THE BIRTH OF TAPE RECORDING IN THE U.S.

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The Birth of Tape Recording in the U.S.

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In 1945 when Major Jack Mullin, U.S.A. Signal Corps, came home to San Francisco with two German Magnetophon audio tape recorders, he had no idea he and three other Bay Area engineers, Bill Palmer, Harold Lindsay, and Myron Stolaroff—not big companies like GE, RCA, or Westinghouse—would be the ones to revolutionize American recording. By 1947, tiny Ampex Corporation surprised U.S. studios and broadcasters with the first successful American version of the tape recorder. How were Ampex's Lindsay and Stolaroff able to build a hi-fi tape machine while others failed?

[This article is dedicated to the late Harold W. Lindsay, AES member and audio pioneer, the designer of America's first successful professional audio tape recorder. Harold's high engineering standards and personal regard for his fellow man made him a friend of us all. We miss him very much.]

In 1982 it is easy for us to take magnetic tape recording for granted. Many members of this Society weren't even born when American engineers set postwar magnetic recording standards that are still followed today.

In professional audio recording in the U.S., the leap from no tape in 1947 to an industry dominated by magnetic recording in 1949 was unparalleled in modern technological history. By the end of World War II, magnetic recording was nothing new in America. We had had wire recording here as early as 1903, when a Danish electrician, Valdemar Poulsen, founded the American Telegraphone Company. By 1900, Poulsen had already become the "Edison" of magnetic recording, inventing almost every known form of electro-magnetic storage, using wire in various forms: solid steel tape, and metal discs. Poulsen's Telegraphone recorders met with public acclaim, followed by repeated marketing failures.

Except for occasional research by Lee DeForest (the inventor of the vacuum tube) and the U.S. Navy, magnetic recording in the U.S. lay dormant until 1939, when a young engineering student in Chicago named Marvin Camras built an experimental wire recorder. Until '39, all wire recorders in this country used DC bias in the record circuit to reduce distortion and increase dynamic range. While recording tones on his recorder with a signal generator one day, Camras discovered that a high frequency AC signal superimposed over the recorded signal dramatically improved signal-to-noise ratio and distortion.

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In America, Camras became the first engineer since Poulsen to make serious advances in magnetic recording. Distributed under license from the Armour Research Institute in Chicago, Camras' magnetic wire recording patents led to the extensive use of wire by the Allied Forces during World War II.

For all its wartime successes, however, many American audio engineers looked at magnetic recording as a dictation device at best, not suited to professional recording. The 1945-46 postwar prejudice against magnetic recording as a professional audio medium was somewhat strengthened by the introduction by Cleveland's Brush Development Company of America's first tape recorder, the Brush BK-401 "Soundmirror". The BK-401 was remarkable in that the machine attempted to use what was, for America, a new technology, although Brush engineers encountered many unforeseen problems making good heads, a stable transport, and good electronics. The BK-401 incorporated Marvin Camras' AC-bias circuit. Using paper tape coated with black oxide, the consumer-oriented BK-401 fell short of professional audio standards of the day. 3M's 1946 introduction of their first magnetic tape product, "Scotch No. 100", made for the BK-401, provided the St. Paul company with a head start in tape research and development. By the next year, when Jack Mullin and Ampex requested tape samples with improved oxides, 3M was ready. Their famous "Scotch 111" and "112" were the result.

In Europe during the 1930s, engineers had been viewing magnetic recording in an entirely different light. As in the U.S., early attempts at wire development had failed in both Germany and England. By 1934, however, the Lorenz Company (now part of ITT) had perfected a magnetic recorder it called the "Stahltonmaschine" or "steel sound machine" that used a flexible, solid steel tape as the storage medium. With the Lorenz Stahltonmaschine, magnetic recording in Europe had graduated from an engineering curiosity to possible professional acceptance. Total acceptance, however, first in Germany and then in America, was to come with the development of high-fidelity recording using magnetically coated tape.

