PART ONE:
SOUND DESIGN AND RECORDED MUSIC

Far too often in today's production work the individual assigned to be the designer of sound and other accompanying music simply goes to a collection of prerecorded music (or "101 Sound Effects") and transfers the required piece to whatever medium of playback is being used for production. Anyone trained on the equipment can do this and the expenditure of creative thought and planning is practically nil. If a sound designer is participating on a production team, the evolution of the production will be influenced by each designer's input and indeed, the final effect may not be found on a prerecorded compact disc (CD). And why should it be? The costume designer cannot shop for flapper dresses of the 1920s nor can the scenic elements be procured at any hardware store. Part of the pleasure, indeed responsibility, of each designer is to create the solution that captures the look and feel required by the specific production. And part of that feel is certainly enhanced by the choices of the sound designer. Because theatrical production is a total design effort, it is incumbent on each designer to understand the script, and be in accord with the other designers, the director, the producer, and the writers. This should include not only theatre but film, television and any other installation which is designed to affect an audience in a particular planned and organized manner. This is not always the case. The best assurance of good teamwork is understanding and acceptance between designers about the paths the production will take.

The sound designer will "score" the production. Scoring, as we think of it today, originated from film work in the early years. Even silent films were filled with sound. In addition to effects, the "pit band," which ranged from hard-working piano player to full symphony orchestra, was expected to heighten the visual world with appropriate music. Vocalists were also often used. Some of this tradition came from the live theatre where almost every production had an orchestra to play music before the play, during the act breaks, and for the audience to exit. Quite often, the musicians played appropriate (often specifically composed) music to underscore a scene. This charming practice has really disappeared, partly because of a change in presentation style and partly for budgetary reasons. For years after the need had ceased, the musicians' union required a certain complement of musicians for each play, and often the producer, to be mean (and get his money's worth), would insist the players adjourn to a lower basement and play for the length of the performance. Featherbedding

with fiddle. Early music in movies served not only to enhance the mood or situation but also to mask the mechanical sounds of the projector. Sheet music for silent films carefully noted the placement for gunshots, horses' hooves, horns, bells and whistles. These became an important addition to the silent film's presentation and were "scored" in. When sound film arrived in 1927, there were over 22,000 musicians working in theatres across the United States. By 1929 over half were looking for work and at that low period of the Great Depression in 1932 there were less than 4,000 still working.

Scoring productions reached a new height in the 1930s when Hollywood employed composers who produced masterful pieces of enhancement, much of which can stand on its own minus the visuals. Max Steiner, Eric Wolfgang Korngold, Franz Waxman and Miklos Rosza come immediately to mind, but there are many, many others. Sound effects were added to the final cut and Hollywood created a new sound man, the Foley artist named after the originator, Jack Foley. All prove the importance of music and sound effects, and make a difference in the final impact.

Composing a musical score for film is still considered a necessity, but theatre, most certainly for financial reasons, tends to deprive audience of this added pleasure. Often there will be recorded "pre-show," "entr'acte" and "exit" music. This is usually intended to fill a silent or empty background. It seems our society has a universal fear of silence; witness the "elevator music" that assaults people everywhere. Gawd forbid we might shop, dine, or even visit a restroom without an intrusive accompaniment from some ceiling speaker vibrating forth thoughtless noise, or worse, the favorite recordings of some minimum wage employee.

Imagine how much more could be accomplished with carefully chosen music. The booming cannons of the *1812 Overture* could enlighten a restroom visit. The point being, the choice of music for production should enhance, not merely fill the void. The correct music can lead the audience into the world of the production. The entr'acte music can help sustain the hard work of director and actors and the exit music is able to remind the viewer of his experience in a fairly subconscious manner.

Because the music will affect the audience, it pays to control the experience. Sound effects should be considered an equal extension of music and be "scored" into the script with the same care. Because it is possible to so carefully adjust the tone and pitch of any sound, the sound designer now has an almost infinite arsenal of subtlety with which to work. The ring of a telephone can be pleasant on the ear or cut through with tension-adding shrillness. The arrival of an "offstage car" can be aggressive or not. The music on the radio can swell or recede, complement the action or contrast it, inform the world or mask it, depending on the effect. The cicadas chirping at sunset will make a difference if they are "on edge" or calming. A low-moaning train whistle gives one message and that same train can "scream" in piercing notes if another effect is desired. The variety is endless but the choices are driven by the desired goals of the

production and that goal is achieved through a team effort. Many theatre people feel live sound is the only appropriate choice for live performance. They back up their peccadilloes with solid arguments about a consistency of worlds—live matches live. The audience's ear is a peculiar thing and will detect the most subtle differences. However, always remember the one thing no one in the theatrical professional can ever say at the end of a long day is, "It's been real."

THE SOUND DESIGNER

For theatrical productions, and this includes theatre, film, television, dance, and all performing venues, designers solve the who, what, where, when, and even the why of the world from which the story is told. Through discussions, research, research, and even more research they define the world to be created. This is often not an easy task and a designer or director or producer could put up road blocks and detours but through meetings and the sharing of knowledge the clear path emerges (hopefully) and everyone agrees. Everyone needs to agree.

What is a sound designer? Designers create solutions that solve problems. In the performing arts there is usually a designer for each element utilized to tell the story. The usual complement includes the costume and scenery designers—the oldest practicing members of the team of professionals. Often, these designers have their roots in the theatre. Property designers bring the items handled by the actors, and often also produce the furniture or those pieces that simply decorate the visual world of the setting. After theatre moved indoors, a lighting designer was required. Music was contributed by a composer and for years the sound effects were limited to a few necessary machines to create "wind" and "rain" accompanied by the crash and rumble of thunder. These were under the direction of the stage manager who gave the cue. As the twentieth century advanced and theatre became obsessed with more real or naturalistic presentation, sound effects were incorporated to enhance the illusion. Of course, those new rivals, radio and movies, created illusion which the theatre borrowed to satisfy the audience expectations. The sound designer became the latest member of the team. The use of recordings and amplification expanded options and replaced older, bulky machinery. As technology became more sophisticated the "soundman" (as women were *not* in the union) had to become more and more a technical expert to master the recording and playback equipment. He now lives in a very modern world of electronics. All too often this separates the position from fellow designers who still talk hands-on "design" in established terms and who often have no real understanding or appreciation of the technical sophistication which now envelopes the sound designer. Many assigned to design sound are acutely aware of the frustration brought about by the communication "block" which exists between designers—and realize the need for clear communication between all members of the production team. Good communication needs a common, acceptable and understandable language. The terminology used by the scenery, costume and property designers

originated in the visual art world and has been adopted (and adapted) for the theatre. These "art" terms are still the solid bases of "artistic" discussion and the connections to lighting and sound are strong, even legitimate, and convey specific information. It is also the language used by directors and producers. To remain a communicative language, all designers must understand the evolution of the "language of design" from the art world complete with intrusions from writers and philosophers. Alas, what is a sound designer? A member of a team of problem solvers. We have as many ears as eyes.

The following paragraphs present a sample of terms often used by designers. Ideally everyone should speak the same language. That is, of course, rather easy to do. But when and how do we learn to hear the same meanings? Alas, we have more ears than mouths. That must be why patience is such a virtue.

THE ELEMENTS OF DESIGN

There are five basic design elements, which, in various combinations, can create a visual design. They are line, shape (and its three-dimensional self, volume), texture, color, and value. These elements are usually combined in a design.

Line, in its proper geometrical definition, is a series of points or dots moving in a direction. In reality it is a narrow stripe of greater length. Because the eye must move along a line to see all of it, there is the illusion of movement and line can convey movement better than the other elements. Line is also used to contain a shape (outline) or is created by the abutment of two shapes, colors or the like, as in the "line" between things. We do not always have to "draw the line," for indeed a painted directional arrow indicates an unseen line as the eye follows the arrow to the logical directed conclusion. In lighting, line is used to describe the direction of the rays of light. In music, line has meaning more closely related to that series of dots created by the notes. Sound can also move us in a direction.

Shape, to the visual artist, is an area created by enclosing some space with a line or a filling in of color or value or texture that distinguishes the form. Lighting designers "shape" the three-dimensional beam of light which will fall upon a surface creating a particular outline (or shape) if sharply focused. When shape becomes three-dimensional, it is volume or mass. Indeed, the lighting designer's shape on the stage is the result of a conical volume of light coming from the instrument. Anything that intrudes into this shaped cone of light is illuminated. Music also has "shape." The prescribed form of the composition dictates its shape. Form is the framework, the model of accepted organization; it is the beginning, the moment-to-moment structuring leading to the end. Form is the shape of music.

Texture. The visual artist uses texture to create a surface that appeals to our tactile senses. In theatre, texture is often achieved by sleight-of-hand using contrasting colors or values of paint. Because distance is the death of texture, the artificial exaggeration of texture can help the audience "see" better. However, a smooth surface, no matter how well painted, is generally not as useful to a

lighting designer as is one with rich, three-dimensional texture. Lighting can enhance texture through the addition of gobo patterns that add another level of visual texture. Lighting designers also refer to the "texture of the light." In the aural world, texture becomes more elusive, but as with the smooth surface contrasted to the rough, texture in music is the relationship of voices and instruments in an ensemble. Texture is the way they are blended together into a musical whole—the density or sparseness of the music.

Music terminology "scientifically" breaks texture into four categories. *Monophony* refers to a piece which has one part, a soloist, either vocal or instrumental. *Hetrophony* has two (or more) performers but they are doing the same melody, granted in slightly different ways through often subtle variations. *Homophony* describes a piece in which the dominant melody is accompanied by one or more parts. Finally, *polyphony* is music that simultaneously combines two or more different lines. These lines can be melodic or percussive.

It is possible to correlate specific levels of musical texture to the visual world and perhaps these four categories might someday make some useful inroads there. Sound and music are also greatly affected by distance, especially in the element of texture.

Color. This is probably the most familiar of the basic design elements. The fact that it is usually the most difficult and potentially confusing element probably comes from the emotional attachments each designer has to subtle differences in colors. Anyone who has bought house paint or skeins of yarn is aware of the attached warning to purchase enough to do the entire job because the dye lot may vary slightly from batch to batch. The color industry has carefully charted colors using scientific breakdowns and assigned to each numbers to recreate the original. However, as the ideal world become reality, the ingredients lose their purity and are often tainted in imperceptible ways. A "red" which once, by adding "yellow," gave forth a brilliant "orange," could, in the next gallon of paint give an "orange" which is considerably duller. This is because there might be a bit more "blue" hidden in the "red" which when combined with the "yellow" will move toward "green." This "green" is now a complement of "red" and has neutralized the brilliance. It can sound quite complicated but the results are easily seen.

Technically speaking, colors have three attributes: hue, saturation, and brightness. Hue is what we normally think of as the color's namesake: red, blue, chartreuse, etc. Saturation refers to the degree of purity, strength, or intensity. Brightness, or value, is the relative lightness or darkness of a color—the amount of light refracted or transmitted by a colored object. Scenery and costume designers usually discuss colors in unscientific terms using names, not numbers. In their attempts to be more specific than "yellow," "blue," or "green" color designations can be quite fanciful, for instance "English Dutch Pink," "Bubba Blue Workshirt," or "Goose Turd Green." When they want to be really specific, scenery and costume designers resort to painted renderings of their designs.

The "colors" of the costumes and scenery are rich in a mixture of textures,

fabric content, and construction. Under work-light conditions there will be one look but as the lighting designer focuses upon these objects there is change brought about by the nature of the light source, its intensity, and, of course, by the addition of color filters. All too often the changes wrought by the lighting designer come as a surprise and are often felt by the scenery and costume designers to be a detriment, not an enhancement. This can easily happen because the total picture is rarely discussed in words that have common and agreed-upon meanings. Everyone wants to believe they are saying the same thing, but between the major shifts in word meaning and the more subtle nuances developed by each profession, discussions with words can easily become skewed. Lighting designers often talk in "crew talk" or numbers: the type and size of instruments, the catalogue numbers for color media, the angle or spread of the beam of light, etc. While this coded language has specific meaning and is precise and efficient for discussions with fellow technicians, it is often a foreign language to the other designers. Sound design only complicate this mix.

Color in music is that elusive quality which distinguishes a note played on one instrument or voice from the same note played on another. The French word "timbre" is often substituted. Timbre is created not by the note but by the many overtones or other sounds mixed with the note. Timbre is also used to describe the degree of ornament in a melodic line in addition to the degree of harmonic richness in a sequence of harmonies through the use of chords. It also refers to the exploitation of the differences between instruments.

If it were possible for the specifiers of timbre (see below) to support the defined terms of visual color, a vocabulary less fraught with interpretative problems could develop. Until that time, ears and eyes need to be on the alert.

Musical instruments and their unique timbres have been broken down into five groups. *Membranophones* are instruments that have skins or membranes stretched on them. Obviously, drums of all shapes and sizes fit here whether struck or rubbed by hand or mallet. *Aerophones* are instruments that set a column of air in vibration by splitting the column of air over a sharp edge or by the movements of a reed or reeds. From harmonica through bagpipe, oboe to organ, French horn to English horn, the air-driven instruments cover a wide range. *Chordophones* have strings that are set into motion by bows, plectra, or picks. *Idiophones* are instruments that sound like themselves. Bells, wood blocks, triangles, or gourds filled with rocks and shaken or stroked on the side, fill this category.

Finally there are the *electrophones* that create a wave form. The theremin, invented around 1919 by the Russian Léon Theremin (1896–1993), is an early example. It can be "played" by moving a hand between two projecting electrodes to change the tone. The other hand affects the volume. Ever since this electronic instrument was used by Miklos Rozsa in the Alfred Hitchcock film *Spellbound* (1945) the very sound of the theremin has become synonymous for "otherworldly" and "insanity." There are also some legitimate pieces written for it. The ondes Martenot is another early electronic sound generator, invented by

Maurice Martenot (1898–1980) and demonstrated in 1928. Perhaps the most famous electrophones (among many, many inventions) is the Hammond organ (1935), a favorite of radio soap operas where its limited range of sound seems appropriate. The electronic synthesizers which proliferate in today's musical market are direct descendents, with many an adjusting knob to supplement the sound. The ease of playing these "keyboards" has made the instruments available to music makers of various levels of taste, talent, or tact.

One interesting byway of color in music is the importance certain composers have assigned to specific colors and specific notes. Perhaps the most famous is Alexander Scriabin (1872–1915). Scriabin dabbled in a strange, mystical theory combining religion and cosmogony that allowed him to create what has been described as "philosophical program music." Two pieces that fit this rather bizarre category are *The Divine Poem* (1905) and *Prometheus* or *The Poem of Fire* (1910). The latter has written into the score indications for a keyboard that originally triggered lights to project onto a screen. The interplay of color is driven by the music and, in Scriabin's mind, this was of one experience. He specifically gave certain notes to a color. For example, red was C major and D major was yellow. Nikolay Rimsky-Korsakov (1844–1908), a contemporary of Scriabin and also a Russian, created his own system that agreed (only in a few places) with Scriabin. The divergence of color/note connections seems to provide the individual with emotional ties but lacks a scientific foundation. Certainly there is no more agreement among visual artists as to the emotive nature of color, and yet, there is a connection, however elusive and personal. The ears of all designers should prick-up whenever "color" is discussed—there could be a fascinating blending of elements specifically "designed" to enhance the demands of the production. One interesting sidelight of color is the work of Thomas Wilfred (1889–1969). The Danish-born singer and scientist in the 1920s presented "color music" with his Clavilux, an electrical control board with sliding pins which affected the intensity of the light. These beams were often projected through focal stages enabling Wilfred to "shatter" and manipulate the beams of light before they hit the projection screen. He called his original moving projections by musical names—"Opus 39 Triangular Étude" and the like. There was no attempt to tie the visual specifically to the musical; they worked together emotionally. However, in 1926, Wilfred, Clavilux at hand, joined Leopold Stokowski (later of *Fantasia* fame) in performances of Rimsky-Korsakov's *Scheherazade*. Wilfred's projections proved to be an enhancement for critics and audience alike as the light "danced" along with the evocative music.

