
THE TOSCANINI LEGACY: PART II, THE SELENOPHONE

By Donald McCormick

This article is a continuation of the article in the fall 1989 *ARSC Journal* issue (Vol. 20, No. 2, pp 182-190) entitled "The Toscanini Legacy." The first paragraph summarizes that article. The previous article covered the contents of the "Legacy" and a summation of the problems we have been facing in our work on it.

In December of 1986, The New York Public Library acquired a major collection of materials relating to Arturo Toscanini that has since been entitled "The Toscanini Legacy." This collection of scores, books, letters, pictures, films, and sound recordings had been meticulously gathered and organized by his son, Walter, from the 1930s to 1969. The film and sound recording portion of this body of material is now a part of the Rodgers and Hammerstein Archives of Recorded Sound, The New York Public Library for the Performing Arts at Lincoln Center, which has begun extensive work to catalog it and make preservation copies and public service playback copies of the most important items in it. To date, efforts have concentrated on performances generally not available previously, which include excerpts from rehearsals with the La Scala Orchestra in 1926, performances with the BBC Symphony Orchestra in 1935 and 1938, Lucerne Festival Orchestra performances from 1939, and NBC Symphony rehearsals from 1940 to Toscanini's last performances.

This article will focus on a very specific and unusual segment of this collection—the Selenophone, and the nitrate-based sound-on-film recordings of five 1937 Salzburg Festival opera broadcasts conducted by Toscanini and Bruno Walter. The Toscanini performances are the Maestro's last fully staged complete opera performances anywhere in the world. The operas are *Die Meistersinger*, *Falstaff*, and *Die Zauberflöte* with Toscanini, and *Don Giovanni* and *Le Nozze di Figaro* with Bruno Walter. There was a sixth opera broadcast that season—*Fidelio*, conducted by Toscanini—but we know of no copy of this anywhere. The following history of the Selenophone and these Salzburg performance recordings is based on correspondence found in the letter files of "The Toscanini Legacy."

The Selenophone machine was developed and distributed by the company of the same name founded by an Austrian technical pioneer, Oskar Czeija, who also had founded the Austrian Radio Corporation (RAVAG) in 1924. The company had been developing and manufacturing sound film equipment for several years when, in the early to mid-1930s, it developed the Selenophone U7 apparatus which utilized the principle of photographic reproduction of sound for the recording of live music and speech. Historically, then, this technology was being developed simultaneously with magnetic tape recording.

The advantages of film recording over the prevalent wax-disc recording system in use at the time were that it could give a continuous recording of up to 30 to 35 minutes without a break, and that multiple positive prints of the original negative film could be produced without any loss in sound quality from one copy to another. After the 1938 *Anschluss*, Czeija was dismissed from Austrian Radio and his Selenophone Company appears to have been taken away by the Nazi regime. Before describing the actual machine and its operation, here is a brief history of how the actual film recordings survived in "The Toscanini Legacy."

Austrian Radio traditionally broadcast the first nights of these 1937 performances to radio sets in Austria and other parts of Europe. NBC Radio also was scheduled to broadcast segments of them via their shortwave radio transmitter to the U. S., as it had been doing since 1935. Since Dr. Czeija was also the president of the Selenophone Company, he had Austrian Radio relay these broadcasts via telephone lines to his office building in Vienna where they were then recorded on Selenophone film. This information was provided to us by Mr. Robert Hupka, who was present at the Salzburg Festivals from 1934 to 1937, and who knew Oskar Czeija's son.

In a letter dated February 26, 1968, to Walter Toscanini, John Royal, former Vice-President of NBC Radio wrote:

Back in the early days of Radio, there was strong competition between the National Broadcasting Company and the Columbia Broadcasting System, in Europe. We never paid for any broadcasts but had reciprocal arrangements with the various countries in Europe that we would give them anything that they wanted over here. I might say the balance of trade was in our favor because we took more from Europe than they ever took from the United States and I think the same applied to Columbia.