In the late 1920s, Fritz Pfleumer, a German mechanical engineer who was also an audiophile, built the world's first working prototype tape recorder. Using paper strips that he coated with carbonyl iron particles suspended in lacquer, Pfleumer built a tape machine that was good enough to convince AEG-Telefunken in Berlin (the German General Electric) that tape recording had a future. Working with the giant BASF/I.G. Farben chemical concern in 1936, the AEG engineers marketed their new recorder under the name "Magnetophon" or "magnetic phonograph". By 1938, the AEG Magnetophon was advanced enough to have three of the four necessary components of modern professional tape recording: 1) a stable transport,
2) Good tape created at BASF, and 3) the ring head for erase, record, and playback, developed by AEG's Eduard Schweller, a head that closely resembles most of today's heads. The fourth element of hi-fi tape recording, good electronics using AC bias in the record circuit, would have to wait until after the start of the Second World War. And therein lies one of the biggest industrial espionage mysteries of this century.

By 1932, a year before Hitler came to power, German radio stations were using relatively high-quality wax and lacquer discs to transcribe programs for delayed broadcast. By 1936, three years after the decreed unification of stations into a single network based in Berlin (and called the Reichs-Rundfunk-Gesellschaft, or RRG), Germany was interconnected by a series of high-quality underground 10 kHz audio lines (600 ohm balanced, with less than 1 dB loss over 1000 km). Keep this fact in mind later, when we get to Hitler's speeches recorded on the Magnetophon.

In 1938, the chief engineer of Reichs-Rundfunk, H.J. von Braunmühl, adapted magnetic tape as the future standard for broadcast recording in Germany. Von Braunmühl wanted to replace the cumbersome transcription discs then in use, and was convinced that the DC-bias Magnetophon could be improved for on-air use. By 1941, two years after the start of World War II, all German radio stations were equipped with high-fidelity console AEG Magnetophon tape recorders, the so-called "HTS" version based on the 1939 "K-4" model.

Hi-fi tape had come about in 1939-40 when Walter Weber of the RRG had, like Marvin Camras in Chicago the same year, accidentally discovered that an AC-bias current in the record circuit improved quality. DC-bias K-4 Magnetophons had limited specifications, with a frequency response of only 50 Hz to 6 kHz, 5 percent distortion and a dynamic range of 40 dB. Weber's AC-bias circuit improved the K-4 to 40 Hz to 15 kHz, 65 dB dynamic range and only 3% distortion. Naturally, the hi-fi Magnetophon quickly replaced the transcription discs at all German radio stations.

1941 was the year German broadcasting put the AC-bias AEG Magnetophon on the air regularly, coupled with routine day and night interconnects among the stations of the RRG. From Bamberg to Bremen, from Berlin to Breslau, broadcasts could originate at one place and transmit from another. The Berlin Philharmonic began regular recording sessions for 24-hour use on the air. By wartime, over 95% of RRG programming originated in Berlin. Occasionally, tapes were sent to individual stations for later broadcast. Occupied Europe and Africa, not connected to the RRG net, received much programming via Magnetophon tape. High-fidelity tape recordings of the Berlin Philharmonic made between 1941 and 1945 that Deutsche Grammophon/ Polydor recently discovered in Cairo got there through RRG tape "bicycling", the earliest tape network.
At the RRG in Berlin during the war, a typical broadcast day would include both live and taped speeches by Nazi officials, interspersed with taped music and commentary. The tape recorder had added a flexibility to broadcasting that would not reach American radio until almost ten years later, in 1948-49.

In 1981, just 40 years after the start of hi-fi tape on German radio, I told several retired RRG engineers about the postwar Allied belief that "the Nazis ordered the Magnetophon to be developed in order to fool the Allies as to the exact whereabouts of Hitler while he made live-sounding speeches simultaneously in several different locations". The old engineers were both shocked and amused at our naivete. With Hitler's odd sleeping habits and 24-hour access to a studio in his bunker, he could, and did, broadcast live speeches via separate transmitters all over Germany at all hours. Naturally many of his speeches were also recorded on hi-fi Magnetophons, as was much other voice and music programming then. Our ideas about Nazi Party prowess included the belief that the Party could "order up" one of the most important electronic developments of this century. Nothing could be further from reality. The Nazis merely inherited—and exploited, naturally—an existing recording technology, along with an existing broadcast recording routine.

1942 in England saw the entry of Major John T. (Jack) Mullin, U.S. Army Signal Corps, into the picture. Mullin is the man who, more than anyone else, can take credit for bringing the hi-fi German tape recorder to America. At this point, good fortune and an element of chance affected the outcome almost as much as good audio engineering.