"Light is the artist's sole medium of expression. He must mould it by optical means, almost as a sculptor moulds clay. He must add colour, and finally motion to his creation. Motion, the time dimension, demands that he must be a choreographer in space."—Thomas Wilfred.

The rapid proliferation of light shows in the late 1960s and early 1970s is yet another example of an attempt to merge the two experiences. Drugs were optional.

Value also has some shifts of meaning when moving from the visual world to the aural. Visually, value refers to the degree of lightness on a grey scale, which is a prescribed series of steps from white to black. White is the highest value, black the lowest.

The colors or hues can be matched to a grey scale—yellow being at the higher end, violet toward the lower. The lighter values appear to move forward and the lower or darker values appear to recede. Thus it is value which really makes form. Colors of equal value and their grey equivalent visually "sit" on the same plane.

By adding white or black to a color, the color is made into a tint or shade. The value is affected, but the hue is unchanged. The saturation is the brilliance or purity of a color. Mixing it with another color will lessen the brilliance of the original and affect its value. Value in music is more closely related to color or timbre. However there are some interesting connections. Lighter timbres offer a thinner more transparent sonority while the darker tend to be thicker and heavier. The lighter tend to come forward and the darker to recede. Some voices, usually sopranos, are referred to as "white." They are fairly free of vibrato and often a bit piping. Dark voices can descend into the rarefied world of "black" basses.

If the elements of design seem to wander divergent paths as they move from field to field, hang on. The "isms"—those so casually talked about conceptual catch-alls—sometimes require maps to figure out where one is. Always ask for directions when lost. Your chances of arriving on schedule are greatly improved—especially if you're meeting people.

— THE "ISMS" AND THE ARTS

When one of the arts takes a new path and explores ideas in a new way, the result often becomes an "ism." Obvious "isms" in the art world are impressionism, cubism and surrealism. These "isms" are easily recognized and discussed. But these three, as well as many others, take on additional meanings both with the passage of time and the transfer into another art form. Designers from different disciplines have different understandings of each other's "design basics" as the words in each vocabulary take on new meanings. The "isms" often become convoluted and warp their original meanings. The following discussions are attempts to trace the evolutions in some major artistic movements and identify how some of these adjustments changed their original meanings.

Everyone thinks they know what constitutes **realism**, but the obvious answer is, in many ways, the most obscure. Realism is not an accurate, exact recording of what is real. Artistic representation automatically precludes this. When an artist attempts to represent a common, everyday event, the illusion is created by a selected and shaped interpretation of the original. Ideally the realist is neutral, devoid of idealization and free of melodramatic enhancement—all of which are states fairly alien to artists.

In the mid-nineteenth-century European art world, the painter Gustave

Courbet (1819–1877) and draftsman Honoré Daumier (1808–1879), both early realists, created works that were a reaction to romantic and classical "idealized" art that depicted mythology, historical subjects and emotion-laden landscapes. The realists exposed social injustice and political wrongs common to their day. In the literary world, Honoré de Balzac (1799–1850), Gustave Flaubert (1821–1880), George Eliot (1819–1880), Fyodor Dostoyevski (1821–1881) and Nikolay Gogol (1809–1852) were joined by playwrights Henrik Ibsen (1828–1906), Anton Chekhov (1860–1904), George Bernard Shaw (1856–1950), and later Arthur Miller (1915–2005), to advance the movement. To some extent, impressionism is a reaction to realism in the art world, as is naturalism in the literary world. With the dawn of the twentieth century, realism was again challenged by cubism, expressionism, modernism, futurism and others. Hollywood became the safe home for twentieth-century realism.

In music, realism has its moments. Beethoven felt he "realistically" depicted the sounds of nature in his Sixth Symphony, the "Pastoral," but hearing the results today can but bring a smile. Rossini was lauded for his realistic storm in *The Barber of Seville*. It was to the late nineteenth-century Italians that the torch of musical realism was passed; they created *verismo* operas. "*Verismo*" means real. Most of the *verismo* composers, like the earlier writers and playwrights, stuck to characters and situations from the lower strata of society. The situations emphasized violent clashes of temperament which could be resolved only with heightened passions, intense hatred, and paroxysms of unbridled lust. Plotted betrayals and death by various and sundry sensational methods, especially murder, were common. *Verismo* by extension soon included all late-nineteenth and early-twentieth-century Italian opera (and that of other countries that emulated the style). "*Verismo* singers" are those who sacrifice beauty of sound and traditional (classical) vocal necessities to make a dramatic point with a sobbing catch-in-the-throat and "gutsy" chest tone. The most famous *verismo* operas are *Cavalleria Rusticana* by Pietro Mascagni and *I Pagliacci* by Ruggero Leoncavallo. "Cav" and "Pag" are the one-act tips of a mountainous range of works. Again, it should probably be stated that realism is not real. It is an illusion of reality, carefully selected and manipulated to make an audience think they are watching an actual event.

Naturalism is a branch of realism. It began in literature with Emil Zola (1840–1902) who believed it was possible to scientifically record the actions of his characters. Unfortunately, to record events completely and dispassionately does not necessarily make exciting entertainment, but Zola discovered a surefire antidote—take off the characters' clothes and record dispassionate sex. This still works and is perhaps over-employed in today's theatre, film, television, and those large-print romance novels found in the grocery store. (Whatever happened to those dark, secret little back rooms?) Naturalism presents characters as passive victims of the forces of nature and their surroundings. Theatre extends and tweaks these circumstances to describe a greater, more detailed illusion of reality. The rollicking excitement of the 1950s "kitchen-sink dramas"

proves there is life after Stanislavsky. (Music cannot be natural because it is the food of love. Read on.)

Early in the twentieth century there arose a theatrical convention called **literalism**. This advocated detailed and exact reproduction of the setting of the story. It was even better to transport the actual location, lock, stock and barrel, to the stage. Perhaps one of the most famous is David Belasco's production of *The Governor's Lady* (1912) in which a Child's Restaurant was dismantled and reconstructed on stage. Everything was exactly as it had been in the real world—except for the incongruous ground cloth on the stage floor, complete with wrinkles. This established piece of theatrical practice was a solution to which everyone involved in recreating the real world seemed totally oblivious.

With realism must be connected **surrealism**, for it portends to be even more real than realism. France was the home of surrealism. The movement was born in the early 1920s with the Dada movement serving as the midwife. The *Surrealist Manifesto*, presented in 1924 by André Breton (1896–1966), states the goal: "to resolve the previously contradictory conditions of dream and reality into an absolute reality, a super-reality." Freud became the movement's godfather. Surrealism spread to America as Hitler spread across Europe. Its most noted painters were Max Ernst (1891–1976), Joan Miro (1893–1893), Yves Tanguy (1900–1955), Salvador Dali (1904–1989) creator of the melting watches, and Réne-François-Ghislain Magritte (1898–1967). Surrealism attracted French poets including Louis Aragon (1897–1982) and Paul Éluard (1895–1952). Perhaps the greatest piece of surrealistic theatre is Alfred Jarry's *Ubu Roi*, which was actually written in 1896, long before there was an official movement. There are some noted surrealistic films including the early works by Luis Buñuel (1900–1983) *Un chien andalou* (1928) and *L'Âge d'or* (1930), both produced in collaboration with Salvador Dali. These films still shock audiences with their terrifying images. A more popular example of surrealism can be found in Alfred Hitchcock's *Suspicion* (RKO, 1941) and even in Vincent Minnelli's *Yolanda and the Thief* (MGM, 1945). (Music has been cheated out of surrealism because, by definition, music is not real in the first place.)

Somewhat related to surrealism is **symbolism**. It too began as a protest. In late nineteenth-century France, the poets Paul Verlaine (1844–1896), Stephane Mallarmé (1842–1898), and Arthur Rimbaud (1854–1891) rebelled against the naturalism of Zola and his followers. These poets felt that art could do more than describe the observable, it could, using symbols, suggest a transcendent reality behind the surface appearance. Painters were quick to seize upon this theory and, utilizing varied styles of presentation, let line and color express ideas through suggestion and evocation. Odilon Redon (1840–1916), Gustave Moreau (1826–1898) and Puvis de Chavannes (1824–1898) in France, and Edward Burne-Jones (1833–1898) in England with Edward Munch (1863–1944) in Norway became the prime visual proponents. In the theatre, Maurice Maeterlinck (1862–1949) wrote symbolic dramas. In the latter part of the nineteenth

century, Richard Strauss (and others) could be said to have borrowed some of the exaggerated form and color to increase the impact of tone poems. (In truth, music is fairly "symbolic" at all times.) Symbolism was a path that was lightly trod by the surrealists on their way to other places. It led, however, directly to expressionism.

Expressionism began in the worlds of art and literature. In art, the delineation is a bit blurred with the overlapping of cubism and futurism, but the path can still be seen. The painters, Emil Nolde (1867–1956), Ernest Ludwig Kirchner (1880–1938), Max Ernst (1891–1976) and James Ensor (1860–1949), plus others of *die Brücke* and *der Blaue Reiter* groups, display distortion and exaggeration for emotional effect, thus allowing the illusion of inner emotions to reign supreme. The writers August Strindberg (1849–1912), Frank Wedekind (1864–1918) and Georg Kaiser (1878–1945) supplied not only plays but opera libretti for noted "modern" composes including Alban Berg (1885–1935), Arnold Schoenberg (1874–1951), Anton Webern (1883–1945) and the early works of Kurt Weill (1900–1950). Eugene O'Neill (1888–1953) is one of the American playwrights who experimented with expressionism. His plays *The Emperor Jones* (1920) and *The Hairy Ape* (1922) are rarely revived.

Expressionism in music is dominated by Arnold Schoenberg. Throughout the 1910s and 1920s, he and his compatriots, Berg, Webern and later Ernst Křenek (1900–1991) and Paul Hindemith (1895–1963) evolved a new, universal language which can be heard as both the "last gasps of romanticism" and the "shouts" of the new. The fate of expressionism was sealed by the Nazi condemnation of this *entartete Kunst* (perverted or degenerate art). Neoclassicism can lay some claim to being its successor.

The film *The Cabinet of Dr. Caligari* (1919) is probably the most famous expressionist film, but the influence can be seen in many others including *The Golem* (1920), *Metropolis* (1926), *Sunrise* (1927) and *M* (1930). It has been argued that the film noir world grew out of expressionism and some late practitioners included Alfred Hitchcock and Orson Welles.

Impressionism is a movement that began in French painting in the 1860s. It was a reaction against the academic teaching and conventions of romanticism that held art should convey an intense personal emotion. The impressionists tried to capture the effects of light on a surface and believed that the effect was more important than the surface. The term impressionism was first used to describe the paintings in the 1874 Paris Exhibition. Edgar Degas (1834–1917), Edouard Manet (1832–1883), Claude Monet (1840–1926) and Pierre-Auguste Renoir (1841–1919) were noted impressionists. In music, the term has been applied chiefly to Claude Debussy (1862–1918), who violently denied the label, though in fact his treatment of effects of tone easily compares with Monet's treatment of the effects of light. Debussy also wrote *Prélude à l'Après-midi d'un Faune* and transferred to expressions in tone the words of the author. Debussy was a prolific scorer of poems by symbolist poets, especially Paul Verlaine. Other composers who have been called impressionists include

Paul Dukas (1865–1935), Florent Schmitt (1870–1958), Maurice Ravel (1875–1937), Albert Roussel (1869–1937), Jacques Ibert (1890–1962) and Deodat de Sévérace (1873–1921). Some non-French musicians must include Frederick Delius (1862–1934), Charles Martin Loeffler (1861–1935), Charles Tomlinson Griffes (1884–1920) and Ottorino Respighi (1879–1936). Only Germany seems devoid of impressionist composers. Hmmm! Willi Apel (editor of the *Harvard Dictionary of Music* among other books) notes that the impressionist composer "...hints rather than states; in which successions of colors take the place of dynamic development, and 'atmospheric' sensations supersede heroic pathos; a music that is vague and intangible as the changing light of day." It was Debussy's opera (to an almost verbatim text of the play) that has carried Maurice Maeterlinck's *Pelleas and Mélisande* toward a bit of immortality. In as much as impressionism eliminates most of the theatrical precepts set forth by Aristotle that are key to the structure of a dramatic piece, the theater has not embraced the concept.

Film, being a child of light, has evolved a slight variation on the painter's technique of brush strokes of bright colors to capture light. In film, impressionism is an edited sequence made up of brief, seemingly unrelated images. Excellent examples are found especially in the early works of René Clair (1898–1981) and the montages crated by the great Soviet filmmaker Sergei Eisenstein (1898–1948).

Pointillism, the practice of applying small dots of paint in the manner of Georges Seurat (1859–1891), creator of *Sunday Afternoon on the Island of La Grande Jatte*, is not impressionism because it is more interested in colors on a surface which mix in the viewer's eye and less with the effects of light. Although it was first exhibited at the eighth (and last) impressionist exhibition, it is now properly called pointillism or if push comes to shove, postimpressionism, which was a reaction to re-introduce more "realism" into the elusive world of light.

"The artist's feeling is his law!" could be the cry of **romanticism**, the long-lasting "ism" which covers most of the nineteenth century and a good part of the twentieth century. Romanticism was a reaction against the ordered rationality of the Age of Enlightenment. The freedom and spontaneity of individual expression was a mirror of the freedoms sought by people in the late eighteenth century, a time that has, with much justification, been called the "Age of Rebellion and Revolution." The colonies of America must take credit for getting the (cannon) ball rolling. The success of the American Revolution opened the eyes of the citizens of France and one bad thing led to another. Indeed, the established rulers of Europe were quite worried. The classical era was crumbling. The writers, as so often happens, led the way. The concurrent Industrial Revolution uprooted the farmers and brought them to cities as needed (and cheap) labor. The upheaval pointed out the delicate balance of man and nature (and dare it be suggested, God?) Johann Wolfgang Goethe (1749–1832), Walter Scott (1771–1832), Lord Byron (1788–1824), Honoré de Balzac (1799–1850) and Alexander Dumas (1802–1870) lent their voices to the hearts and minds

of a rapidly rising middle-class, hungry for new ideas. Painters must give credit to Eugène Delacroix (1798–1863) who painted in great bursts of color, emotion and turbulence, and for whom there was no classical or even neoclassical restraint or order. Oddly, his favorite composer was Mozart, the epitome of the earlier times. Other painters include J.M.W. Turner (1775–1851), John Constable (1776–1837), J.A.D. Ingres (1780–1867) and Honoré Daumier (1808–1879).

