under calibrated conditions on the equipment similar to that which Mapleson used. This was not difficult as there are still plenty of Edison Home Model A's in good working condition around. One of the most important articles written to date concerning acoustical analysis was that of Maxfield and Harrison in 1926, whereby they related acoustical energy to electrical energy and described what was later to be known as the "theory of matched impedance." In reality they were describing to us the pre- and post- (record and playback) or pre-emphasis/de-emphasis equalization that is still the manner in which records are cut today. Walter Welch, author of From Tin Foil to Stereo spends an entire chapter chastising Maxfield and Harrison for "creating a monster" (his words). Welch's reasoning for this in that practice is that many recording companies equalized the recording according to what they felt the artist or instrument should sound like. We all know this goes on today just as it did in the early days of electrical recording. What should be pointed out, however, is that Maxfield and Harrison were experimenting with ways to extend the upper and lower frequency range and reduce surface noise. Their theory is sound, even to the authenticity-mad diehards, but in practice, its virginity was lost to commercial enterprise.

It is amusing to note that if one can accurately calibrate the "acoustical curve" imposed by the horn and diaphram on the wax recording (we have done this) by inverting that curve on playback, one perceives a fairly linear representation of the recorded material.

The exact method for our recording Edison Blanks will be described later in this paper; but getting back to the analysis: In trying to ascertain some of the characteristics of cylinders in general, I gathered together samples of every type of cylinder I could find from our Archives, from collectors, and from other sources. I selected a representative batch of Brown waxes, Black waxes, Amberol, Blue Amberols, "Concerts", Columbias and others and first sent them to Ed Catalano who is the chief chemist for LAST (Liquid Archival Sound Treatment). Ed reported to me that the surface deterioration was caused more from an internal stress decomposition than by mold and mildew. Photomicrography was done on the cylinder surface, as well as breaking several samples and photographing the various layers. Although Maplesons did not suffer, on the basis of visual inspection, from excessive fungi attack, it was clear that the axiom which has been repeated in every article on the Maplesons I've ever seen saying that the excessive surface noise is due to fungi attack of the surface of the cylinders is just not true. The fact is that Lionel Mapleson and his colleagues by 1937 had played the cylinders to a literal point of no return--informationally speaking.

Proceeding from this point, I gathered the cylinders and sent them to George Alexandrovich of Stanton Magnetics and asked him to evaluate the various cuts with the SEM microscope. He took wax impressions of the grooves of the various cylinders and measured the various cutting parameters such as depth, groove width, sidewall deformation characteristics. This was extremely important in determing tracking parameters, stylus selection, vert/lat phasing problems and the like. What we found was generally speaking the processed cylinders (molded) tracked at approximately 2-7 gms though Blue Amberols are pretty sturdy and can be tracked heavier if necessary. The Brown Waxes (a la Maplesons) on a cleanly shaved, freshly cut surface that has been warmed and prepared cuts a .0041" mil diameter at a very shallow depth at 100 LPI. The commercially produced cylinders we evaluated for the most part fell within the same depth parameters but were played back with a stylus in the .0036" mil tip radius specification. The surface content varies according to the material composition. Some of the unmodulated groove cylinders John Fesler cut for me, surface content was measured (with a Badap and HP spectrum analyzer) at levels as low as 3 to 8 DB. Black waxes measure at least double that and unmodulated grooves cut on a shellac disk are triple that.

As far as level goes in recording originals, the horn and diaphram like to see a SPL in the neighborhood of between 95 and 105 DB. When you think of the fact that Mapleson was 40 feet away, even with his large horn, it's amazing he was able to get any modulation at all. I

won't risk making a value judgement here, but it has been said that the singers and orchestras performed with a little more gusto than do today's counterparts.

When you record with an SPL of over 105db a curvature overload (the radius of curvature of the wound track modulation becomes equal to, or smaller than, the radius of the replay stylus) occurs as tracing distortion where high levels are coupled with high signal frequencies. In the case of the Maplesons the track configuration was seriously degraded by constant and improper playing thereby nullifying any standardization application to the lot. We did decide (because of comparative performance identification considerations mostly) to transfer all the cylinders at one speed, namely 184rpm. There were a few transferred at 120 and 160, but most of the lot ran from 184 and up (the old machines had vari speed for pitching but all tracked at 100LPI via a feed screw mechanism). This will be discussed in greater detail later in the paper.

Tracing distortion, surface cracks, internal stress cracks, out of roundness, groove deformities, different s/n ratios, different speeds, rendered each and every Mapleson a project in itself.