Mullin, a U.S. Army major detached to the Royal Air Force, liked to work late in his electronics lab in England. The only stations on the air at 2 am were the 24-hour RRG broadcasts. Mullin couldn't understand how or why large symphony orchestras could perform "live" all night long, week after week. Mullin knew the Germans had some form of advanced recording device, but had no idea just what they were using. His superiors could not clear up the mystery because of a curious set of circumstances set in motion in 1936.

According to the former chairman of AEG-Telefunken (a company formally linked with American General Electric before WW II), as well as reports from other participants, AEG brought a Magnetophon K-2 to GE at Schenectady in 1936 for a secret demonstration meant to convince the American marketers to sell the German tape recorder in this country. Remember that basically, the addition of an AC-bias record circuit would have turned the K-2 machine into a high-fidelity tape recorder. We could have had broadcast-quality tape in America as early as 1940!
Yet, reportedly not a single audio engineer was included in the marketing team that made the decision that the DC-bias Magnetophon sounded no better than 78 rpm discs, and was therefore unsaleable in the U.S. as a consumer machine. GE lacked a Jack Mullin or a Harold Lindsay in Schenectady to push the idea of high-fidelity tape recording as those two did 10 years later in California at W.A. Palmer Films and Ampex Corporation. Today, Jack Mullin says he doesn't blame the GE people for their 1936 decision. "Once you heard a DC-bias recording," he says, "you never wanted to hear tape again!"

By 1941, two years after the start of World War II, the Allies had set up a rudimentary spy network whose job was, in part, to ferret out any German technical innovations. The U.S. Embassy was still functioning in Berlin, as America remained neutral until 11 December 1941. Not a word appears to have been written from the Embassy or other U.S. consulates in Germany about the high-quality 24-hour broadcasts of the RRG. The Germans, meanwhile, with almost 10 years of broadcast routine behind them, took high-quality transcription so much for granted that they never bothered to classify the AC-bias Magnetophon during the war. Allied spies, meanwhile, were hard at work digging up all the secret stuff.

Even after America entered the war, Allen Dulles' spy organization, as well as American diplomats based in neutral Switzerland, missed clues about the Magnetophon that were almost literally left on their doorsteps. German newspapers and magazines, widely available in Switzerland, often printed feature articles about German radio stations and their operations. One Berlin paper in 1941 even reported an engineer's proposal of a stereo Magnetophon, to be used with multiplexed FM radio!

Allied ignorance about the Magnetophon and its importance didn't end in Switzerland. When Jack Mullin finally saw the hi-fi Magnetophons at the Radio Frankfurt substation at Bad Nauheim, he was surprised to see American GIs nonchalantly using tape for their daily broadcasts, making no reports to headquarters about the machines they were using. This was July, 1945, two months after VE Day. And Mullin had only accidently heard about these wonderful tape recorders, through a chance meeting with a British officer who shared a similar interest in high-fidelity recording.

Mullin was unaware of how little public information about the Magnetophon was getting home to the States. Marvin Camras in Chicago, responsible for much of the research and development on Allied wire recorders, reported hearing little in public about German tape, although some classified Allied documents (FLAT and
RIO$ reports) had reached Washington.

A friend of Mullin's in the Signal Corps, Col. Richard Ranger, became interested in tape in late '45 after hearing about Mullin's "discovery". Also, J. Herbert Orr, a major in the Signal Corps and founder of Orradio Industries in Alabama (now Ampex Magnetic Tape Division) began active work with tape in Germany in 1945, and later continued work at home. When Mullin reached San Francisco as a civilian in late '45, both he and his new partner, William (Bill) Palmer of W.A. Palmer Films, assumed that some GIs somewhere in Germany who had connections with GE, RCA, Westinghouse, or other large electronics companies, would be sending Magnetophons home as Mullin had done. Certainly, at any moment, GE or RCA would announce an improved American version of the tape recorder. Surely by the end of 1946 or early '47, an American company would be building tape recorders, they thought.

Nothing happened.

America continued to ignore tape recording. Mullin and Palmer themselves turned out to be the essential catalysts for the development of tape recording in this country.

In late 1945, Mullin had sent 35 mail packages home to San Francisco from Germany, all stuffed with parts for 2½ Magnetophons, along with about 50 rolls of BASF/I.G. Farben tape. Imagine what would have happened if the mail plane had gone down somewhere en route! It's my thesis that, had Jack Mullin failed to reconstruct and show his German tape recorders to West Coast engineers, other American tape development efforts would have been delayed by two to three years. That would have been just enough time for AEG/Telefunken and Grundig to appear on the American scene with their successful, proven postwar tape recorders. Even as late as 1947, had the Ampex people failed to perfect their first machine, the Model 200, the postwar Germans would have had an excellent chance to enter and dominate the U.S. market.