Music also reflected the social upheavals of the times. Niccolo Paganini (1782–1840) became the first "superstar" performer. He was mobbed by screaming females (there is a pattern here), played to sold out houses, made a fortune and was certainly possessed by the Devil. Music then expanded in two interesting directions. Opera became even more popular with the *nouveau-riche*. The more spectacular the productions could be, the better (little change here in two centuries). Giacomo Meyerbeer (1791–1864) created the five-act monster, Grand Opera, complete with ballets in which the twinkle-toed mistresses of the wealthy patrons could show off and everyone could ogle the fruits of their capitalist labors. In contrast to Grand Opera there was a proliferation of music for the home. It was not only found in the great salons of the capitol cities where a hostess could present Chopin, Liszt or any number of other bright young things, but also in the humbler homes. If the composer could not play his own works, then his sheet music was available in every bourgeois castle. Indeed, the home was the most prolific music-making place. The Industrial Revolution had made possible an abundance of inexpensive paper and the latest novels of Walter Scott poured off the presses with wild abandon as did the most recent paraphrases on the latest opera arias or symphonies, transcribed for that obligatory piece of household furniture, the piano. Young ladies were expected to play; gentlemen who played were considered educated. Music in the home was *de rigueur*. Before the record player, radio and television, the piano was the center of entertainment. The great abundance of salon music from the romantic age more than confirms this.

Probably the most confusing "ism" is **neoclassicism**. In the world of art and architecture, neoclassicism refers to the explosion of Greek and Roman borrowings associated with Napoleon and the fashioning of his "Empire" in the turbulent years after the French Revolution. Of course, the influences of the ancient world were felt before. The discovery in 1748 of Pompeii and Herculanium (both were buried in 79 A.D.) brought forth stunning examples of art, architecture and artifact. France exulted in and was a great exporter of the Louis XVI style, and the Régence, Directoire and Empire that followed. Neoclassical furniture designers in England (and through published pattern books, America and most of the civilized world) included George Hepplewhite (d. 1786), Thomas Sheraton (1751–1806) and the Adams Brothers (Robert, 1728–1792, and James, 1730–1794). Their works were eagerly sought by cultured people who wished to be *au courant* on every level. Their designs are still in fashion and in use today. Noted neoclassical painters included Jacques-Louis David (1748–1825) and Jean-Auguste-Dominique Ingres (1780–1867).

Josiah Wedgwood (1730–1795) the English potter captured in his Jasperware with its white, low-relief figures against a colored background the essence of the Adams brothers' intentions. The works are still being produced in the Wedgwood factories. In all the creations of the neoclassicists, there is a banishment of the rococo asymmetry, replacing it with a fairly strict axial symmetry utilizing motifs from the classical world, especially medallions, urns, masks and the like.

In music, neoclassicism jumps forward a century and identifies with works from the twentieth century in which the composers consciously utilize the techniques, gestures and forms employed in music from the late seventeenth and eighteenth centuries—that classical era of Handel and Mozart in which composers sought a change from the "weight of the Baroque." Neoclassicism is a reaction against hypersensitivity and the extremes of emotions. It embraces detachment and lack of personal involvement. Neoclassical composers include Igor Stravinsky who studied Bach, Handel and Carl Maria von Weber for his neoclassical works. Francis Poulenc (1899–1963), Bohuslav Martinů (1890–1959), Arthur Honegger (1892–1955), Aaron Copland (1900–1990) and Paul Hindemith (1895–1963) were also, at times, consciously influenced by these earlier composers.

Thus, the classical era of music is contemporaneous with the neoclassical era in art and architecture. Theatre, of course, was the great borrower of the ancient world, creating works that strove to recreate the glory of Greece and Rome. Audiences still suffer. (There is additional information on the classical era in Part 2, Classical Music, between Soler and Salieri (page 150.)

Fauvism was a short-lived movement from the world of fine art. The fauvists utilized intensely vivid color in a non-naturalist manner. The appellation is from the French word *fauve,* meaning wild beast. It was first used in 1905 and applied to artists André Derain (1880–1954), Georges Rouault (1871–1958), Henri Matisse (1869–1954) and Raoul Dufy (1877–1953). Certainly Matisse is the most consistent and long-practicing of the fauvists. Outside France, the fauvist influence was felt in Germany in the painters who called themselves *die Brücke* (the bridge) and *der Blaue Reiter* (The Blue Rider, after a painting by Wassily Kandinsky). The influence of German expressionism gives the works a unique, but colorful, look. If fauvism was a reaction to postimpressionism, seeking color inspiration from Van Gogh, Cézanne and Gaugin, their legacy of intense color was embraced by the cubists and futurists.

Cubism began as an art movement co-hatched in 1907 by Pablo Picasso (1881–1973) and Georges Braque (1882–1963). From cubism's birth to 1912, the term "analytical cubism" is applied. This rational, intellectual and logical approach made the works of various artists appear quite similar, with the intersecting of planes. Three-dimensional objects were dissected, analyzed and "re-assembled" into two-dimensional images with shape being the driving factor. After 1912, color became the driving factor and "synthetic

cubism" was born. The artist now replaced shape with more decorative elements including stencils and collage. Juan Gris (1887–1927), Ferdinand Léger (1881–1955) creator of the décor and costumes for the Ballet Méchaníque, and the sculptor Jacques Lipchitz (1891–1973) carried on the cubist traditions. Because cubism, at heart, reduced natural shapes into geometrical equivalents, it is a visual "ism' with no equivalents in the other arts. However, its influences on Dadaism, surrealism and futurism affect other fields.

Dadaism was founded in 1915 by the poet Tristan Tzara (1896–1963). It was, in part, a fairly violent reaction to the traditional and conventional values found in the established arts of the time. Certainly the disillusionment brought about by the slaughter of World War I influenced the Dadaists. The Dada artists did not have a uniform style but poked fun (even jabbed and stabbed) at a disrupted public complacency. Found objects, especially those of an archetypal nature found in illustrations and advertising, were acquired and assembled in collages of striking anger. The works were deliberately anti-aesthetic with their unlikely combination of photomontages and typestyles, and they often had a potent political message. A prominent artist who usually worked in the more practical fields of design was Marcel Duchamps (1887–1968) whose 1912 painting *Nude Descending a Staircase* was the *success scandal* of the 1913 Armory Show in New York. Duchamps later presented a bottle rack and a urinal as "ready-mades" and found, much to his chagrin, that critics spilled quantities of ink praising their aesthetic beauty. Man Ray (1890–1976), the American who later studied in Paris, worked extensively on his Rayographics, photographic impressions made without a camera on a sensitized plate. Much of his pioneering work was later emulated by the pop art world of the 1960s. Man Ray also worked with movies and two of his surrealistic films are *Le Retour à la raison* (1923) and *L'Etoile de mer* (1928).

Dada theatre reached its zenith in 1916 when Hugo Ball (1886–1927) and Richard Huelsenbeck (1892–1974) joined Tzara to found the Cabaret Voltaire in Zurich. The German artist, Kurt Schwitters (1887–1948) created music for the group. Schwitters also appeared in Bauhaus, the design school founded in Dessau, Germany after the World War I. Other composers, however, were connected with or greatly influenced by the Bauhaus movement. Some include George Antheil (1900–1959) whose two-minute Sonatina of 1922, "Death of the Machines" and Stefan Wolpe (1902–1972) whose music from the 1920s owe some debt to the Bauhaus. Other composers could include Josef Matthias Hauer (1883–1959), Hans Heinz Stuckenschmidt (1901–1988) and Waldimir Vogel (1896–1984).

Perhaps the anti-art "philosophy" of Dada found a kindred spirit in the Bauhaus, which sought solutions by stripping away the superfluous trappings of historical decoration. The school felt that in the core handicrafts of artisans lay the base for mass production. Bauhaus artists encouraged, indeed, insisted upon music, drama and painting as part of the natural training for designers. Dada no doubt added humor to the mix as well.

The Dada movement, if indeed the loosely jointed group of participants could be a movement, was short-lived. Its influence, however was profound upon the surrealists, abstract expressionists and the even later conceptualists. Today's eye-catching juxtapositions in advertising and graphics owe much to Dadaism. (Mamaism is not related, even by marriage, though some see humor as the base of both.)

Futurism, born out of the same chaotic times that spawned Dada, belongs primarily to the literary world and that of painters. It was the Italian poet Filippo Tommaso Marinetti (1876–1944) who published the *Futurist Manifesto* in 1909. "Art is evolution, improvisation, verve, enthusiasm, superlatives, elasticity, elegance, generosity...it rattles at every chain." The manifesto urged painters to display the modern world with its speed and energy. By combining elements of cubism with the colors of the fauvists, the Italian painters tried to capture movement. The futurists died, along with millions of others, during World War I. However, the futurists fertilized the Dadaists, and in Russia where the turmoil was moving at an even more rapid rate, futurism blossomed forth in the first decades of the new Soviet country, especially in art, theatre and music. Theatre had already experienced futurism with the Italian designers Giacomo Balla (1871–1958), Fortunato Depero (1892–1960) and Enrico Prampolini (1894–1956). Music was also challenged by the Italian futurists. The movement and sound of motors and machines became artistic effects for the composer. Francesco Balilla Pratella (1880–1955) absorbed impulses from the other arts and evolved them into music. After the 1917 Revolution, Russian composers felt they had the freedom to develop music that was unaffected, genuine and elemental, resounding in the cacophony of everyday life. Composers as diverse as Nikolai Roslavits (1881–1944), Alexander Mossolov (1900–1973), Alexander Goedicke (1877–1957), Michael Gnesin (1883–1957) and Lev Knipper (1898–1974) wrote music that could be understood by all, from farmer to steelworker to bureaucrat. Many a composer changed his tune when it did not hit Stalin's ear with expected sweetness. One interesting sidelight of the futurists: with their visual exultation of war and violence they were seen by some as the precursors of fascism. (Perhaps it was the timing.)

Constructivism is a Russian movement founded in 1913 by Vladimir Tatlin (1885–1953). This was at the time of Russia's attempt to catch up to Western modernization. Inspiration was drawn from the materials and aesthetics of the modern machine and technology. The art was three-dimensional in its beginning and focused on sculpture, later moving into architecture. Constructivism found increasing disinterest in Soviet Russia, and the sudden fall from official favor encouraged many artists to leave for Europe and America. Constructivism influenced the cubists and futurists and had a profound effect on the thinkers of the Bauhaus. After Hitler's rise to power in Germany, an even larger contingent of influential thinkers, artist and architects resettled in England and the United States.

Formalism is another Russian movement that affected form and formal structure. It began in the theatre about 1905 with Vsevold Meyerhold (1874–1940). He was also formalism's strongest advocate. Formalism was Meyerhold's reaction to Konstantin Stanislavsky (1863–1938) and his brand of naturalism practiced in the Moscow Art Theatre. Meyerhold developed a system of actor training called "bio-mechanics" which combined movement from sports, the circus and time/motion studies. Meyerhold felt the actor should be treated like a puppet with inner feelings suppressed and exchanged for symbolism. The theatre of Meyerhold is still visually exciting when viewed in old photographs and films of his productions; however, audiences soon tired of the emotionless performances. The rise of socialist realism in the Soviet Union brought forth a level of theatre more accessible and thus more enjoyable to the great masses of new theatre-goers. Meyerhold was arrested in 1938 and died two years later under Stalin's rein of terror. Not a pretty time for the creative artist in any field.

There are other "isms" used in creating a production. Perhaps the least understood and at the same time the most dreaded is commercialism. One must always be wary when this is mentioned in a production meeting. It is also astounding how quickly everyone agrees with the definition and how often the results are actually the opposite.

A BRIEF HISTORY OF RECORDING FROM CYLINDERS TO THE DIGITAL AGE

A history of recording for commercial consumption can, more or less, be divided into quarter-century eras of sonic development. The "acoustic age" is roughly from 1900 to 1925. In 1925, electric recordings became available, and the quality of 78s steadily improved until about 1950. In 1948, Columbia Records introduced their long-playing microgroove record. Then came the monophonic era, and after 1958, the stereo era of LPs arrived and lasted into the early 1980s. However, by the mid-'70s, digital recording was well established. After the introduction of the CD in the U.S. in 1983, a popular and practical carrier for digital information was available. Each new innovation quickly replaced the existing format, relegating it to a covering of dust or to the garbage heap. The compact disc holds a strong position as the twenty-first century begins, but other formats can already be seen lurking beneath its shiny surface.

Before the digital era there were three basic methods of capturing sound. First, sound waves could be mechanically incised into the surface of a material which became the carrier of the grooves onto a cylinder or flat disc (direct to disc). A second method magnetically charged a spool of wire or a ribbon of metal or metal-coated tape. The third system optically "photographs" the sound waves onto a light-sensitive film and "read" the playback with photocells.

— CYLINDERS

Thomas Alva Edison invented the cylinder recording/play-back machine in 1877. He called his recording device a "phonograph." There were, of course, others who had theoretically created a recording machine. As early as 1806, the Englishman, Thomas Young, registered the vibrations of a tuning fork onto a rotating drum covered with wax. He was only trying to measure minute units of time and could not make the leap. In 1859, Leon Scott, the French librarian, improved Young's machine that he named the Phonautograph, now called the Vibrograph. The coated surface could record the human voice with the vibrations quite visible. The story goes that Scott visited Abraham Lincoln and recorded his voice on paper covered with lampblack. The recording is now lost. The *New York Times* (27 March 2008) reported on a ten-second phonautograph of a singer captured on soot-blackened paper was played utilizing optical imaging and a "virtual stylus." This paper recording predates Edison by seventeen years. In the 1870s, another Frenchman, Charles Cros invented the Paleophone. Cros filed a document with the French Academy of Sciences indicating how the voice could be engraved and be made to be reproduced. Unfortunately he died from absinthe in 1888 before he could build a working model. Edison sketched out the idea and, with verbal instructions, gave it to his model builder John Kruesi. On 6 December 1877 the working model was completed and Edison recorded the first words to be captured and replayed on a cylinder wrapped with a piece of tin foil, "Mary had a little lamb…" Edison repeated the ditty for the fiftieth anniversary of the invention and that recording has survived. The earlier event was recreated in the film *Edison the Man* (MGM, 1940). The accuracy of the scene is quite good and the working machines show extraordinary research and reproduction on the part of the prop builders.

That first cylinder player, utilizing a tin foil sheet wrapped around a mandrel, embodied many techniques that were the foundation of Edison's future machines and the key points of the ensuing "patent wars." If there ever was a more litigious industry it is unknown. The recorded information was encoded using vertical indentations known as the "hill-and-dale" method. The recording horn (and playback horn) were connected to the stylus and were driven by a threaded rod with a rack-and-screw mechanism, which precisely matched the established "grooves" of the recording. This allowed later cylinders to have as many as 200 grooves-per-inch and, because there was no lateral pressure from the pickup arm, the sound was cleaner, less "hissy" and the recording free from side-wall wear. Indeed, the playing time surpassed that of the flat disc, as did the fidelity of the playback. If Edison, after a few demonstrations and half-hearted marketing attempts, had not moved on to other inventions (the most pressing of which was the electric light) the cylinder player might have survived its rival, the flat disc. In 1881, Chichester Bell and Charles Sumner Tainter perfected the wax cylinder (superior to Edison's tinfoil in wearing ability) and the recording,

still "hill-and-dale," was "engraved" or "cut" in contrast to Edison's method of "indenting" or "embossing." Such details are the basis of patents. Bell and Tainter approached Edison in 1887 with a desire to jointly develop future machines. They were emphatically rebuffed and sold their machine and patents to the American Graphophone Company. Edison, reawakened to the potential of his invention, re-ignited his efforts. A major advance in his "improved phonograph" was a battery-operated motor which established a constant speed.