One of the things that we of NBC picked up were the concerts in Salzburg. The reception was fair, but improved each year. The President of the American Radiator Company, a great friend of your Father's, made a personal deal with the Maestro to pick up four concerts sponsored by the Radiator Company on the NBC Radio Network. The reception was about 75%, but the publicity was excellent. This caused CBS to go to Austria and try to make a secret deal with the Ravag Company of Austria and an offer of \$5,000 a year for five years was made for exclusive broadcasts out of Austria. Max Jordan, our representative in Europe at that time, heard about the Columbia offer and he cabled to me. I got on the next boat, went directly to Vienna, and I offered them \$6,000 a year, for ten years, and to the Chairman of the Board of Directors of Ravag [Dr. Oskar Czeija] with whom I was negotiating, I offered to buy a Selenophone, which he was exploiting and manufacturing. This last offer I think impressed him. Then I added that my purchase of the Selenophone would depend upon my being able to secure copies of the Salzburg concerts, especially those by Maestro Toscanini, for which I would be willing to pay. I knew that they were not making pick-ups in Salzburg and that the copies would have to be made from concerts received over the wire in Vienna. After much conversation, we closed the deal and we of NBC were given exclusive [rights] in Austria. As an added item you will be interested to know that shortly after the contract was made, Hitler invaded Austria and Max Jordan had a great exclusive at the very moment Hitler crossed the border.

Columbia was refused broadcasting rights and they called Lenox Lohr, our NBC President, who, in turn, called me at four in the morning. I advised him to tell Mr. Paley [President of CBS] to go to hell. I then realized that if Hitler was in Austria, anything with Toscanini's name on it would be destroyed, so I suggested to Mr. Lohr that we would give Columbia permission to go into Austria for a week. It was an idle gesture.

The Toscanini files also contain a copy of an agreement dated July 31, 1937, indicating that NBC *did* purchase two machines with miscellaneous parts, a film cutter, and film prints of five of the six operas broadcast that season. The *Fidelio* performance was either never ordered or never delivered. We have no information why.

NBC made aluminum-based lacquer disc dubbings of the five performances, probably in 1942. The year is an educated guess based on a catalog of the NBC Collection now housed at the Library of Congress which preservation sound engineer Seth Winner consulted in a microfiche copy at the Museum of Radio and Television in New York City. The catalog lists these performances as Salzburg, 1942. We believe that the dubbing date mistakenly was transcribed as the broadcast date.

Our "Toscanini Legacy" files also have correspondence between the LC and Walter Toscanini, which verifies that the LC also had obtained positive print copies of these performances and a Selenophone machine in the early 1940s from an unspecified source. Sometime in 1942, they also made 16-inch lacquer dubbings of the five operas. A letter dated December 10, 1952, from Harold Spivacke, chief of LC's Music Division at that time quotes:

I did not mention the Salzburg recordings to you because we were more or less sworn to secrecy when we first copied them. It was quite a job because it required the rebuilding of the film machine and our engineers achieved remarkably fine results. The quality was so much superior to anything available at that time that it really broke our hearts not to be able to play the records for anyone. I am pleased to be able to report that we found these records, and I played a little bit of one side which still sounded excellent.

Walter then ordered tape dubbings of these discs from LC, because NBC could not locate either its film prints or its own lacquer dubs. The machine at the LC and their positive film prints have not been located in a recent search. According to Bob Carneal and Sam Brylawski at LC, the film copies might have been destroyed after dubbing because they did not have a proper storage area for nitrate-based film at the time. No one knows what happened to their machine.

In 1953, NBC miraculously found their film prints and disc copies, and all, including their two machines, were given to Walter Toscanini in 1956. Walter then corresponded with Oskar Czeija's son, Karl, and solicited his help in getting one machine working to make new tape copies from NBC's film prints to play for his (Walter's) father. He called upon the Westrex Corporation to manufacture a new power supply for the machine's motor. Walter's audio engineer, John Corbett, then produced a new set of tape transfers from the original film prints. Walter was able to play these transfers for his father shortly before the Maestro died.

Further correspondence from Karl Czeija to Walter in 1964, indicates that Czeija was having no luck unearthing any other performances once captured by the Selenophone anywhere in Europe.

As late as 1968, still displeased with even these 1956 tape transfers as well as all other existing dubs in his possession (the NBC lacquers and his tape copies made from the LC lacquers), Walter consulted an audio engineer, J. L. Graham, to help make new tape dubbings by upgrading the electronics of the Selenophone machine. Before that project was initiated, however, Walter suffered an incapacitating stroke, and no more work on these recordings occurred, until the Rodgers and Hammerstein Archives began its project in 1989. During the seventeen years that the "Toscanini Legacy" was in storage awaiting official transfer to The New York Public Library in 1986 these Selenophone film prints were kept in a special, bonded film storage vault in New Jersey.