In early 1946, Mullin had joined his old friend, San Francisco filmmaker Bill Palmer, as partner and chief audio engineer of W.A. Palmer Films, a pioneer in 16 mm industrial and educational sound films. Mullin used his two rebuilt Magnetophon K-4s, which he renamed the "Magnetrack" system, for unsynchronized or "wild" film sound tracks. Mullin also took his recorders around the Bay Area, recording live performances.

In 1946-47, high-fidelity tape was still something of a mystery in America. One day, while Mullin was playing back one of these recordings in the small studio loft at Palmer Films, a visiting Hollywood agent, unaware of the existence of tape, exclaimed, "How did you guys fit a whole orchestra up there?"
In 1946, Mullin also recorded a session by a young San Francisco singer, Merv Griffin, with Lyle Bardo and his orchestra. The tape recording, long-since erased, was the source of the first commercial record album in the U.S. to be mastered on tape, "Songs by Merv Griffin", released on the Panda label in 1946.

On 16 May 1946, Mullin and Palmer demonstrated their Americanized Magnetophons at a San Francisco Chapter meeting of the IRE (now IEEE). Audience members included, among others: Harold Lindsay, who would become the chief designer of Ampex's first recorder, the Model 200; Charles Ginsburg, who, six years later, would head Ampex's successful videotape research and development team; Walter Selsted, future chief of engineering at Ampex, and Frank Lennert who, early on, was to become an important member of the Ampex engineering team and the designer of the famous Model 350. Ampex co-founder, Alexander M. Poniatoff, not at Mullin's IRE demonstration, heard about the tape recorder the next day from his excited young friends Selsted and Lennert. Poniatoff took no action about tape recording that spring.

Later that year, in the fall of '46, Poniatoff hired Dalmo-Victor engineer Harold Lindsay to help choose a good postwar professional product for Ampex to make. Poniatoff and his partner, T. I. Moseley, had founded Ampex in 1944 to build small radar motors and generators for Navy contractor Dalmo-Victor in San Carlos, CA. Ampex, at that time, was still a tiny company with just a handful of employees.

By December of '46, Poniatoff had taken Lindsay's advice to look at the possibility of tape recorder manufacture, and had decided to build America's first mass-produced professional tape recorder. In his typically decisive manner, Poniatoff made this momentus decision literally overnight, putting Harold Lindsay in charge of the new project. By then Col. Ranger and J. H. Orr had already begun a venture to build an American Magnetophon. The first "Rangertone" in prototype form was shown to East Coast broadcasters several months before the Ampex Model 200 was ready. According to Jack Mullin and other engineers who heard the first Rangertone, the machine made recordings of only mediocre quality. Broadcasters, including ABC, also rejected Ranger's first effort, by which time Ampex had already signed a contract for their Model 200 with ABC and Bing Crosby in September, 1947.

During 1946-47 in America no one besides Ampex, Mullin-Palmer, Ranger-Orr, and Brush Development-3M was working on tape recording. Ranger and Orr were temporarily out of the running due to technical and organizational setbacks. Mullin and Palmer had "relegated" themselves to exclusive distribution of future Ampex recorders. The consumer Brush BK-401 was un-
acceptable for most professional use (though Joel Tall at CBS mastered the "Hear It Now" series on a Soundmirror), and 3M was turning its considerable talent over to making new tapes for Ampex and Mullin to test. America's first successful tape recorder and really good tape would have to come from Ampex and 3M. Otherwise, the Germans would surely take over the U.S. market with their postwar Magnetophons.