In 1888, the twelve-year-old pianist, Josef Hofmann, made the first cylinders of "serious music," and on 29 June of that year the first "live" recording was made at the Crystal Palace in London. The occasion was a Handel Festival performance of *Israel in Egypt*. In 1889, Johannes Brahms recorded one of his Hungarian Dances for Edison's German agent. This cylinder was re-discovered in 1935 and has often been transcribed to the most currently available delivery method. The sound is, unfortunately, practically unlistenable. The first commercial recordings made by the Edison Company were released between 1889 and 1892 and joined those of his now-rival companies. A typical recording session of the time is one made by flute and piccolo soloist Frank Geode. He made seventy-five cylinders on 24 May 1889. There were eight titles which were spread over fourteen numbered cylinders.

Because there was no method for "pressing" or duplicating cylinders, each had to be recorded individually, which for a popular title must have been exhausting for both the performer and the technical staff. It was discovered early on that a bank of recording machines could be employed. Though this tied up equipment, it quickly multiplied the number of cylinders recorded. In 1892, a system for duplicating as many as 150 copies from a "master" cylinder is mentioned. The Pathé company, based originally in Paris, recorded on large cylinders in the hill-and-dale method and through a pantographic device mechanically transferred the recording to either smaller cylinders or discs with the dubious advantage of reproducing the "rumble" and other imperfections of the original cylinder into the grooves of the second-generation recordings. While the earliest cylinders consisted mostly of white wax and a small amount of carnauba wax, the surface was too soft and prone to destruction. Edison and his laboratory created "metallic soaps." Salts of a fatty acid were combined with various metals to create a material with a waxy feel but insoluble in water. Certainly these metallic soaps, because of their feel and the established term of "wax" from earlier cylinders, kept the generic name. The metallic soaps quickly dominated the cylinder world before the introduction of celluloid.

Celluloid is probably the first synthetic plastic. Invented in 1869 by John Wesley Hyatt, celluloid was a mixture of camphor and cellulose nitrate. This moldable thermoplastic material was first used for cylinders in 1893 by Henri Liveret.

A system perfected by Frank L. Capps further explains a method for molding cylinders. After the metal matrix or mould is completed, a celluloid cylinder or "blank" is inserted. The two cylinders are then immersed in alcohol or the

commercial "celluloid thinner" amyl acetate. When softened by the solvent, the celluloid expands considerably. When removed from the bath, the solvent can evaporate only from the interior surface. Consequently, the whole interior surface shrinks, drawing back and contracting the whole thickness of the cylinder wall. When thoroughly dried it is separated from the slightly tapered matrix, and on its outer surface contains a faithful copy of the original sound record. A solid core of cardboard or plaster is affixed inside the celluloid tube to give it rigidity and strength, allowing it to be handled without distorting the tube. Eventually the title and the artists' names were molded into one end of the celluloid tube. The finished cylinder was stored in a pasteboard tube, often lined with soft cloth, which was capped with a removable lid. Another popular system was a covered box containing pegs over which the cylinder rested.

It was on 18 December 1900 that the Lambert Company of Chicago patented a method of molding cylinders (from pink celluloid). Mass production could now be achieved. The Lambert Company advertised their "unbreakable" cylinders using an elephant daintily perched on top of the recording. It looked like a circus act but on the cylinder was written "CAN'T BREAK EM." Edison followed in 1901 with his "gold molded" cylinders, but they were of some black wax formula. He could not break the patents on celluloid. Not until the introduction of his "Blue Amberol" cylinders in 1912 could he overcome this obstacle. The Edison lawyers had, however, bankrupted both the Lambert company and their successors by this time. Might made right!

An article in *Literary Digest* (23 March 1901) describes Edison's "New Permanent Phonograph Record."

> Mr. Edison's process is simple but interesting. He takes a copper electroplate of a wax record (cylinder). This copper relief obtained is then electroplated with silver, the surface of which, next (to) the copper, of course has precisely the form of the original wax surface. The copper matrix is then dissolved away with acid.
>
> In the electroplating process the wax record is revolved under a bell-jar, in a Crookes vacuum, through which an electric discharge is passing between electrodes of gold. This causes a discharge of a vapor of infinitesimal particles of gold, which attach themselves to whatever they strike, forming a continuous coating of excessive thinness and following the outline of the surface with absolute fidelity. Upon this coating the copper matrix is plated, to form the inside surface upon which the silver is deposited when the wax is removed.
>
> The gold, like the silver, being unaffected by the acid used, remains as a plating on the silver record when the copper matrix is dissolved away. The amount of gold used is scarcely appreciable, and the silver may, of course, be a thin shell, backed up by other material, so that the records are not as expensive as might be supposed from the materials employed.

In 1908 Edison introduced the wax Amberol series that doubled the 100 windings-per-inch. These new cylinders played longer than four minutes and successfully competed against the timing limitations of the 12-inch disc. In Europe, the flat disc had gained supremacy as the favored form of record. In 1909,

Edison closed his European cylinder operation. Columbia, also in 1909, made a desperate bid for the cylinder market with a four-minute "unbreakable" record based on patents for a metal reinforced cylinder belong to the Indestructible Phonograph Record Co. Edison introduced in 1912 the "Blue Amberol" cylinder made of a hard-wearing, relatively silent-surfaced plastic which was played on an Edison Diamond Reproducer, guaranteeing over 3,000 playings without wear. These blue cylinders had a plaster of Paris lining for support. The clarity and brilliance of the Blue Amberol is still amazing. Columbia abandoned all cylinder sales in July 1912; Edison's cylinder market remained strong in rural areas, built by traveling salesman and Sears & Roebuck catalog sales.

The same year also saw Edison finally bow to pressures from both his board of directors and his sales teams from across the country. He introduced a flat disc recording. Edison Diamond Discs were a quarter-inch thick with surfaces of Condensite laminated to a solid core. Condensite is a resin plastic very much like Bakelite, the first artificial plastic, patented in 1909 by Leo Baekeland. Typical of the quirky inventor, the Edison Diamond Disc Phonograph was different from the competition. As with his cylinder players, the pick-up arm contained a diamond stylus mounted into a floating diaphragm. This arm was driven across the disc by a rack-and-screw mechanism that matched the grooves of the disc, which were recorded in the "hill-and-dale" method. The pick-up arm had a lifting and lowering device (which also locked into the threaded screw) and would trigger a switch to automatically stop the machine at the end of the record. This was all accomplished with a superb wind-up motor. Of course the machine would play only Edison records which, despite the advances, also doomed it on the marketplace.

In the spring of 1915 Edison presented his favorite soprano, Anna Case (1889–1984) who also happened to be under contract to him, in a series of "Tone Tests." (The idea of these "tests" began when the Metropolitan Opera star entered a phonograph store in Des Moines, Iowa, and started to sing along with her own record. The astounded shoppers said they couldn't tell the difference.) Before a live audience, in such auspicious temples of music as Carnegie Hall, Case (or other singers from the Edison company) walked on stage in full evening dress and stood next to a Diamond Disc Machine. The two would begin singing together. At different points the artist would pause and the machine would continue. Occasionally the house lights would be dimmed and the audience would be left to wonder whether they were listening to the machine or to the live singer. It is difficult to imagine how anyone was deceived by these demonstrations, but more than 200,000 people attended some 4,000 "Tone Tests" and the sale of Diamond Discs soared. The lovely Miss Case is remembered for her concert and recital work later in her career. She ended on a high note when she married the wealthy Clarence Mackay in 1931 thus becoming the stepmother to Irving Berlin. In 2004 Nicholas Brooke presented his opera "Tone Test" which recreated the performances of Anna Case. Despite the technical superiority of Edison's recordings, sales continued to lag behind

the lateral-cut discs of the well-established competition.

Edison may have been America's greatest inventor, but as an arbiter of musical taste he left a bit to be desired. Edison personally dictated who and what was to be recorded. Because he always seemed to be a bit behind Columbia and Victor for popular and operatic music, he had one strike against him. He further insisted that all classical vocal selections be backed by special orchestrations for a small chamber orchestra with harp which would never "blast" the recording horn. The same-sounding, homogenized backing robbed the music of any originality. Edison hated singers who had a pronounced vibrato, or "wobble" as he called it, and his preference for popular music was not "hot jazz" but the sentimental heart-songs of his youth. He auditioned new recordings by biting into the wood case of his Diamond Disc Players to sense the vibrations he missed due to his progressive deafness. The deeply incised teeth marks are visible today at the Edison Museum.

In 1927 Edison began to employ the electrical recording process, two years after its introduction in commercial recordings. He even recorded some Blue Amberol cylinders electrically! In addition to electrically recorded Diamond Discs utilizing the vertical cutting methods, by early 1929 Edison was experimenting with laterally cut discs. There was earlier an adaptive device which allowed lateral discs to be played on the Diamond disk machine. Whether or not the 24 October Wall Street Crash played any part in his decision, Edison gave personal instructions on 1 November 1929 that all activity connected to recording was to cease. This included the remnants of cylinder manufacture, the Diamond Discs and the many factories that built record-playing machines, including the elaborate cabinets that housed them. The exceptions were the cylinders used in the office dictation machines, a subsidiary of the Edison Manufacturing empire. These products continued into the 1960s. Selections from the Edison catalog, including the un-issued experimental lateral cut discs, have been reissued on compact disc.

— DISC RECORDS

Credit for the invention and exploitation of the flat disc record goes to Emile Berliner (1851–1929). Born in Hanover, Germany, Berliner immigrated to New York in 1870. In 1887 he applied for a patent (granted in Germany, England, and America) for a means of engraving sound laterally on a lamp-blacked glass disc which was revolved on a turntable and etched by a stylus mounted to a feed screw. Later experiments involved photographing onto metal, and then to the improved method which coated a zinc plate with a film of fat. The cutting stylus cut easily through the fat; the disc was immersed in an acid bath which etched the groove, having no affect on the fat remaining on the disc. This "permanent" record could be played or it could be used to create metal masters for pressing multiple copies of the record into various materials including celluloid, Bakelite or vulcanized rubber (Vulcanite). The first commercial use of these discs was in a 1889 hand-cranked "gramophone," a name chosen by Berliner for the

machine, sold as a children's toy. The five-inch "plates," as the discs were called, were designed for the German market and when the machines were sold in England, new recordings were required. Parkins and Gotto sold the gramophones for two Guineas and the plates for one shilling. In 1892 they issued what must be the first record catalogue, a five- by eight-inch slip of paper with a picture on the front and fifty-four "plates" listed on the back. None of these name the artists. In 1894, Berliner launched the United States Gramophone Company in Washington, DC. The first catalogue lists discs at fifty-cents each or $5.00 per dozen. A good meal could be had in a restaurant for much less than the cost of one plate. The earliest record listed was recorded on 29 October 1895 and featured George J. Gaskin, "The Boy Tenor" (who was closer to thirty), singing "I Don't Want to Play in Your Yard."

In 1897, Berliner employee Fred Gaisberg created the first recording studio in Philadelphia. The same year Berliner opened the first retail record shop, also in Philadelphia, which was managed by Alfred Clark, who would eventually head-up EMI. The first American records made for dancing were recorded by Sousa's Band in 1897. There were two polkas, three waltzes and the obviously popular dances entitled, "Happy Days in Dixie," "Ma Angeline (popular Negro melody)," "Orange Blossoms (Arthur Pryor's New Negro Oddity)," a possible ragtime cakewalk, and "La Cyarine." Many of these early Berliner discs have been reissued on CD. The year 1897 also saw the first use of shellac discs though the heavy tone arm took its toll on the surface.

Eldridge R. Johnson, operator of a small machine shop in Camden, NJ, was employed by Berliner in 1895 to build a player utilizing a clockwork motor, which would, once wound up, alleviate the constant hand cranking required to play the discs. It also established a constant speed of revolution. The $25.00 machine played seven-inch vulcanite records and was a great success. Eldridge Johnson conducted experiments to eliminate the excessive surface sound from zinc-etched discs. He recorded on a wax blank, which through electroplating became a master and produced the duplicate stampers. This "Improved Gram-O-Phone Record" was soon on sale. In addition to vastly improved sound, the records had a glossy black paper label with easy-to-read gold lettering. Before this, all information about the recording was etched onto the disc. All the while, legal restraints crippled production. Johnson was victorious in a court battle on patents in January 1901, and re-named his company "Victor." In addition to having improved sound, Johnson introduced the enlarged ten-inch record and machines to play it. Both the seven-inch and ten-inch records were single-faced (recorded on one side only) and bore paper labels. By 1904 Victor had introduced the twelve-inch disc (with more than four minutes of recording time) and also manufactured a custom-order fourteen-inch disc (1904–1905).

Berliner decided to branch out to Europe. On 9 July 1898 Fred Gaisberg and William Sinkler Darby arrived in England. Machine parts sent from America were to be assembled in London. Master recordings from London or elsewhere in Europe would go to Berliner's pressing plant in Hanover, Germany, and the

plates were then exported to the appropriate locale. The first European catalogue was issued on 16 November 1898. A much enlarged second edition was issued in February of the following year. Also in 1899, the still-used trademark of the "Recording Angel" was registered; in September the painting by Francis Barraud (1856–1924) of Nipper, a bull-terrier mix, was purchased and became "His Master's Voice," perhaps the most recognized trademark in the world. Nipper was probably born in 1884 in Bristol and belonged to a scenery painter, Mark Barraud. When he died in 1887, Nipper went to live with Francis Barraud, a brother and a painter of fine art pictures who lived in Liverpool. Francis owned an Edison cylinder player and often recorded his own voice. Once he noticed Nipper listening to the horn and painted the scene. He tried to sell the work to the Edison Company, but they were not interested. However, those at the Gramophone Company were and agreed on 21 September 1899 to purchase the work if two changes were made: the black enamel horn should become brass and, more importantly, the Edison cylinder player should be repainted to become one of the newer disc machines. Three weeks later Barraud delivered the painting, received £50 for his work and £50 for its copyright. Registered in the United States in 1900, Nipper first appeared on a record supplement sheet and on record labels in 1902. A century later Nipper, the most recognizable symbol in the world, lives but most people are oblivious to the ironic turn of event which really prevent him from hearing His Master's Voice, because a flat disc machine, unlike the cylinder, could not record. In England, Fred Gaisberg quickly incorporated the ten-inch record, and to distinguish his recent Russian recordings, proposed a Red Label. Three years later the red label moved to New York and became the Victor Red Seal series of prestigious classical (mostly operatic) records. Gaisberg figured the Russian aristocracy would willingly pay five times more for prestigious artists and the success proved him right. In America, Red Seal, single-sided discs ranged in price from $1.00 to $7.00 (for the *Lucia* sextet.) The $7.00 disc in today's dollars would cost around $150. Not bad for a four-minute record. The label remains to this day a sign of quality performances.

The beginning of commercial recording really dates from 1902 when Edison's rival, Columbia (which produced recordings on cylinder and disc), pooled its disc recording patents with the Victor company. This assured the quick supremacy of the disc. Columbia ceased cylinder production in 1912 leaving Edison the primary cylinder manufacturer. In Europe, Pathé Frères, the largest producer of cylinders, adopted the disc in 1906 and abandoned the cylinder in 1910.

In 1904, the German Odeon company issued the first double-sided discs, which they patented, much to the chagrin of the competition. Zonophone had pioneered the double-sided disc two years earlier in South America. Soon everyone was issuing double-sided discs, though Victor continued to press its most important Red Seal records on one side only. There was often information pasted on the back. Advances were made in the machinery, too. The first record player (with its downward pointing horn) contained in a cabinet was put on the market.

Called the "Victrola," the 1906 prototype became a standard piece of living room furniture; the name in America was synonymous with "phonograph" or "record player." England adopted Berliner's title, "gramophone," and still uses it.