Probably the easiest way to describe the Mapleson transfer is to describe a typical transfer work day. We (David Hall and myself) would start with one of the seven original boxes the Maplesons were packed in and work on that till the box was finished. The cylinders were packed randomly in the 7 boxes. In each there was no program order or performer order followed. We did them as they came out of the box to minimize handling, many times not knowing what was on the cylinder till we played it. Prior to starting in the morning, the entire transfer chain was calibrated to OVU/+4DBM and aligned. The cylinders we intended to transfer that day were allowed to warm up under a 40W soft light while still in their original containers. Each cylinder was microscopically examined and groove size and description given to David Hall who would write it down in his notebook. If the cylinder had cotton fibers on it from the box linings, they were blown off with an air gun. A special treatment of LAST prepared especially for the cylinders by Ed Catalano would be applied if needed.

The cylinders would then be placed on the mandrel of the cylinder reproducer till snug, but not forced. The reproducer is comprised of a Rabco SL8E modified tonearm (tangential) capable of tracking 100 to 200 LPI, driven by the groove and battery powered servo motor, equipped with a Stanton 500AL cartridge. The mandrel is an original tapered Edison mandrel, driven by either an Ampex 2 speed hysterysis motor or servo motor. The motor is mounted off the body of the reproducer thereby eliminating any mechanical vibration. The motor is belted via a gated pulley for the standard cylinder speeds to a very heavy brass pulley with the mandrel attached to it.

After fitting the correct stylus--many would be tried for each cylinder--the vertical and lateral component would be monitored (the cart is wired in stereo with output of the transformer-based Stanton 210 in the linear mode wired to a Mallory switch which allows me to do this) as well as just the left or just the right of the vertically modulated groove. One soon learns from this type of setup that those who insist that there is no lateral modulation on a cylinder groove just aren't listening. The signal arrives at the patch bay at a level of somewhere in the vicinity of -40 to -20 VU. The signal is elevated by a couple of U.R.E.I LA-3A amplifiers. Level is adjusted to peak at maximum cylinder modulation of 0 to plus 3. The next step in the chain is the Packburn Transient Noise Suppressor. Space does not permit an in-depth discussion of this device, but its chief contribution is to eliminate picks, pops, cracks and other transient noises with no effect on the musical content. When the signal leaves the Packburn it arrives at the Obran 622 Parametric which is used as a low end filter (20hz to 60hz). The thump and rumble associated with these cylinders, and most cylinders, is mechanically induced by the original machine or occurs as a result of out of round problems. This problem appears within this freq. range. It's easy to see this with the use of a BADAP spectrum analyzer like mine. After the thumping is eliminated, and the ticks and pops removed, the next place the signal goes is to a pair of U.R.E.I. 565 'Little Dippers'. These filters are usually set as band pass filters with an 18db per octave slope at 12.5K. Throughout this whole process each step of the way is monitored on the BADAP and Leoder oscilliscope checking resonances, polarity etc. Unusual problems would be notated by David in the notebook as well as the final stylus selection. Note that in all these steps no boost or curve equalization of any kind was added or imposed. At this point the cylinder which is being reproduced at (most of the time) 184rpm would be recorded onto 1.5mil Scotch magnetic tape at 15ips on a Scully 280B calibrated to "0" plus 4dbm -200n/wbm. All tapings of each cylinder were verbally slated. Each cylinder was transferred completely Flat/with filtering/all previous 78rpm and LP transfers/thereby giving us the recorded history in one place.

A tape is being collated alphabetically, opera by opera, of all the flat takes and filtered takes (actually there were many tapes) and pitched to the printed music. Every effort is being made to achieve accurate identification of casts and performance dates, with resort in some instances to comparison via voice-print technology.

This writer is also preparing a software program for our computer system that will allow us to service the complete Mapleson History of CRT as part of our new Public Service installation at R&H. The next step is to record the spectral analysis from the Badap simultaneously as the cylinders are played into it on a U-Matic video cassette deck. I would also like to record all the Flat takes digitally in anticipation of some wonder gadget or computerized filtering.

The question has been raised as to whether or not the project was

worth the time and expense. I am of the opinion that it was worth it: not only to bring to light some of the best operatic voices that ever lived, but also it enables us to share the knowledge we had gained about acoustical recording (vertical and lateral) with others. For years collectors have boasted of Black Box and super secret methodology for cylinder transfer. It's time we put the voodoo back in the closet and approach acoustical recording from a more objective viewpoint.

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