At Ampex in the fall of 1946, Poniatoff's hiring Harold Lindsay to head the tape recorder research and development project was a good example of the Russian's intuition about people and engineering. The Ampex president ran a small company with few cash reserves, and could not afford to hire more than one new employee to design a tape recorder from the ground up. At Ampex, Harold Lindsay would have to be many engineers in one. As chief designer of the Ampex tape recorder, Lindsay would need experience in metallurgy and hydrogen annealing techniques for the most critical components, the tape heads; in motor design; in electronics; in the physics of pulling and stopping tape and reels; in industrial and mechanical design for a rugged cabinet, top-plate, and head housing; and in manufacturing and quality control techniques once the prototype was complete. The 37-year-old Lindsay had a varied engineering background that included work at the Shell Development Co., the Manhattan Project, and a brief stint with Charles Litton, as well as free-lance work in high-fidelity sound reproduction and acoustic reinforcement ("P.A."). Ampex project leader Lindsay was also blessed with an extremely talented associate, Myron Stolaroff, an employee of the tiny Ampex Electric and Manufacturing Company since its founding in 1944. Stolaroff did much of the design of the electronics of the Ampex Model 200.

When Poniatoff decided that his company would build what he hoped would be America's first successful professional tape recorder, few people had a clear idea how the machine should perform or what it would look like. Richard Ranger and J. Herbert Orr designed their machine closely along the lines of the Magnetophon. Mullin and Palmer in San Francisco, using American electrical components and different record bias and playback equalization values, had improved the original electronic specifications of their two Magnetophons. The two engineers even built a prototype recorder for film sound that was all new, except for the Magnetophon head assembly. Mullin and Palmer thus showed that there was nothing sacred in the design of the original German Magnetophon. Tremendous improvements in the electrical and mechanical design of an all-new American tape recorder were inevitable.
What started as a liability for Ampex in the early stages of their Model 200 design became an asset in the end. Adhering to an oral agreement made with Richard Ranger in New Jersey in 1945, Mullin would not let Ampex engineers look inside his two Magnetophons. Mullin wanted to help his new friends at Ampex, but, in true gentlemanly form, kept his word to Ranger. Lindsay, who had design ideas of his own anyway, was thus doubly motivated to create a really new machine.

Though Lindsay and his associate Stolaroff were influenced by what little they knew about the German machine, they had their own ideas about head and motor design, bias and equalization values, and the machine's industrial design, including the use of platters that stayed with the tape instead of with the machine. Ampex and others later added a top platter as well, creating the first 14- and 10½-inch tape reels later standardized by the NARTB (NAB). These early design departures from the Magnetophon account for many of today's differences between American and European audio recorders. Speaking of America's first successful professional tape recorder, the Ampex Model 200, Harold Lindsay said, "We re-invented the wheel!"

Harold Lindsay's personal dedication to ruggedness and reliability in his product designs, coupled with a concern for his products' users, were what lay behind all of his work. At the outset of Model 200 development, Lindsay said that he wanted this professional tape recorder to be as reliable, rugged, and easy to operate as the famous Scully disc lathes commonly in use in broadcasting at that time. Broadcasters' immediate acceptance of the Model 200 showed that Lindsay met his goal.

Though Bill Palmer and Jack Mullin could not allow Lindsay to look inside the Magnetophons, they helped Ampex engineers every other way they could. When Lindsay's mechanical braking system, used all the way through the recent Ampex AG-440 series recorders, seemed not to function correctly, Bill Palmer spent two days making mechanical and electrical adjustments until he proved that Lindsay's design did, indeed, work. It was Mullin and Palmer who lent the Ampex people several precious German tapes out of their dwindling supply of 50 rolls. Only with Mullin's Magnetophon recordings, really a kind of "standard alignment tape", could Lindsay and Stolaroff test their new designs. In those early days of 1947, Lindsay could have chosen any tape speed and tape width he wanted for the Model 200, but he took the logical course of following the basic German tape parameters: 30 inches-per-second using 1/4-inch tape. Back in Germany in 1945, Mullin had measured the German tape at a 1/4 inch, moving at 30 i.p.s. In fact, 1/4 inch equals 6.35 mm, while the German tape was a few thousandths wider, at 6.5 mm. The difference was really insignificant, as was the case of tape speed. Using AEG asynchronous AC motors and a 10 mm +/0 capstan width for standardization, the German
engines had created a tape speed of 76.8 centimeters-per-second, commonly rounded up to 77 cm/s, or 30.24 inches-per-second. Reasonably, Mullin had written "30 ips" in his 1945 analysis of the German tape speed.