By 1906, the seven-inch disc record was replaced by the ten-inch and twelve-inch disc. The piano, stand-by instrument for accompanying singers and instrumentalists, was giving way to the orchestra, granted with less than a full complement of players. In 1911, a double-sided disc presented the Court Symphony Orchestra performing Schubert's "Unfinished" Symphony—one abridged movement on each side. In later years, the same symphony would occupy six twelve-inch sides in a less strenuously edited version. In 1909, Beethoven's Fifth and Sixth symphonies had been recorded with a studio orchestra. This was surpassed in the 1914 by the first complete recording of Beethoven's Fifth by a world-class orchestra and conductor: Arthur Nikisch and the Berlin players filled eight, single-sided twelve-inch discs. Orchestras in Europe and American soon began recording symphonic music—albeit, often in truncated and re-orchestrated versions—and captured it in the limited range of the acoustic process.

The talking machine is a wondrous piece of mechanical sophistication which depends on a indispensable but disposable component—the needle. This tiny metal spike, by traversing the groove of the disc, transfers the vibrations to the diaphragm in the tone arm and into the horn. After each use, worn down by the abrasive components in the disc it was discarded and a new needle inserted. The needle has its own interesting history and variation in development.

According to an article dated 9 October 1910 in *The Talking Machine World*, the first manufacturer of needles was W.H. Bagshaw, who established a needle business in 1870. He received a mysterious order for a peculiar kind of needle, the use of which he could not discover. He shipped the order only to discover a year later how it was being used. Bagshaw studied the conditions and perfected his earlier needle. He later expanded and made many styles, shapes and sizes for early talking machines.

As the popularity of the machines grew so did the needle industry. In a pre-World War I article, *The Talking Machine World* featured a page-long article on the process of making needles, suggesting no one could possibly count the billions consumed in America alone.

The process is thus: 3/16 inch carbon steel rods are heated in an annealing oven and slowly cooled to soften them. They are "pickled" in an acid/water solution, then taken to a wire-drawing machine and reduced to No. 8 wire. This hardens the steel and the annealing/softening/pickling steps are repeated five times before the requisite drawing creates a wire 1/16 inch in diameter. The wire is straightened and cut into 18-inch long rods. A special grinding machine points about 150 ends at a time, flips them over and grinds the opposite end. In bundles of about 100, the cutting machine creates 5/8-inch long rough needles. The rods are re-sharpened and cut again until used up. The rough needles are spread onto a heavy iron tray until about an inch deep and heated cherry-red

in a furnace. The hot needles are thrown into a whale oil bath and cooled. After being drained, the gummy needles are agitated in a bath of soap and water then dumped into tumbling barrels filled with sawdust which dries them. After the dust is vacuumed away they are polished. Several thousand are mixed with a pasty compound and placed in heavy canvas bags which are tightly wrapped in rope. The bags are placed in a mangler which massages the tightly packed needles. Once polished, they are again agitated in a cleaning solution, rinsed with clear water and again dried in sawdust-filled rotating barrels. A final polishing, again packed in canvas bags, wrapped with rope, produces thousands of needles which are sent to the stock room for weighing (not counting) and packaging in 100-needle (or more) packets. Not once in the forty-two steps is a needle handled individually.

The growth of the phonograph and manufacture of an ever-increasing number of recordings accelerated the use of disposable needles. Shortly after England entered WWI in 1914, notices began appearing in the "From our London Headquarters" section of *The Talking Machine World* expressing an unforeseen problem: "Steel Scarcity Affects Needles." Retailers in England were advised to exercise the greatest economy. Customers should be allowed only one box of needles at a time. It was suggested each needle should be used a second time. The price was also raised to five shillings per box of 1,000. By 1917 "…a dearth of steel for all purposes other than the manufacture of war articles… is causing serious concern in trade circles. It is plainly necessary to adopt immediate measures for the call-in and utilization of the comparatively larger quantity of steel in the present shape of used needles, which at the present time is treated as so much waste." Unfortunately, there was no machine to re-sharpen the needles and the chance of building one in war-torn England was impossible. There was talk of an attachment which could be fitted to any gramophone, being a carborundum disc which would thus "revolve and sharpen worn-out needles equal to new." The shortage increased and prices for new needles continued to rise. The first re-sharpener arrived and could be mounted next to the turntable which, when revolving, would rotate the sharpening disk. An adjustable needle holder allowed the point to be re-sharpened. Unfortunately, the severe shortage of labor prevented mass manufacturing of the sharpening device.

Meanwhile on the Western Front, the Germans had discovered a different solution. They loaded trench bombs with used needles which when detonated would propel thousands of the sharp points into anything in the vicinity. A camp surgeon noted: "The Boches must have thought it took a lot of needles to play a French record, judging from the number we took out of the poor soldier."

By 1918, steel supplies had been seriously curtailed. Substitution materials were suggested. Bamboo or fiber needles became available. While they could not transmit as loud a tone, they could be had and were easily re-cut to place a new point on the end.

Manufacturers experimented with wood needles and eventually utilized bamboo, not properly speaking a wood but a grass. Its tough cellular

composition and glassy exterior was found ideal. Bamboo poles twenty-feet in length and between 2-1/2 to 3-1/2-inches in diameter were imported from Japan. They were sawn into sections and split in half. A specially devised machine then split off crude blanks for single needles at a rate of 180 per minute. The pithy interior of the bamboo was also eliminated. The blanks then went on a conveyor belt where the sap was forced out and replaced with essential oils and waxes. A drip kettle loaded with 100,000 blanks was lowered into the oil mixture and cooked at 340-degrees Fahrenheit for forty minutes. The hot needles were then drained, transferred to barrels and tumbled in a coarsely sifted hardwood sawdust where they cooled and were polished. Then each bamboo blank was pointed by hand in a machine capable of sharpening 30,000 needles per day. The finished needles were then inspected, counted (by weight) and packaged in envelopes or tins as required.

While the bamboo needle was kinder to the surface of the disk, the volume it produced was not as great as that of a steel needle. Actually, many connoisseurs preferred the bamboo, appreciating both the preservation of their discs and the more mellow, less scratchy sound.

Experiments from readers suggested the ordinary bush thorn gave a good sound, but they were difficult to procure and hard to be kept sharp. One reader suggested the spines from hedgehogs. Again procurement presented a problem. Sapphire points and glass too were tried. The sound was "harsh" and the wear on the record's grooves considerable. In June 1918, the Vallorbes Jewel Co.'s fifty-record needle arrived on the scene. It was expensive but sporadically available.

The steel shortage remained acute for many months after the Armistice. With the relaxation on supplies, manufacturers re-converted machinery and designed newer and better machinery to sate the growing demand for steel needles, the disposable link in the talking machine. But, as reported in *Scientific American* (18 September 1920) the non-steel needle was pursued for other reasons. Clay needles, claimed the creator, gave a very clear tone with little surface noise for at least 200 uses, over 100 times the ordinary steel needle. Made from shale which has practically no grain nor grit, the needle could take a very high polish. Carefully selected "bricks" of shale were placed in an electric dryer and slowly dried. The dried shale was sawn into pieces 3-1/4 inches in length by 1/8-inch square. The shale "pencil" is fed into a needle machine where a grinding device revolving at 10,000 revolutions per minute rounds each rotating strip. As the "pencils" are turned into perfectly round needles a second grinder creates a perfect point. The needle is trimmed to 3/4-inch lengths before entering a kiln where the temperature is increased to 2,000 degrees Fahrenheit. The vitrified shale is now a needle of exceptional hardness.

In 1917 Thomas Alva Edison gave an interview that was reprinted on 22 January 1917 in *The Talking Machine World*. It had been fifty years since he had invented the phonograph.

An interviewer for the *New York Sun* recently had a full page story in the magazine section of that paper on Thos. A. Edison's views of the world at seventy. Although Mr. Edison was not seventy years old until 11 February, the newspaperman beat that date by several days in order to get his feature story.

Mr. Edison offered some excellent reasons for his great vigor at seventy, and declared that he ascribed his good health to the fact that he ate and drank sparingly, limiting himself for weeks at a time to eleven ounces of food daily, including water.

Naturally the interviewer came around to the question of the phonograph, which Mr. Edison liked to work. In response to a direct query as to the sort of phonograph music Mr. Edison has the greatest fondness for, he declared: "Heart songs. Yes, heart songs; they're the real music for me."

"What heart songs?"

"'Suwanee River'—oh, all of'em. But I like all kinds of music. I was figuring to-day that I had heard 17,500 pieces played by the phonograph, and I enjoyed most of them. I like all of Verdi, all of Brahms, all of Beethoven—ah, there was a composer! I like everything but cubist music, which is hideous. I mean, for example, "Debussy." One can acquire a taste for almost anything, but I can't stand the type of music that is like a cubist picture. There is no melodic invention in "Debussy," not a single note that is related to its predecessor. Why, I can turn the phonograph backward and make better music than that. We get curious effects by reversing the phonograph—strange and interesting and sometimes delightful effects. You know, there are not more than 250 melodic combinations in music. All comic songs originate in twelve tunes. There are only forty-five waltz movements."

The interviewer did not know it. In fact, those fun loving eyes of Mr. Edison were dancing so obviously despite the gravity of his face that the visitor faintly suspected he was being spoofed. Let the musical sharps decide.

"I am afraid," Mr. Edison resumed, rather wistfully it appeared, as if he hated to admit that his child had grown up, "that there is not much more to be done with the phonograph. It seems to be about perfected. We have eliminated all the sounds of the machinery, we have reproduced the overtones of music, and when the voice of a machine cannot be distinguished from the voice of the singer who made the record when they stand side by side, there seems to be little more left to work for."

Discussion of the phonograph led to an inquiry as to the fate of a precious collection of records sent to Mr. Edison in 1894 by his European colleague, Col. George Edward Gouraud. It was on 24 May of that year that the inventor unwrapped the waxen cylinders in his laboratory and heard for the first time the speech of Gladstone, Tennyson, Browning, the Prince of Wales, Lord Kelvin and other famous men, some of whom were already dead when their living voices spoke to the man who had made this perpetuation possible. Tennyson, for example, recited his ode to Wellington, and Browning "How They Carried the Good News From Ghent to Aix."

"That's so," Mr. Edison said when the Sun interviewer asked about these records. "What did become of them, Meadowcroft? It seems to me they were broken somehow, weren't they?"

"No, most of them are preserved," the secretary replied. "You have Gladstone and some of the others in a glass case right here in the library."

"I'm very glad," returned Mr. Edison. "Have them plated." He explained that the plating process would insure permanent preservation.

"And if it's not a secret, what are you working at just now?" was the next question.

"No secret at all. I am getting up some machinery for grinding diamonds so there won't be so much waste in the making of the diamond stylus now used on the phonograph. Diamonds, you know, are fairly expensive, but I think I see a way to get better results by better grinding."

Of course Edison's Diamond Disc players utilized a permanent diamond stylus in a floating diaphragm.

The world of acoustic recording is delightfully re-created in the MGM musical *Two Sisters from Boston* (1946). Lauritz Melchior (1890–1973), the great Danish heldentenor, played the part of Robert Ostrum, a famous opera singer. In one scene he is making a record at the Phonographic Company Recording Studio housed in a basement of a run-down neighborhood. The studio is packed with miscellaneous recording horns and equipment. The small orchestra is packed tightly behind Melchior, who is singing before a horn which is attached to a booth housing the noisy recording equipment. Melchior intones a condensed version of Wagner's "Morgenlich leuchtend im rosigen Schein" from *Die Meistersinger von Nurnberg*. As he emotes an assistant pushes and pulls him against the horn to prevent his loudest notes from overloading the grooves. The orchestra rises and moves toward the horn for solo passages and interludes. The violin section contains a Stroh violin. This instrument was invaluable in the acoustic process because it greatly increased and focused the violin sound into the recording horn. The neck resembled a normal violin but extended to hold the chin rest at the far end and tuning pegs at top. The hollow body had disappeared, and at the bridge on the finger board was mounted a flexible metal membrane, out of which a metal horn was attached. This protruded to the player's left. Often a smaller horn was directed toward the performer to help him hear the instrument. Thus a string instrument had many of the characteristics of the powerful brass. This hybrid was invented by John Matthias Augustus Stroh (1828–1914) and was manufactured in London by Stroh and his son Charles between 1901 and 1924. George Evans took over production until 1942. The Stroh violin was joined by horned violas, cellos, and guitars among others. They were also used in some dance bands.

Other studio tricks not shown in the film clip mentioned above included raising different players on platforms to help focus the sound and turning French horn and tuba players so the bells of their horns would face the recording horn. This necessitated using mirrors to see the conductor. If a piano was used it would be an upright with the back removed, positioned on a platform and pointed toward the horn. Many of the deeper strings, cellos and double basses, were simply replaced by louder brass. The tubas playing the basses' music in the 1924 acoustic recording of Mozart's Violin Concerto no. 4, K. 218, hit the ear a bit strangely, but violinist Fritz Kreisler, firmly planted in front of the horn, delivers a marvelous performance and the members of the abridged orchestra crammed behind the soloist respond well for conductor

Landon Ronald. Once the ear adjusts, it sounds quite natural.

An additional treat in the film is the brief scene inside the recording booth where the engineer is brushing away the wax debris left by the stylus when cutting through the warmed wax-coated platter on the turntable. The completed disc is dropped into an acid bath and then played. The sound is suitably dimmed, but not enough to prevent Melchior's once-sleeping dog from leaping onto the table before the recording horn and cocking his ear as the engineer announces, "His Master's Voice." Well, it was Hollywood in 1946.

The acoustic process reached several plateaus of perfection. The first was achieved in vocal recordings. Some voices seemed made for the recording process. They were of a volume and timbre which set the recording stylus vibrating in a perfect manner and did not activate the metal overtones of the recording horn. This latter phenomenon could be countered somewhat by wrapping adhesive tape around the horn.

When Enrico Caruso (1872–1921) recorded his ten discs in 1902, both he and the disc-playing industry were just beginning. He recorded well (one take only) and enjoyed the quick £100. The Gramophone and Typewriter, Ltd. company enjoyed their profit even more. Caruso made over $2,000,000 from recording in his lifetime and his heirs made even more. Those early recordings were crude. Made in a Milan hotel room with a temporarily set up machine, it is amazing they have any merit. However, when Caruso arrived in New York for his Metropolitan Opera debut, his Milan recordings had preceded him, Caruso was signed by the Victor company and he eventually recorded numerous titles; most of these were released in his lifetime, but some trickled out in 1930 and the last shortly after WWII. They have been reissued many times since and still sell well. One can only guess at the huge profits realized by Victor and others. Caruso's single-sided twelve-inch Red Seal Record of the "Lucia Sextet" (less than five minutes long) sold for $7.00, which is more than each disc costs in the complete twelve-CD set! And the sound today is far superior to the original.

As Caruso's recording career progressed, it is possible to hear the continuous improvement in the process. The constant search for better wax for the blanks, a more sensitive diaphragm for the recording needle and less resonant metal horns all contributed, as did improved play-back equipment and the quieter surfaces of the discs themselves. It is said that the record made Caruso's career. But in truth his records brought the industry of age and gave it a respectability it had sorely lacked.

Famous singers soon realized the advantages of recordings in building and holding their public and they now flocked to the studios. Many thousands of discs were "waxed." It would not be until the electrical era, however, that truly successful recordings of complete operas would be made. But there were attempts.