At this point, a brief examination of how a Selenophone recording was originally made probably would be helpful. At the time of the Selenophone's invention, recordings of live concerts usually involved cutting wax discs of diameters up to 12 inches, revolving at approximately 78 rpm. These wax discs were then plated, and stampers were made to produce shellac pressings. Aluminum discs for use in home or field recording were noisy and offered limited frequency response. The average duration of five minutes of

recording time per disc side required a minimum of two simultaneous record cutters to prevent constant content gaps created by the need to turn over the recorded discs at the end of each side. Thus, the two cutters could record overlapping side breaks, so to speak, albeit still with instantaneous breaks that would start and end abruptly. Needless to say, this involved a tedious process of reloading and/or flipping wax disc blanks at very frequent intervals.

The Selenophone, by contrast, provided continuous recording capability, lasting some 30 to 35 minutes without these “breaks.” Quite simply, it utilized the optical soundtrack portion of the recently developed sound-on-film process being used on 35 millimeter talking motion pictures. Using a special cutter to splice off the side sprockets and visual portions of the blank film stock, the remaining seven millimeter strip of optical film was then loaded into black, covered canisters in a dark room, since the blank film was sensitive to light exposure. These canisters were then loaded onto the supply side of the Selenophone, and the negative film was fed through a transport into another enclosed canister on the take-up side. A light beam on the machine was triggered to reflect onto the passing film creating vertical images corresponding to the incoming audio signal. The film passed through the Selenophone at a speed of approximately 20 to 25 ips. From this finished negative, positive copies on nitrate stock could be developed for playback. A special advantage of this technique was the inherent ability to splice negatives together, producing a positive print containing an entire act of an opera (up to 35 minutes) without a break. As mentioned earlier, another advantage of the process made possible multiple positive prints from an original negative without any loss in sound quality from one copy to the next. The “visual print” on the negative did not fade or wear out.

In 1989, two years after the Rodgers and Hammerstein Archives began to work on “The Toscanini Legacy,” Curator Don McCormick and Seth Winner decided to attempt a reconstruction of the original Selenophone machine in order to produce new archival tape copies from the original film prints. Like Walter Toscanini himself, they were dissatisfied with the existing lacquer and tape dubbings in the “Legacy” and thought one more effort from the original source film prints might prove worthwhile. With the assistance of David Thomas, a cataloging librarian working on a grant-funded special project in the Archives, the machine was mechanically reassembled from its pieces, making use of a simple diagram drawn by John Corbett in the 1950s indicating how the film should be threaded through the machine’s transport. Through personal contacts, engineer Seth Winner located Mr. John Taddei, former operations engineer at CBS Television for nearly 40 years. Mr. Taddei had been one of the pioneers in the development of the long-playing record, as well as a personal technical advisor to William Paley, former President of CBS. John Taddei’s background in audio and visual applications proved to be the key element in the success of this project.

The first problem faced quite simply was how to activate the machine’s drive motor properly. Walter Toscanini had purchased a new power supply in the 1950s to convert the standard 110 volt AC outlet available to him into three-phase 220 volt AC power to drive the machine. When hooked up to the Archives’ standard 110 volt AC outlet with this power supply, the drive motor wouldn’t turn! When the power supply was tested, it indicated only 170 to 180 volt AC between any two poles when the measurement should have read 220 volt AC. Our solution was to have a three-phase outlet installed near the transfer work station, and to eliminate Walter’s power supply altogether. The motor was now operating!

Next, Winner ascertained that the two belts driving the take-up arm and the capstan roller of the machine had dried out and were cracked and stretched. Winner substituted a new automobile fan belt for the old take-up arm belt, but the size seemed

slightly too big. The take-up armature was extended outward by adding washers between it and the machine body, and the new belt fit properly. A trip to an electrical appliance store supplied a new capstan belt which seemed to match the size of the old one. When it proved to be too thin, two belts were used, one on top of the other.

At this point, using John Corbett's diagram mentioned above, Winner and Taddei learned how the machine actually "played" the seven millimeter strip of sound-film. The film pancakes were laid onto aluminum discs (flanges) measuring approximately 17 1/2" in diameter. The flange was placed on the supply armature of the machine, and the film was threaded through the transport to the take-up armature onto an empty disc flange and hub, turning in a clockwise direction. As the film passed through the transport, a 12 volt lamp would shine a light beam through it into a small hole in an enclosed housing containing a photocell attached to a preamplifier. The photocell would convert the light patterns into audio signals, and the preamplifier would amplify the signals to line level for playback through a standard audio system.