Always eager to help his new Ampex friends, Mullin had advised Lindsay in late 1946 to start his research and development with the most critical tape recorder components, the heads, especially the playback head. In typically generous fashion, Mullin offered the use of one of his Magnetophons as a test bed for that first head, which Lindsay therefore built to fit into a German K-4 head assembly. Harold Lindsay in his 1977 db article, tells the next part of the story best:

"In the spring of 1947, after several months involving construction of lamination dies, a hydrogen annealing furnace, core stacking and lapping fixtures, and many tedious hours of stamping, stacking, hand lapping and winding, we were at the point of final assembly and static testing. We believed we had gone as far as we could without tape—we were ready for that long sought, but now almost frightening moment of truth, the final test. I phoned Jack and set a date. The following evening found an excited but nervous Ampex group on its way to the W. A. Palmer Studios in San Francisco, where Jack Mullin and Bill Palmer had been using the Magnetophons for over a year in their commercial film production.

The first tests were to be subjective listening tests using the best master taped material in the Palmer studio. We listened critically to this as it was played back with the normal Magnetophon head, using their best monitoring equipment. After replacing the German reproduce head with the Ampex prototype and rewinding the test material, we were ready.

I have always remembered that next moment, just before pressing the start button, as one of the most anxious times in my entire life—so much hung in the balance: a dismal failure, or the beginning of an exciting future.

The tape whipped up to speed; we were stunned, entranced, suspended in an eternity of mere seconds. Then cheers and hand shakes and clapping—the sounds of a wild celebration. Our ears had just told us what measurements later confirmed—we had outperformed the Magnetophon head. We were
destined not to failure, but to fame."

Throughout the spring and summer of 1947, the Ampex Model 200 prototype began to take shape. (The engineers had decided to call their machine "200" rather than "100" fearing customers' common avoidance of a small company's first product.) A source of high-quality American tape was a problem. 3M's black oxide Scotch No. 100 tape, made for the Brush BK-401, produced unsatisfactory results on both the Ampex prototype and on Mullin's Magnetophons. Fortunately, Audio Devices, makers of Audio Discs, had heard about the wonders of high-fidelity tape recording, and asked Ampex to test some new tape they had made. Lindsay and Mullin later reported that the early Audio Devices tape was some of the best they tested.

The 3M team in St. Paul led by Dr. W. W. Wetzel, made a similar, informal testing agreement with both Ampex and Mullin. Of the many 3M tape samples tested in California, Nos. 111 and 112 seemed to work the best on both Mullin's machines and the Ampex prototype.

Meanwhile, word had begun reaching Hollywood about high-fidelity magnetic tape recorders. A December, 1946 Mullin-Palmer demonstration at MGM in Hollywood had excited much of the Los Angeles engineering community. Bing Crosby's associates, including Frank Healy, Hugh King, and Murdo MacKenzie, heard about the Magnetophon and invited Mullin and Palmer to the NBC/ABC Radio Center in Hollywood for an August, 1947 trial. Also invited was Richard Ranger, who had already demonstrated his prototype "Rangertone" to NBC/ABC executives in New York.

The recording session was to be Bing's first show of the 1947-48 season of the "Philco Radio Time". Bing had left NBC in 1945 in a dispute over his right to air his show recorded on 16-inch transcription discs rather than live, as was common practice in American radio then. (Remember that the Germans had already been using recorded transcriptions on the air since the early 1930s.) Bing hated the regimentation of live broadcasting, with the strict adherence to the clock, and the network censors always present at each show, inhibiting his interaction with the audience.

ABC, newly created from the split of NBC decreed by the U.S. Justice Department, agreed to let Crosby record his show on disc for the 1946-47 season. A part of the agreement was ABC's promise to buy all-new recording equipment for Bing and others on ABC to use. Until then, ABC had been borrowing NBC's equipment for all of its production and broadcasts. Bing's Hooper ratings, the predecessor to today's rating services such as Arbitron and Nielsen, had always been high when his show was live.
Now, on disc, Bing's ratings began to drop. ABC told Bing that if his Hooper dropped below 60, he would be cancelled.

As Bing's radio ratings plummeted, his producers looked for reasons, and came up with the problem of poor recorded sound quality. The discs used for on-air broadcast were the result of two, three, and even four generations of disc-to-disc editing. Bing's people had to find some way to reduce the number of disc generations to one or two for the least distortion, and higher ratings. Mullin's tape machines were a possible solution.