In 1903 the Italian branch of Gramophone and Typewriter released Verdi's *Ernani* on forty single-sided ten-inch discs. It was abridged. *Il Trovatore* followed in 1906 with a hodge-podge of singers recording the five principals. The

truncated opera was on eighteen sides. Leoncavallo conducted a nearly complete version of his opera *I Pagliacci*. The German Gramophone Company delivered a *Die Fledermaus* in 1907 and German versions of *Faust* and *Carmen* in 1908.

The French Pathé Frères were equally ambitious with their double-sided fourteen-inch discs recorded in the "hill-and-dale" process. They released nine complete operas, and built special, side-by-side, two-turntable players so the works could be heard without stopping to change the record. Some other "complete opera" sets were issued in Europe—nothing from the United States—but it was not until the late 1920s that the floodgates were opened.

Symphonic music also suffered in the acoustic years. There were occasional abbreviated versions of single movements or overtures and re-orchestrated displays for bands or soloists of all ilks until a trickle started with the 1909 four double-sided discs of Tchaikovsky's *The Nutcracker Suite*. These were placed in a hard-covered "album." It was another first. Record buyers responded well and other abbreviated pieces appeared. The 1914 recording of Beethoven's Fifth Symphony conducted by Arthur Nikisch (four double-sided records in Germany and eight single-sided in England issued piecemeal) cinched the trend. By the end of WWI in late 1918 the world was ready for Tchaikovsky's Symphony no. 6, Beethoven's Violin Concerto, Dvořák's *New World Symphony* and even a contemporary suite of Igor Stravinsky's *Petrouchka*. A level of "recorded perfection" had been reached by the middle of the 1920s with a range of 164-2,088 cycles. What more was needed? The fantastic growth of the fledgling medium of radio and the success of the public address system were about to answer that loudly.

There were two phenomena which paved the way for electric recording: the development and rapid popularity of radio, and the arrival of the public address system. Both were possible because Lee DeForest had perfected the audion tube, which could amplify sound waves and thus drive the ever-improving speaker.

Lee DeForest (1873–1961) was trying to create a detector for electromagnetic radiation. After studying John Flemming's "electronic valve" (diode) he added a third electrode (a grid) between the cathode (filament) and plate (anode). A small signal (voltage) at the grid would result in large change in the plate voltage. The first amplification device was born. He called this triode invention the "audion" and received a patent in 1907.

Other than the compressed air driven Auxetophone (discussed elsewhere), the other significant amplifying device was the electrical loudspeaker. The first was developed in 1906 by Miller Reece Hutchinson and Kelly Turner. Their Dictograph loudspeaker was installed as part of an office communications system.

In 1912, Bell Telephone Co., in conjunction with Western Electric, installed loudspeakers in Chicago at the Olympic Theatre. These projected backstage sound effects for a production and not the voices of actors, who already knew how to project. A year later the public address system became a reality when the governor of Oklahoma spoke to an group assembled in a hotel room twenty-two miles away over an open wire circuit. The open-air system was installed in 1916 for the National Education Association convention at Madison Square Garden.

The 15 July 1918 edition of *The Talking Machine World* noted:

> The almost general use of the gramophone in theatrical plays is not so widely known as one would think. "Not counting the many performances where it plays a part in view of the audience," says Leyden College in *The Voice*, "I could mention fourteen productions in the West End of London, where band 'off stage'—orchestras in the ballroom—caroling of birds—shouts of crowds, etc., are all the work of specially made records. The effects are better obtained, and, of course, there is the economical side in these times. The gramophone is a permanent property at most theatres." It would indeed be a long story to cover the many diversified characters played by this most wonderful of all musical instruments!

Beginning in 1920, the first experiments with electrical recording showed promise. The introduction of the amplified public address system and broadcasting of radio made electrical recording possible, even necessary.

Two engineers, George William Guest and Horace Owen Merriman, made one of the earliest electric recordings. They needed to record the burial service of the Unknown Warrior at Westminster Abbey on 11 November 1920. It was impossible to set up the unsightly (and noisy) recording apparatus. Instead, they placed a single microphone at the site and through telephone lines ran the sound to the recording equipment housed in a truck parked near the Abbey. The signal was fed to the cutting stylus by an electromagnet. Not only was this perhaps the first electrical recording, it may also have been the first electrical location recording. The results are badly distorted but the speakers, massed choirs and brass bands can be heard.

In America, scientists at AT & T's Bell Telephone Laboratories had since 1915 been trying to develop electrical recording, and by 1924 they felt it was perfected. They approached Victor, but because of the royalties involved, failed to sell them the revolutionary system.

However, in Chicago, Marsh Recording Laboratories had just issued the first electrical recordings on their Autograph Label. Each sold for $1.50. Unfortunately, despite vibrant performances by Jelly Roll Morton, King Oliver and others, their limited distribution prevented them from making much impact.

The Bell Laboratories had their test pressings made at the Pathé factory in Brooklyn. The manager was Frank Capps, longtime friend and former colleague of Louis Sterling, the American manager of Columbia in England. Capps secretly pressed some additional copies and sent them to Sterling. They arrived on 24 December 1924. When he listened to them the next day Sterling realized he had received a two-edged Christmas present. The sound was far superior to anything he had heard but his company had just invested heavily in a large number of recordings of full symphonies which would soon be obsolete. Sterling took a ship to New York the next day. When he met with the Western Electric people (who managed the commercial side of the Bell Laboratories' work) he was informed that the electrical recording process would only be licensed to an American company. Undaunted, Sterling received a loan from J.P. Morgan and bought controlling interest in American Columbia, and organized it as

a branch of his English firm. Agreements were soon signed with Western Electric, and Columbia had beaten Victor by a few weeks. However, the two companies agreed to keep quiet about the new technology until both could sell their present stock of soon-to-be-outmoded records and record a proper number of new ones.

In mid-March 1925, Victor sent a ten-inch electrical record to their dealers in the Philadelphia area of selection from the local Mask and Wig Club show. Columbia's first electrical recording was a twelve-inch, double-sided disc of "John Peel" sung by fifteen glee clubs backed with "Adeste Fideles," supposedly performed by 4,850 voices. Neither was touted as a new process, but the public soon heard the obvious difference. England's first electrical release was Jack Hylton and His Orchestra's "Feelin' Kind o' Blue."

The first official Victor electrical record was made on 21 March 1925 by Alfred Cortôt playing Chopin's "Impromptu no. 2" and an arrangement of Schubert's "Litaney." In July, Victor released the first orchestral recording, Saint-Saëns' "Danse Macabre" performed by the Philadelphia Orchestra, conducted by Leopold Stokowski. The first full symphony, Tchaikovsky's no. 4, was released in December 1925. The Royal Albert Hall Orchestra was conducted by Landon Ronald.

Compton Mackenzie, editor of *The Gramophone* magazine, voiced the opinion of many: "The exaggeration of sibilants by the new method is abominable, and there is often a harshness which recalls some of the worst excesses of the past. The recording of massed strings is atrocious… I don't want to hear symphonies with an American accent. I don't want blue-nose violins and Yankee clarinets." Certainly the new records did not sound like recordings should sound! Mackenzie's cries of horror were often echoed when the digital CD arrived. Change is a bitch.

Part of the listeners' discomfort was also due to outmoded equipment, but the industry soon caught up with all-electric players, better and lighter-weight tone arms and more reliable speakers. The record industry was reborn and booming, but this happy time was soon to be ended by the Great Depression.

Some of the first RCA Victor electrical recordings were conducted by Leopold Stokowski at the helm of the Philadelphia Orchestra. The make-up of the orchestra was still saddled with traits of the acoustic era. Horns replaced (or doubled the lower strings) and the seating favored the lighter instruments in front. The Stroh violins had been replaced by their legitimate cousins and the sound is still not that of a concert hall, but Dvořák's *New World Symphony* is, at last, complete. Others soon followed, with the orchestra resuming a more normal complement. In May 1926, the live performance of Boito's opera *Mefistofele* was recorded from the stage of Covent Garden. The star was the great Russian bass Fydor Chaliapin. The next month, excerpts of the June farewell appearance of Dame Nellie Melba were recorded, including her touching farewell speech. Both of these evenings are still available.

The year 1927 was the centennial of Beethoven's death and Columbia, both in England and in America, planned the most ambitious recording cycle to date. All the symphonies (with different orchestras and conductors) would be issued in late March. These were joined by twelve of the sixteen string quartets played by the Lener Quartet, three piano sonatas (the "Pathetique," op. 13, and "Appassionata," op. 57, played by William Murdoch and the "Moonlight" with Ignacy Friedman). Finally, the "Archduke" Trio, op. 97, with Sammons, Squire and Murdoch and Sammons and Murdoch in the "Kreutzer" Violin Sonata, op. 47, were issued. The phonograph had come of age.

An interesting alternative to the widely accepted Western Electric system was one developed by General Electric using a beam of light to modulate the electrical signal to the cutting head. Brunswick records used this. But in 1926 they switched to the more established Western Electric. In Europe, Odeon and Parlophone began electric recordings in 1927.

The following year honored the centennial of Franz Schubert, and a unique competition offered £200,000 for a suitable ending for the "unfinished symphony" or for an original work which could serve as "an apotheosis of the lyrical genius of Schubert." The Swedish composer Kurt Atterberg won the top prize with his Sixth Symphony, which was quickly recorded by Sir Thomas Beecham and released to a less-than-enthusiastic public. The recording does have the unique place in history of being the first symphony recorded before its première.

The first year of the 1930s saw the introduction of the "run-in" groove at the start of a record. Before this now-standard device was engraved into the master disc, the needle of the tone arm relied on inward pull to guide it into the first groove on the disk. The centrifugal force of the surface would sometimes guide the needle in the opposite direction.

The Great Depression (discussed in more detail in Part Three, Popular Music, page 223) brought about some significant changes in the business of classical recording. To stave off bankruptcy, the HMV, Columbia and Parlophone companies merged to form EMI the Electrical & Musical Industries, Ltd. When their American affiliates discontinued almost all classical recording, EMI became the provider of imported sets to satisfy the few but very determined American buyers. If there proved to be sufficient demand, metal plates were shipped to the United States and pressed in regional plants.

One of the schemes to generate "guaranteed" sales was the brainchild of producer Walter Legge. He convinced HMV that a focused subscription society could be created which would pledge a given amount for their desired releases. The first was the Hugo Wolf society, confined to 500 patrons who would receive the limited edition of a six-disc volume of songs for their pledge of 30 S. or £1.50. The editor of *Gramophone* magazine hectored his readership, wondering why 500 out of a population of fifty million could not subscribe. He even suggested they smoke two less cigarettes a day and save their throats in the process. By the end of the year the goal was near, and the 111 charter members from

Japan made the difference. The discs of Elena Gerhardt's performances of Hugo Wolf's songs were the first of seven sets of records devoted to this repertoire released between 1931 and 1939.

The success of this venture, or at least its ability to pay for itself, started what would become the most important expansion of repertoire in the years before WWII. There were subscription societies that generated sets of Bach, including *The Art of Fugue*; the cello suites with Pablo Casals; the Goldberg Variations with Wanda Landowski; and organ music played by Albert Schweitzer. And then there was the crown jewel, the fifteen sets of Beethoven's complete piano sonatas and miscellaneous pieces played by Arthur Schnabel. All these sets have survived into the CD era with vastly improved sound.

France, Germany, and Italy also added memorable sets to the catalogs of the day. But there was still the reality of the Depression. In America, six million records were sold in 1932. To put this in context, over 140,000,000 had been sold five years earlier. The problem was certainly exacerbated by the rise of radio, which, once the rather small outlay had been made for the set, provided free entertainment—and the variety seemed almost endless.

One thing which helped the depressed record business was the juke-box. The first "coin-in-the-slot" music machine was in a saloon in San Francisco and was inaugurated 23 February 1889. For a nickel, customers could choose a cylinder and listen to it over ear tubes. The novelty earned money. One of the most successful juke box builders was the Rudolph Wurlitzer Company of North Tonawanda, NY. By 1939 there were over 300,000 juke boxes wearing out as many as thirty million discs a year. This helped sagging sales. These sales, in addition to the 35¢ price on most popular records, led the industry up the hard road to recovery. Even classical music was being recorded again. The sound was improving and the surfaces of the discs were quieter. In 1940 Columbia dropped the price of a twelve-inch classical record from $2.00 to $1.00. RCA Victor shortly followed suit, and the sales grew faster than supply could keep up.

Things were really beginning to boom when the Japanese attacked at Pearl Harbor and WWII became global. Almost immediately the supply of imported shellac evaporated, and a different crisis was upon the record industry.

As an aside, it was the 1946 Whurlitzer Model 1015, designed in post war effusiveness, by Paul Fuller which most visualize when juke boxes are discussed. The undulating surfaces contained plastic tubes filled with a fluid with a low boiling point that percolated along thanks to small heaters. The company sold 56,246 of these monstrous marvels before the 45-rpm disk replaced the 78-rpm. The later models shrank to match the smaller disk.

— EARLY LONG-PLAYING RECORDS

Dr. Peter Goldmark's presentation of the LP record in 1948 is considered the introduction of the long-playing, micro-groove disc. 'Tain't so. Edison released extracts from *Carmen* and *Aida* on twelve-inch, 78-rpm discs with

an extra-tight wind on the grooves. They played about twelve minutes per side. Edison also did some early testing of long-playing recordings in 1926, creating a twelve-inch record that played for forty minutes. His "hill-and-dale" recording method allowed the grooves to be very close together, but the surface sound was so loud and the volume so low that the music could not effectively be heard. Of course, the acoustic recording process that he still used did not help him. Also, in 1926 the Vitaphone Corporation (a marriage of Warner Bros. Pictures and Bell Laboratories) presented "talking pictures" by recording the sound track onto sixteen-inch discs (pressed in Victor's Camden plant). This "marriage" began in 1925 when Walter J. Rich joined Warner Bros. to create the Vitaphone Co. In October they began making experimental sound pictures at the Warner Vitagraph Studio in Brooklyn, N.Y. These center-start discs were played on turntables with electrically driven motors synchronized to the film projector. While successful experiments of recording the sound directly onto the film had been made, the existence of tried-and-true technology ruled the day. The 16-inch disc revolved at 33-1/3 rpm that lasted the ten minutes of one reel of film. They were not microgroove pressings. Warner considered the innovation a substitute for pit orchestras in their theatres, thus giving every theatre a luxury afforded only in the big cities. "Who the hell wants to hear actors talk? The music—that's the big thing about this," stated Harry Warner. *Don Juan*, starring a mute John Barrymore, opened on 6 August 1926 and the experiment was successful. Viewed today, the film is still good entertainment. True to his sentiments, Harry Warner put additional musically-oriented, Vitaphone pictures into production. The Warner Bros. moved their sound film production to Hollywood and into the first studio built for sound. *The Jazz Singer* of 6 October 1927 starred the vaudeville performer Al Jolson. The sound was recorded live with the filming. Midway into one song, he stopped singing, turned to the actor playing his mother and ad-libbed, "Did you like that, Mama? I'm glad." The effect was electrifying in 1927, as it still is today. The fate of purely musical films was sealed. The next two years saw Hollywood convert to sound.On New Year's Day 1927 Western Electric created Electrical Research Products, Inc. to license motion picture technology. The Fox film corporation acquired a Western Electric license in December 1926 to use the AT&T electrical sound system in its chain of theatres. Fox augmented their silent features with Fox Movietone newsreels that incorporated a sound-on-film method. On 20 April 1927 they showed their first effort, the marching parade of West Point cadets. Fox achieved something of a coup by capturing both the take-off from Long Island and the landing in Paris of Charles Lindberg and his plane, the Spirit of St. Louis. By 1933, silent films had disappeared. Only Charlie Chaplin continued to make them, with an extensive musical background. The far superior sound-on-film methods of Western Electric quickly became the method of choice. Even the Warner Bros. Studio quietly retired the pioneering sound-on-disc system in 1930.