The lamp required a power source of its own, and Taddei discovered that a direct 120 volt wall current source induced a 60-cycle "flicker" on the photocell which resulted in a hum in the audio output. He advised using a 12 volt car battery with a charger as the lamp power source. The first playback of a reel of film took place, and the speakers emitted the end of Act 1 of *Don Giovanni*. Now we were at least able to accomplish what Walter had in 1956.

Four new problems quickly became apparent. The first proved easy to solve. We had not realized that the machine's drive motor had a separate shield motor which also required a power source. Without this shield motor, the main motor would not revolve evenly, resulting in severe wow and flutter. This shield motor was found in the packing case and connected.

Second, we discovered that the capstan assembly was out of alignment, skewing the passing film upwards. Whenever a portion of the film with a splice went by, the film would fall out of the transport and break. An adjustment screw, located underneath the capstan wheel, was loosened and aligned properly with a few gentle taps from a simple hammer. This seemed to stop the skewing. Any further problem with splicing was alleviated by holding one's finger at the junction of the right pressure roller and the capstan wheel.

The third problem was associated with the very nature of the machine and format. To anyone today acclimatized with current technology and equipment, the frequency response we were receiving was only fair to middling. Taddei examined the photocell and pre-amp assembly and realized that it was a modified sound system from a standard tube-type movie projector. The frequency response only reached 8,000 cycles, because anything higher would have resulted in the obviously unwanted reproduction of the sprocket noise associated with 35 millimeter film. Since the Selenophone used only a seven millimeter strip of sprocketless film, Taddei felt the original movie-projector sound system was not adequate for the quality of sound we were hoping to achieve. He videotaped the machine working and removed the pre-amp's mounting plate for more intensive study at home. A short time later, he returned with a solid-state photocell which had a frequency response ranging from 100 to 20,000 cycles, attached to a new mounting plate of his own devising. The new photocell on its new mounting could be finely adjusted vertically and horizontally, as well as rotated tangentially. This helped overcome problems due to lack of precise alignment when the original photographic patterns of sound were first "recorded." We were now able to alter the focus point of the light beam at any time to receive a more precise "reading" of the film during playback. He also had constructed a new line-level, solid-state preamplifier to attach to the new

photocell. Two additional adjustments we found we could make were to turn the light bulb in its housing to prevent its filament from casting a slight shadow into the photocell enclosure, and to maneuver several tiny, metal slit adjustments in the focusing lens to vary the height and angle of the light beam as it left the lens, both eliminating considerable distortion.

The final problem basically was due to the fact that 50-cycle currency is prevalent in Europe, while 60-cycle currency is the standard in America. The machine was playing back the reproduced sound at a speed approximately 20% higher than it should be played. Since we were going to create analog archival and playback tapes, we decided to solve this problem after original master tapes were made at the higher speed. Preservation and service copies made from the original master tapes were then pitched correctly. Had we been recording digitally, we would probably have needed to adjust the speed of the flywheel driving the capstan motor by adding padding around it.

We now believed we had a more "state-of-the art" Selenophone reproducer than had ever existed before. Remaining problems during the project to rerecord all of our original Selenophone film prints amounted to mostly those encountered by anyone dealing with old, deteriorating sound recordings which have been inadequately handled and stored over a long period of time. There was insufficient leader and end film on all of the pancakes. All leader and end film was removed and replaced with new blank 35 millimeter film stock cut down to size. The machine seemed to require some time to arrive at the proper playback speed, so 20 feet of leader was spliced to each pancake. We also noticed some pitch waver at the end of most of the reels, probably because the torque required to maintain a constant speed of the supply and take-up flanges on this 60-year old machine was not adequate. Some 50 feet of end film was spliced onto each reel, alleviating this snag. Splicing tape had to be totally clear, of course, to prevent any loss of light into the photocell during playback. We used J-LAR Scotch tape and a standard, edit-all 1/4-inch splicing block for attaching new leader and repairing old splices within the reels. Original splicing had been done with masking tape! These were removed and the residue cleaned with alcohol and Q-tips.