Bing's first show of the '47-48 season, featuring Gary Cooper, Peggy Lee, the Rhythmaires and the John Scott Trotter Orchestra, sounded live and was a smash hit in the ratings. Recording the comedy-variety show in the NBC Recording Department was a bank of new Scully disc lathes, along with inviting Jack Mullin and Bill Palmer, and Richard Ranger. Ranger's prototype made such distorted-sounding recordings that his effort was quickly dismissed. The Mullin Magnetophon performed flawlessly. Mullin was told to edit the two 20-minute tapes into one 30-minute show, which ABC then transferred to discs for broadcast in October. Mullin and his two Magnetophons were immediately hired to record all future Crosby radio shows, officially under contract from W. A. Palmer Films in San Francisco. It is interesting to note that Mullin's Magnetophones were never directly used on the air. Everyone's distrust of the new tape medium meant that all magnetically-recorded shows were transferred to 16-inch transcription discs for on-air broadcast.

Not until the first production Ampex Model 200 recorders arrived in Hollywood was tape fed directly over the airwaves, and, even then, with discs running as a backup.

When Bing Crosby asked who was making an American tape recorder to replace the two rare German Magnetophons, Mullin unhesitatingly told Bing about Ampex in San Carlos, CA. Told to 'get them down here for a trial of their prototype', Mullin and Palmer suggested to Ampex's Ponlatoff and Lindsey that the best time to unveil their prototype Model 200 would be on 1 October 1947, Bing's first show of the season.

By the end of September, the Ampex people were still having trouble with the record and bias circuits of the Model 200 prototype, although the machine played back tapes perfectly. The deadline upon them, the Ampex people set up their machine that October day in Crosby's listening room at the NBC/ABC studios. Taking Mullin's advice, they played back the same recorded tape again and again, all day, to a continuous stream of curious engineers. Lindsey says it was like Opening Day at the cinema. Fortunately for Ampex and the future of American recording, no one thought to demand a recording demonstration. Shortly afterwards, the Ampex engineers had straightened out their record circuit problems and were ready to manufacture the Model 200.
After the successful Ampex Hollywood demonstration, Bing Crosby, reminding ABC about the network's commitment to purchasing new recording equipment, told ABC that he wanted tape recorders, specifically Ampex machines. The ABC people replied that they had already provided new recorders, those ten new Scully lathes in the NBC Recording Department. No, countered Bing, the lathes belonged to NBC, not ABC. The new network would have to get its own recorders, i.e., Ampex Model 200s, or Bing would leave radio altogether.

Until that time, October of 1947, with his partner Jack Mullin recording the Crosby show, Bill Palmer was hoping for the exclusive Ampex distributorship for the West Coast. If anyone deserved that plum, it was W. A. Palmer. ABC officials in New York and Los Angeles, however, had reservations about the ability of tiny Ampex Corporation (at one time during Model 200 development, reduced to only six employees including Poniatoff, Lindsay, and Stolaroff) to deliver the product, and questioned the role of the equally small W. A. Palmer Films as distributor. Crosby stilled ABC's criticisms with an offer. If Bing Crosby Enterprises, Inc. became the distributor of the Ampex tape recorder and guaranteed the small company's Model 200 production, would the network buy the recorder? ABC agreed. Ampex, with no marketing plan of its own for the new machine, gratefully accepted Crosby's sales offer, as well as the ABC contract for twenty Model 200s. When San Francisco Bay Area banks refused to loan the small tape recorder company money to build its first machines, even though it had signed contracts for 20 machines from ABC, Bing sent a check by mail for $50,000 to begin Model 200 production, no strings attached. He did not even include a cover letter.

ABC's skepticism about tape recording was based not only on their research of an inexperienced manufacturer (Ampex) and a small distributor (W. A. Palmer). The New York ABC executives had already heard, not only the Brush BK-401 Sound-mirror with its consumer-level audio quality, but also a New York demonstration of Richard Ranger's prototype Rangertone, using J. H. Orr's first Alabama-made tape. The high distortion Rangertone electronics and the consumer Brush machine naturally prejudiced the ABC people against tape. The wonder that fall of 1947 is that skeptical network executives were suddenly hearing undeniably good quality from an already discredited medium, magnetic tape. The American networks' 180-degree shift in thinking about magnetic recording is summarized most dramatically by this statement by Frank Marx, Vice President in charge of engineering at ABC:

"...commencing April 25, 1948, and continuing through September 25, 1948 a total of 22 weeks, the American Broadcasting Company in Chicago recorded on the Ampex, approximately seventeen hours per day. For these 2618 hours of playback time the air time lost was less than 3 minutes, a truly..."
remarkable record. We believe that a large share of this successful operation was due to the use of the Ampex tape recorder manufactured by your company.