When the Radio Corporation of American (RCA) bought the Victor Phonograph Company in 1919 it could not have foreseen the long-playing 16-inch disc-for-film system, but when the 1920s ended with the Wall Street crash, the company realized something new was needed to increase record sales. Putting twice the music on a disc seemed a good idea. In 1931 sagging sales brought about a slimmed down catalog: "Though not the largest in the history of Victor records, the present catalog is by far the most interesting...." Then the 1931 catalog presented the long-playing record: "A policy of recording all major works on both standard and 33-1/3 rpm records has been adopted. The playing time has been fixed at such a length that no sacrifice of musical quality... inevitable if the grooves are carried too near the center of the record...need be made." Of course, the lower volume of the long-play record, necessitated by the lateral cutting of the groove, could be amplified "without distortion far beyond any reasonable need" on the modern electrical RCA Victor phonograph. And the new two-speed turntable allowed you to play both 78s and the 33-1/3. There was even a proven savings! For example, the stupendous work of Schönberg..."gurre-lieder" (sic)... by the Philadelphia Orchestra, lists at $28.00 for the standard set of fourteen records, and at $21.00 for the identical music on seven long-playing records." This *Guerrlieder* and Beethoven's Fifth Symphony (also conducted by Stokowski) were the only classical works especially recorded for the LP format. The rest were dubbings. Unfortunately for RCA Victor, 1931 also saw hundreds of banks close, thousands of factories shut down and millions of workers unemployed. The cost of buying standard 78s was too much a luxury for many, and this additional outlay for a new turntable and electrical phonograph doomed the introduction of the long-playing record. There was one other small consideration. The narrower grooves pressed into the shellac-based discs were quite noisy and the fragile walls often broke down under the heavy weight of the stylus in the tone arm. The 1932 supplement of the RCA Victor catalogue still listed the discs but there was no "new, exciting recording in both formats." The long-playing record was withdrawn in 1935.

— PRESSING 78S

In the days before vinyl was used for "unbreakable" records, the 78 disc was called a "shellac" record. While shellac was one of the ingredients and helped bind the others, the discs were made up of various combinations of clay and grit, designed to help the heavy tone arm wear down the steel needle to custom fit the groove. Added to this mixture were fibers of lint and hair, to help hold the brittle clays and build up the disc. Coloring agents, lubricants and other "secret" ingredients were added. This heated mixture was shaped into a "biscuit" which was placed in the press with a metal plate on each side. In addition to pressure, steam heated the plates to help spread the biscuit. Once subjected to this combination and properly imprinted with the incised grooves, the steam was replaced by cold water. When the record was cooled enough to handle, the press was opened. The "biscuit" overflow was trimmed away and

labels were added. Some presses accepted the paper labels and bonded them to the biscuit mixture. Earlier presses had the label information etched onto the plates, which allowed the information to be read when the disc was held correctly in the light.

— ACETATE DISCS

In 1934, according to several sources, the English inventor Cecil Watts devised a new form of master record utilizing a layer of cellulose nitrate lacquer bonded to a glass or aluminum platter. This disc was quickly called an "acetate" and had two major advantages: it greatly reduced the surface noise inherent in wax recording and could be played immediately after recording with almost no loss of quality. The superior surface allowed slower recording speeds (33-1/3 rpm) and therefore larger amounts of information could be captured. This was a boon to radio stations and later the military for holding short-wave broadcasts and codes for future use. During WWII glass was used for the acetate base because aluminum was needed for the war effort. A "home version" of the "acetate" disc machine was later marketed to those who wanted to make their own recordings.

One sidelight of 1935 was the speech-only discs for the Talking Books for the Blind which revolved at 24 rpm.

During WWII, transcription discs made of a vinyl plastic were developed, which could accommodate both a narrower groove and a slower speed. These stored war information for the military or entire radio shows for the commercial stations. It allowed the former to keep and translate coded messages more efficiently. The latter could re-broadcast; for example, a nine o'clock show could air every hour for each time zone without paying the cast and crew for hourly live performances, as was the prevailing practice of the time. Bing Crosby was the first important radio star to take advantage of this time and energy saver. His insistence on using the new discs revolutionized radio broadcasting. In 1947, it was again Crosby who not only used the new tape technology to record his show but also quickly saw the editing advantages, which allowed re-takes as required and recording out of order to efficiently use the personnel. Crosby also invested some of his considerable fortune in the later development of video tape.

After the 7 December 1941 attack on Pearl Harbor, the Japanese Imperial Army marched through Asia with a relentless pace. They landed in the Philippines on 10 December 1941 and took Guam in the Marianas the following day. Wake Island fell on 23 December and Hong Kong on Christmas Day. The new year opened no brighter when on 2 January 1942 Manila was lost to the Japanese and Singapore fell on 15 February. Mandalay was taken on 2 May and on 6 May Corregidor surrendered. The ports which conveyed the vital supplies from Burma and neighboring countries were lost for several years. The tide of events soon turned on Japan, but it would not be until after their surrender in 1945 that raw materials, especially shellac, would be easily avail-

able. Fortunately, old records could be recycled and new products were often substituted. However, many a collectors' little-listened-to treasures vanished. Untold priceless items from the acoustic era—mementos of high art past—became the bearers of low art in the millions of dance records and popular ballads which kept up the home front spirit. By 1942 there were over 400,000 juke boxes and more and more radio stations were relying on the popular hits to fill their air time. This could have completely outstripped the supply but James Cesar Petrillo president of the American Federation of Musicians (AFM), on 31 July 1942 placed a ban on his members and recording stopped. The only recordings made were the "V-Discs" for distribution to the members of the Armed Services. Of the big three record companies, RCA Victor, Columbia and Decca, Decca was the first to cave in to the AFM demands and in September 1943, when their backlog of recordings completely evaporated, they signed, giving a quarter of a cent to five cents on every record sold. This "royalty" went to the AFM for their fund for unemployed musicians. Decca began recording immediately, including the hit Broadway show *Oklahoma!* which sold 1,300,000 copies at $5.00 per album. Decca also had the early lead on original cast recordings. And they cornered the market on shellac, too.

In the summer of 1944, after two years of protesting, RCA Victor and Columbia signed on the line. Within hours they were recording. And slowly the trickle of both popular and classical recordings began to appear. Production rather quickly came to life, partly because the war workers were desperate to find goods on which to spend their high earnings.

The end of the war brought unforeseen technical advances to the record industry, including better microphones, better machinery and even better supplies of shellac and a host of new plastics for disc production. It brought the tape recorder into the studio, and soon the smaller portable versions brought hundreds of "studios" to the recording venues, both in America and in war-torn Europe. The last thing which saddled the industry was the four-minute, 78-rpm disc. That too was about to change.

In 1939, Neville Chamberlain recorded his message which told the people of Britain that they were at war with Germany. The technicians used an acetate radio transcription disc, which revolved at 33-1/3 rpm. At the end of the war, the Imperial Emperor of Japan told his people of their defeat and surrender on a 78-rpm shellac record broadcast from different stations. Some of these records were seized by military fanatics and destroyed. It is an enlightening view of which country had the better technology, or at least a supply of shellac.

— VINYLITE

In October 1946, RCA Victor released Richard Strauss' "Till Eulenspiegel" on 78-rpm, clear, red vinylite "unbreakable" records. These discs sold for $1.00 more and were offered on various releases. Vinylite eventually replaced shellac discs for many classical selections and became the material for the long-play

record introduced in 1948. It had been introduced during WWII when used for "V-Disc" production to create a lighter and less fragile disc to ship overseas to the military.

— LONG-PLAY

Conditions were certainly more favorable in 1948 for the long-play record. The economy was good and Columbia records had collaborated with the Philco Company to create an inexpensive plug-in player which had a plastic casing containing a turntable revolving at 33-1/3 and a tone arm fitted with a light-weight cartridge. It sold for $29.95, but that price soon dropped. Columbia had also built up a library of recordings made for the extended length of the LP—almost twenty-five minutes on each twelve-inch side! And they wisely offered the technology of the new vinyl microgroove disc to any company that wished to use it. The press conference on 21 June 1948 introducing the LP was a success. Those attending received, in addition to the cocktails, the now famous picture of Dr. Peter Goldmark holding a stack of LPs while beside him stood an eight-foot tower of the same music on 78-rpm albums. The LP launch was a success with everyone, except Columbia's biggest rival, RCA Victor. Whether still stinging from their 1931 debacle with their long playing record or miffed by the one-upsmanship, RCA was silent. In 1949, RCA introduced their own innovation, the seven-inch 45-rpm record with a large spindle hole which could be played only on their machine, which sold for a mere $12.95. The "Battle of the Speeds" had begun. The public was shocked into a standstill and decided not to buy anything to replace their (often extensive) collections of 78s. Slowly, the superior attributes of the LP became more obvious, and many companies began to issue a wide assortment of new recordings. However, the larger companies were forced to issue the same new record in as many as four speeds: 78, 45, 33-1/3, (and occasionally 16-2/3) revolutions per minute! This was expensive duplication. Sanity prevailed and the consumer selected the LP for long selections, initially classical works and collections. The LP even borrowed the name "album" from the set of 78s housed in paper sleeves and hard cardboard covers. The 45 replaced the 78 as the carrier of popular music singles and the sonically inferior 16-2/3 recordings were relegated to talking books for the blind and other speaker-oriented material. It was said that RCA phased out the executives who promoted the 45 concept as they phased in the company's use of the 33-1/3 long playing record, which allowed them to promote their extensive Red Seal Catalogue. The 78 record had all but vanished by the early 1960s. The Valentino sound effects records sold for theatre use was one of the last holdouts. Unfortunately, the record industry failed to learn any lessons from the "battle of the speeds" and continued to present the record-buying public with confusion, which shut off buying until multiple choices were expunged. Two important examples are the introduction of stereo discs in 1958 and the quadraphonic fiasco of the 1970s.

Stereo recordings also have a history almost as old as recording itself.

Edison experimented with records containing concentric tracks, each with a separate signal. There were also experiments with dual machines. One required a special pick-up arm and the other doubled the trouble with two arms. Neither became commercially viable. Pathé in France, shortly before WWI, manufactured some center-start discs with two grooves side-by-side. Their "hill-and-dale" system allowed stability of grooves and the twin pick-up arms fed separate signals to two horns. Certainly the exigency of the times forced Pathé to concentrate on efforts for the war. A similar approach was utilized by Cook Laboratories early in the LP era with a special two-track stereo recording requiring a specially designed pick-up cartridge. It did not survive. In 1931, Alan B. Blumlein, who worked for the Gramophone Co. in London, applied for a British patent "to provide a sound recording and/or transmission system whereby there is conveyed to the listener a realistic impression that the intelligence is being communicated to him over two acoustic paths in the same manner as he experiences in listening to everyday acoustic intercourse and this object embraces also the idea of conveying to the listener a true directional impression." Blumlein covered two methods of capturing the sound in one groove of a disc. First was the "VL" method which combined Edison's "hill-and-dale" or vertical methods, and Berliner's side-to-side or lateral cutting methods. Each method carried one signal. His second method was a similar system but one which tilted the sides of the groove to a 45° angle to the surface of the disc. This 45/45 system was adopted worldwide by the industry in 1958. There was an American patent granted to Westrex/Bell Telephone Laboratories in 1937 which also utilized the 45/45 method. In 1933 Blumlein conducted experiments with the 45/45 system on 78-rpm discs at the new EMI labs. EMI was created from the consolidation of various English companies of the hard-hit record industry. The Great Depression prevented any commercial exploitation of the stereo disc and the Second World War further delayed the launch. A fortunate situation, as seen in hindsight, because the war produced many advances in listening/recording equipment including the submarine detecting devices developed by Decca which led to *ffrr* (full frequency range recordings). The war also perfected polyvinyl plastics and the important innovations of the tape machine which revolutionized recording. The fact that Europe was in shambles and every orchestra was desperate for any extra income was also a factor which contributed to the post-war recording boom.

After the Recording Industry Association of American (RIAA) recommended the Westrex 45/45 system on 25 March 1958, a trickle of stereo records, the first from Audio-Fidelity, hit the marketplace. The discs required a new, lighter weight pick-up arm with a stereo stylus. LPs were issued in both monophonic and stereophonic editions. This duplication lasted into the mid-'60s when manufacturers had produced a relatively cheap pick-up arm with a stylus small enough to play both stereo recordings and the older monophonic ones. For collectors, a glorious few weeks in 1967 saw American retailers dump their duplicate monophonic discs in what the industry called

"monocide." By the end of the decade, the only monophonic recordings issued were older recordings of historical interest. Many of these were sonically destroyed by "fake stereo," which electronically toyed with the sound, moving it about in the two channels, often accompanying it with an excess of echo or reverb. It fooled no one.

As the monophonic disc became history, four-channel recordings were presented, using the dubious logic that if two channels were good, four would double the sales. In 1968, Acoustic Research of Boston demonstrated the possibilities. In 1971, CBS demonstrated their SQ discs, quickly adopted by EMI. However, other companies adopted the Sansui QS System, a rival incompatible with the Sony SQ method. The public refused to be drawn into the corporate battle and both systems died. At least it appears the industry manufacturers finally learned, from both the battle of the speeds and the quad fiasco, to "get their defecation in one location" before launching a new product. Perhaps the Beta/VHS war helped solidify the reality, because the uniform launch of the Compact Disc was one of the most successful transitions in the history of the industry. It is interesting to note that many of the ill-fated Quad recordings are now re-mastered and returned to the market place on the latest multi-channel CD formats.

— CLEANING RECORDS

"Cleanliness is next to godliness" goes the old and truthful saying. *The Talking Machine World* carried an advertisement in the 15 February 1920 edition for GROOVITE—"It cleans as it plays." For a mere fifty cents, one acquired the only satisfactory preparation for cleaning records. "Merely pour a small amount of the liquid on the record. It will run around the spiral groove the same as water runs down a gutter. And the needle will carry Groovite over the engravings and remove the last particle of dust and grit. It cleans as it plays." There is no mention as to where the dust and grit ends up. No doubt as a residue in the grooves, but the advertisement demonstrates both the consumer's concern for junk on the record surface and the need of agents to sell a miracle product to relieve the concern. However, the need to remove unwanted residue is still a problem. This is especially true for tape machines and records. While the most common cleaning solution in the studio for cleaning tape machines is isopropyl alcohol, it must never be used on shellac-based 78s. Alcohol is the solvent for shellac, and dissolving away the source material is not desired. Water is anathema to any grooved recording because it will turn the dust and debris into mud which, when pushed about by the stylus, will become an abrasive compound and do irreparable damage to the record. (A slight retraction follows a few lines down.) The mud will also dry and harden in the groove, further complicating the cleaning process, not to mention the effect on the sound. To remove dirt and dust from 78s, a cloth of velvet or velour (or even corduroy) can be folded into a pad and the surface of the disc rubbed in a counter-clockwise motion, concentrically with the grooves, which will allow the fine nap of the cloth to

sweep away the dirt and dust. By rotating the pad or refolding it to a clean surface, most of the debris can be removed. To clean the pad, simply shake out the collected matter. Do this anywhere but near the recording, because the static electricity built up will pull the dust back into the grooves. Obviously only well-grounded people should clean records. If the record is caked with dried matter, a warm wet cloth can be laid upon the spot to soften the hard deposit. Detergents and grease cutting solutions should be used with discretion. Many 78s were made with miscellaneous bulk fillers including clay, hair from various animals and cotton fibers. Even though the "biscuit" of this compound was pressed with intense heat, it is not stable and could be adversely affected by liquids or chemicals. Always make certain the disc is thoroughly dry before playing it. In truth, if an LP is really "trashed," putting water into the groove prior to playing cannot hurt anything and may even improve the sound. May. Spraying the disc's surface with lubricants, especially silicon or similar products, has been advocated. If they are applied judiciously and worked into the grooves with a velour pad, they seem to reduce surface sound. Make certain the product contains no solvents, especially alcohol, which can soften the disc's surface. The solvents might also soften the glue or mastic holding the diamond tip of the stylus and that could cause a problem. It is safer for the recording if unwanted sound is reduced through electronic means in the re-mastering onto tape or CD. The non-musical noises from 78s are characteristic of the genre and to totally remove them could prove a Pyrrhic victory. Compressed air, either from a compressor with a nozzle or in an aerosol can, can also remove dirt and dust from the grooves. Make certain the disc is well supported (on the turntable or other flat surface), because the air pressure could crack the disc. Some sort of exhausting system is also beneficial to remove the dust. If a 78 should break, try taping it together on the back side. Masking tape is ideal. A bit of rubbing over the crack on the front with a grease pencil and a thorough "cleaning out" of excess wax with a brush or velour pad may save the day. 78 records get only more brittle with age.