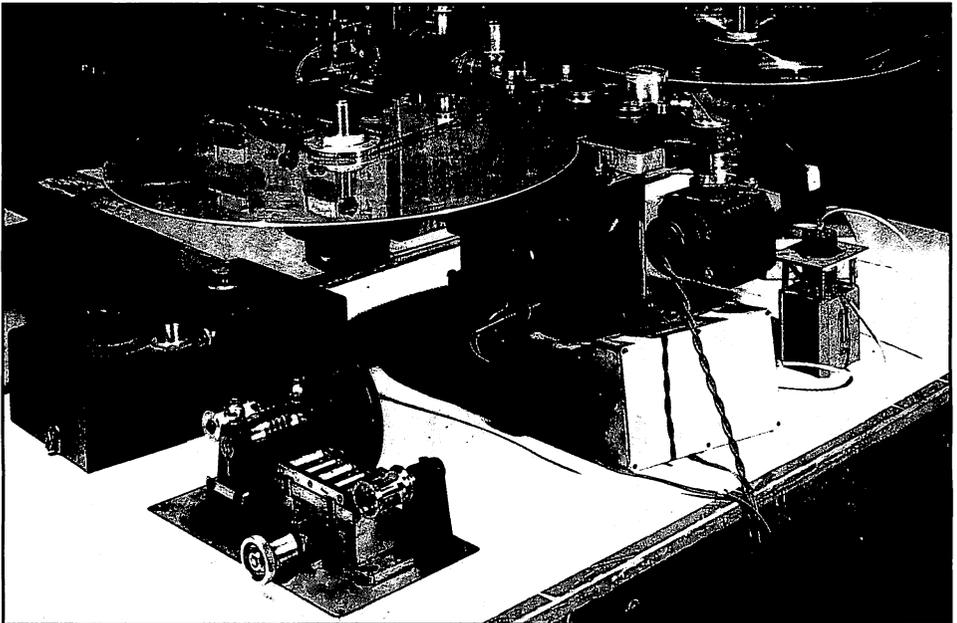
Some of the original disc flanges which had been packed in metal canisters and stored for so many years were damaged or warped. We purchased new aluminum-based lacquer blank discs of 17 1/2-inch diameter, from a company called Transco in New Jersey. These had to have new holes drilled to accommodate the old hubs from the originals. The second pancake of Act 2 of *Don Giovanni* had completely fallen off its flange! It required seven hours to wind it back by hand. The beginning of that reel was badly damaged, meaning a loss of approximately one minute of music. Since the Selenophone has no fast-forward or rewind mechanisms, each reel had to be "replayed" back onto its original supply flange when finished. In addition to the lost minute from *Don Giovanni* mentioned above, some music was missing from the reels for Acts 1 and 2 of *Die Meistersinger*. The first was added to our finished service tapes from a private tape made from the old NBC lacquer dubs which Winner located. The Wagner excerpts missing were patched into the finished tapes from the Library of Congress lacquer dubs Walter had obtained in the 1950s.

With the machine reconstructed and running satisfactorily, and with several months of learning experience on the intricacies of this fascinating machine, Winner set about making new master analog tapes of all five opera performances in the "Legacy." Each film reel was copied onto AGFA 468 tape stock at 15 ips using an Otari MX5050 tape recorder with no equalization. As mentioned earlier, these were transferred at a higher speed (pitch) because of the electrical current difference. From these master tapes, two listening/service copies were made of each opera, again on AGFA 468, but at 7 1/2 ips. Using scores and a pitch pipe, they were hopefully transferred on pitch. As

mentioned above, a few minutes of missing music were patched into these finished service tapes from alternate sources. Some filtering and equalization was utilized in producing the service copies. We set our OWL 1 equalizer at 250 Hertz turnover. Our Urei 565 filter network settings were set as follows: low frequency cutoff at 80 Hertz; first notch filter set at 110 Hertz (medium band width); and second notch filter set at 13 KiloHertz (wide band width).

The finished results now are available to the public for listening in the Rodgers and Hammerstein Archives of Recorded Sound at the New York Public Library for the Performing Arts in New York City. Our own collective opinion of the results find them considerably better than any of the existing, previously made dubbings we have heard (the NBC lacquers, the Library of Congress lacquers of *Die Meistersinger*, and Walter Toscanini's tape dubs from the other LC lacquers and from the film prints in the 1950s). The project has received much favorable publicity in the press.

A few problems remain. The *Falstaff* film prints had sustained a scratch during those dormant years; the original microphones were placed in the front of the stage during performance resulting in a balance less favorable to the singers who were moving about the stage; the original broadcasting engineer resorted to hand monitoring during loud passages because of the limitations of the broadcasting equipment at that time. Some of these frustrating and limiting conditions will never be overcome, but we feel that another interesting and invaluable chapter has been added to the history of recorded sound preservation and the annals of "live" opera performances from the past.



What is thought to be the world's only remaining working Selenophone, an archaic recording device that captures sound on optical film. The disassembled Selenophone was part of the Toscanini Legacy, a collection presented to the New York Public Library's Performing Arts Research Center in 1987. (Photo: New York Public Library)