We wish to thank you for your splendid cooperation in supplying us with this fine piece of equipment capable of withstanding the severe conditions imposed during our delayed daylight saving time program."

Between October, 1947, and July, 1949, Ampex made just 112 Model 200s. Halfway through production in the fall of 1948, the San Carlos engineers had acquired enough experience and knowledge, especially in head design, as well as in customers' reactions, to decide to build a new model tape recorder. The Model 200 had served to demonstrate conclusively that magnetic recording belonged not only in radio broadcasting, but as a better means of mastering recordings for recording studios.

With the addition of new engineers to the staff, including Walter Selsted and Frank Lennert, Ampex was ready to design a smaller recorder that would cost only $1500 (the Model 200 cost $3825) and would run at 15 ips instead of 30, with no reduction in performance and reliability. The Ampex Model 300, introduced in July, 1949, institutionalized tape recorder standards that are still in use to this day.

The greatest testimony to the skill and dedication of these early Bay Area audio engineers—Mullin, Palmer, Lindsay, Stolaroff, Poniatoff, Selsted, and Lennert among them—is that a tape recording made with condenser microphones on an Ampex Model 200 or 300 from 1948 and '49 sounds as good as many monophonic analogue recordings made today. This is an astonishing statement to make at an AES convention 35 years after the fact. It only remains for you to come to the Museum of Magnetic Recording in Redwood City, CA, and hear for yourself, if you’ve forgotten or are too young to remember, just how good audio recording became, almost overnight, between 1947 and 1949.
An 1898 Telegraphone, invented by Valdemar Poulsen (1869-1942) of Denmark. Wire wrapped around the brass drum gave a playing time of about 30 seconds. Kaiser Franz Josef of Austria recorded a message on such a machine at the Paris Exhibition of 1900. The recording still exists.

Photo courtesy of the AEG-Telefunken Archives, Braunschweig, Germany
Fig. 2.

H.J. von Braunmuehl (1.), one of Germany's magnetic recording pioneers, in a demonstration of the Lorenz steel sound machine on a Hamburg commuter railroad train in 1934

Photo courtesy of Norddeutscher Rundfunk (NDR) Archives, Hamburg, Germany
Fig. 3.
A close-up of a studio K-4, ca. 1939. All pre-war Magnetophons (excluding field units) had 3 motors and 3 heads, with automatic shut-off at the end of the reel.

Photo courtesy of Norddeutscher Rundfunk Archives, Hamburg, Germany
Fig. 4.

Jack Mullin (l.) in 1947, demonstrating his two "Americanized" German AEG Magnetophons to Murdo MacKenzie, Bing Crosby's technical producer

Photo courtesy Ampex Photo Archives
Fig. 5.

Harold W. Lindsay, the chief designer of the Model 200, checking out one of the first production models in January, 1948

Photo courtesy of Ampex Photo Archives
Here's the machine that put Bing Crosby on tape...

Amplex MAGNETIC TAPE RECORDER

The ability of the Amplex Magnetic Tape Recorder to maintain its unique high-level of fidelity has been fully demonstrated over the past season on the Crosby program. This "true-to-life" reproduction is the result of engineering improvements by the Amplex Company on the high-quality German magnetic tape machines.

The American Broadcasting Company has purchased 24 Amplex recorders to date and is using them from 15 to 18 hours a day in continuous commercial network operation. The results, from the standpoint of quality and reliability, have been unbelievably satisfactory, and the cost of ABC's recording operation has been reduced substantially. There is no waste of material as with discs; there are no discards; and editing on tape is made simply with a pair of scissors.

EXCLUSIVE DISTRIBUTORS

East of the Rockies:
AUDIO & VIDEO PRODUCTS CORP.
681 Fifth Avenue, New York 22, N. Y.
Telephone Plaza 9-6031

West of the Rockies:
BING CROSBY ENTERPRISES, INC.
9028 Sunset Boulevard, Hollywood 46, California
Telephone Croxton 11171

Fig. 6.

Amplex's first advertisement, run in Variety on 28 July, 1948. Bing Crosby Enterprises, Inc. became Amplex's West Coast distributor, while Audio and Video Products Corp. handled sales east of the Rockies.

Photo courtesy of Ampex Photo Archives