Long-playing records made of vinyl entered the public recording world in 1948. It is unusual today to find really clean vinyl. There are commercial products that promise results. Fortunately, an excellent solution can be made for cleaning the discs. As with 78 discs, water and dirt make abrasive mud. The napped cloth of velvet, velour or even corduroy, will remove much of the dirt and dust; this should be done before applying the following solution: Take a sixteen-ounce bottle of 190-proof, denatured alcohol (available at the drug store) and add to it two mothballs. These should have naphthalene as the active ingredient. Once the mothballs have dissolved and gone into solution (a day or so if sitting or faster if shaken), mix a half-and-half solution with the infused alcohol and distilled water. This agent will thoroughly clean vinyl LPs and protect the vinyl, too. Put the recording on a turntable (one you don't mind getting wet) or a flat surface covered with a lint-free cloth (a good linen dish towel will do nicely). Pour some of the diluted naphthalated alcohol onto the

record and work it into the grooves. A natural bristle brush works well, though a soft mushroom-cleaning brush found in most kitchen stores has the advantage of a block of bristles in a convenient handle. Work the solution in a concentric motion following the grooves. If the surface becomes dry, add more liquid. When the record is clean, pat the surface dry and then wipe with a clean, dust-free cotton velour or corduroy cloth, digging into the grooves with the nap, until all the solution has been absorbed and the disc is dry. This wiping and drying must be done quickly, because the rapid evaporation (courtesy of the alcohol) can leave mud in the grooves which, when dry, can become a hardened deposit, which obscures the sound and wears the stylus. Light cleaning of LPs can be done with a damp cloth. It is possible to soak LPs in warm, slightly soapy water (dishwashing liquid) to loosen caked-on deposits, but this could cause the ink on the label to run or even disappear. The label could also wrinkle or separate from the disc. Avoid harsh cleaners that will also remove part of the surface and roughen the path of the stylus. There have been products on the market (L.A.S.T. is one of the best) to restore and make a more silent surface. Be careful of vinyl conditioners not made for LPs because they can easily build up and clog the fine groves. Always experiment on an unwanted LP.

If a record is badly warped it might flatten if placed in a "press" between two pieces of plate glass. When left for several hours in the sun or a warm (NOT hot) oven it will sometimes return to a flat surface. A brick on top of the glass could help. When flat, allow to cool *completely* before removing from the plate glass press or the problem could become worse. Remember to always store records either flat or vertically away from radiators, sunlight or other heat sources. Never let them rest at an angle or on uneven surfaces.

When planning to play older discs, whether 78s, acetate on aluminum or glass, or even early LPs, the proper stylus must be employed. The wrong needle, especially those in the more modern players, can do irreparable damage to the grooves. Fortunately, everything is available but may take some time to acquire.

A note about the inner sleeve and the outer cardboard shuck of the LP. Because friction builds static electricity which pulls dust to the surface of the LP, it is sensible to slice open one side of the inner sleeve, whether paper or plastic or a combination of the two, so the sleeve can be opened by lifting one corner for inserting and removing the LP. This also allows you to hold the disc with a spread of the hand with fingers on the label and the thumb on the outside edge. This ensures no greasy fingers touch the record, which will leave prints to "glue" dust to the surface. When taking a recording out of the cardboard shuck or jacket, place the shuck against the body and press it open. With the other hand, reach in and remove the inner sleeve containing the LP. This alleviates excess friction which builds static electricity. Reverse the process for replacing the disc, which should be done immediately when finished.

Slicing open the tight-fitting sleeve is also advised for CDs. As increasing numbers are now housed in paper sleeves, either attached inside a booklet or

boxed together in a container, the sliding in and out produces untold numbers of scratches on the "indestructible" surfaces of the CD. If there is any grit on the disc or in the sleeve, the scratches can become detrimental. The open sleeve also alleviates the necessity of touching the surface of the CD and leaving a greasy fingerprint.

— PHILIPS-MILLER

There have been several successful recording techniques which both rivaled and eventually replaced the grooved record. One of the most interesting was the Philips-Miller system. Unlike optically recorded sound film used by the motion picture industry, there was the Philips-Miller sound recording system developed in the 1930s for the Dutch Radio Broadcasting Union. Like sound film, this also utilized a celluloid film. However, this unique "Philimil" film was seven milimeters wide and was coated, not with a light-sensitive emulsion, but with a relatively thick layer (60 microns) of clear gelatin which was topped by a thin layer (three microns) of opaque black. This black layer was incised by a chisel-shaped sapphire. This "cutting head" had a 176° angle on its base, which when activated by the sound waves, moved vertically. This motion cut through and removed a part of the opaque layer, creating a line of varying width depending on the strength of the signal driving the depth of indentation. The laminated film, traveling at a speed of 32 cm/second, thus recorded the sound pattern. Playback passed the Philimil film through a system containing a light source on one side and a photocell on the other. The Philips-Miller system was thus a combination of mechanical and optical recording.

Even though the Philimil film had a frequency range of 30 to 8,000 Hz or, depending on sources, 10,000 Hz and could record two-channel sound, it was replaced in the early 1950s by magnetic tape. The ease of handling magnetic tape helped doom the Philips-Miller sound recording system. The fragile nature of the three-layer Philimil film and the specially designed machines for recording and playback no doubt helped its demise. One interesting point concerned the hollow shape of the guiding wheels which allowed the Philimil film to move through the process with nothing touching the engraved surface.

The Philips-Miller audio system was invented by an American, Dr. James Arthur Miller (1891–1971) from Flushing, New York, who licensed his Millerfilm (or Miller tape) and ideas to the Philips company based in Eindhoven, Holland. The system was used extensively in the Dutch radio studios but was also employed in the mid-1930s in Luxembourg, Norway, England (by the BBC), and even in the U.S. in New York at WQXR. WQXR was the first American station to broadcast a tape recording. On 26 August 1938 between 6:30 p.m. and 7:00 p.m., New Yorkers listened to a recording from the Philips-Miller system. The British were probably the most enthusiastic users of the system, but Hitler's attack on Holland also brought an end to the supply of Philimil tape, which could only be recorded once. The BBC returned to the sonically inferior wire

recorders or discs until the arrival of magnetic tape after the war.

Few recordings utilizing the Philips-Miller recording system have survived or been reissued on modern sound carriers. The notable exception is the 1939 Palm Sunday performance of Bach's *St. Matthew Passion* conducted by Wilhelm Mengelburg. This yearly tradition began in 1899. The catastrophic events of 1940, brought about by Hitler's invasion of Holland, ended the tradition. This performance was captured by Dutch radio and has been reissued on both LPs and CDs, which were derived from the discs. The 1939 sound rivals that of the best of the 1950s pre-stereo tape recordings.

There were also experiments and several hundred stereo recordings made in the late 1940s and early 1950s, utilizing a two-track Philips-Miller tape. None of these appear to have been reissued for public consumption.

— MAGNETIC RECORDING

In 1878, Oberlin Smith described the principle of magnetic recording in the American journal, *The Electrical World*. In 1898, the Danish engineer Valdemar Poulsen (1869–1942) patented the Telegraphone, which recorded crosswise on steel piano wire mounted horizontally on a drum that was turned by hand. The machine required headphones because of its limited dynamic range of less than twenty decibels. However crude, the Telegraphone won the Grand Prix at the Paris Exposition of 1900. Also in that year, Kurt Stille introduced a modified machine in which the steel wire was drawn past a fixed head, being wound from one reel to another. The Telegraphone moved the wire at seven feet-per-second and the "apparatus for electro-magnetically receiving, recording, reproducing and distributing articulate speech" worked, and Poulsen is recognized as the "father of magnetic recording." There were some real problems with the Telegraphone. The wire was fragile and would twist, tangle and break, which resulted in a dangerous flying-about of the needle-sharp ends. There was no provision for rewinding the wire spools; they had to be removed, interchanged and run back. This took about a half-hour because the speed was as fast as the wire could withstand, seven feet-per-second. Acoustic problems also existed. Because the wire was recorded crosswise or in a perpendicular direction the quality was poor, with a dynamic range of less than twenty decibels. This was further compromised by a high noise level. The amplification for the wire recorder (and all other recording devices) was greatly increased with the introduction of Dr. Lee DeForest's invention, the triode vacuum tube. The further invention and utilization of the ring-type head which concentrated the magnetic field, incorporated with longitudinal wire recording, allowed lower speed and a greater amount of information to be stored.

In the mid-twenties, the United States Naval Research Laboratories, utilizing leased Telegraphone technology, discovered AC or high frequency bias recording techniques which lowered background noise. The Navy hoped to record, transmit at high speed to lessen sending time, and re-record for later decoding, their more mundane messages. Unfortunately, the wire would not

withstand the increased speed. During WWII, the American military utilized many wire and metal ribbon recording devices. Wire recorders were in common use into the 1950s.

In Europe various companies leased manufacturing rights for the Telegraphone, utilizing Kurt Stille's patents. Around 1929 the Blattnerphone, utilizing a steel ribbon tape 6 mm wide and 0.2 mm thick, was perfected by film producer Louis Blattner. The Blattnerphone was used in England for recording motion picture soundtracks, and several films using the synchronized steel tape were released before sound-on-film recording was seen as superior.

The Echophone was another German experiment. The recorder was the first to house the steel ribbon or band in a magazine instead of on open reels. This simplified the loading and transportation of the recorded material. The Echophone was sold to the International Telephone and Telegraph Company, and was redesigned and marketed as the Textophone. The Textophone was immediately put to use by the Gestapo when Hitler came to power in 1933.

If mighty oaks spring from little acorns, many great inventions also have meager beginnings. Magnetic tape is a perfect example. Hans Fantel retells the story by Heinz Thiele in an August 1994 *Opera News* article. In the 1920s, gold-tipped cigarettes were all the rage, and Dr. Fritz Pfleumer (1881–1945) was trying to bond gold bronzing powder to the tips so the smoker's lips would not be gilded. By bonding the metal powder into a plastic binder the problem was solved. Pfleumer next had to figure out how to make certain the cigarettes could be packaged with the gold tips at the top the box. He created an inspection process which magnetized the gold tips so they could be electromagnetically scanned. Fritz Pfleumer's mind jumped to wonder if the electrical sensing of the magnetized particles in the coated plastic could be used to record and retrieve musical information. In 1928 he created a magnetized ribbon of paper and took out patents. Apparently, J.A. O'Neill, an American, had created a magnetic coated paper in 1927 but it apparently disappeared. Pfleumer's patents were further developed by AEG (Allegmeine Elektrizitäts-Gesellschaft), where Heinz Thiele became part of the project. Difficulties in the early tape with restricted range and excessive noise were overcome by another odd twist of fate. Thiele belonged to the same hunting club as Dr. Wilhelm Gaus, a chemist with Badischen Anilin-und-Soda-Fabriken or BASF, part of IG Farben. In the small talk between shooting birds the two scientists discussed the problems and Gaus, a physical chemist, posited that the size of the iron filing was too large to accommodate the small wave-forms of the higher frequencies and too irregular in shape to assure a quiet background. He suggested a process of chemical precipitation to produce smaller, uniform particles of ferric oxide to be adhered to the tape. BASF later produced a superior cellulose acetate-based tape and by 1934 could deliver 50,000 meters of magnetic tape from its factory. By 1935 the technical deficiencies were overcome to the point that the first commercial tape player built by AEG was exhibited at the German Annual Radio Exposition in Berlin. The Magnetophone was an instant success, partly because the tape was

relatively inexpensive, about fifteen cents per minute as opposed to the wire or steel ribbons, which cost about a dollar for the same timing.

The German Magnetophone became available to the public in late 1935. On 19 November 1936 while on tour in Germany, Sir Thomas Beecham, always interested in the latest recording techniques, conducted the London Philharmonic Orchestra in the minuet movement of Mozart's Symphony no. 39, K. 543, "Jupiter." This was recorded at Beecham's request at a guest appearance in the BASF Leisure Center at Ludwigshafen on a Magnetophone machine and is the first "serious music" available from a tape source. This early taped performance (and others from these years) has been reissued several times.

There was little interest in the new technology until fate stepped in. Reichmarschall Hermann Goering had recorded a broadcast on thirteen wax discs. When the re-broadcast was about to begin it was discovered that disc ten was missing. The next morning the director of the station was ushered into an angry Goering. He rather calmly avoided deportation to a concentration camp by telling Goering how such accidents were common but could be avoided utilizing magnetic tape. Soon all the studios of the Reichsrundfunkgesellschaft were supplied with tape recorders and their propaganda potential was realized.

Fritz Pfleumer survived the war but was a broken man. He died 29 August 1945 in what remained of Dresden. His home, his papers, and all his possessions were destroyed in the Allied bombings of 13 February 1945 that burned uncontrollably for days and killed many thousand Dresdeners. Even before he died, however, his tape recorders were being "liberated" and sent to the United States where they would soon take on a new and exiting future.

Bell Telephone Laboratories was the only large concern in the United States which had earlier experimented with magnetic recording. They developed a steel-tape machine called the Mirrophone. When demonstrated at the 1939 New York Word's Fair, visitors were amazed to hear their conversations instantly played back with such clarity. They were, however, more amazed at the early demonstrations of television. Acoustic Consultants began the manufacture of the Soundmirror magnetic-recording machine in 1937. The Brush Development Company bought the rights to the Soundmirror, only to find themselves caught up in WWII. Brush manufactured many types of magnetic recording machines for the various branches of the Armed Services and made great headway improving paper-tape coatings and wire-recording bands and threads.

One of Brush's employees was Semi Joseph Begun (1905–1995), who had been born in Danzig, Germany. He had worked at AEG and helped develop the Magnetophone. Being Jewish, Begun was forced out of AEG and emigrated to the United States in 1938. He joined Brush Development that year and energized the Soundmirror's development.

The Second World War saw great advances in tape recorders, especially in Nazi Germany. Dr. Goebbels's propaganda ministry utilized the tremendous possibilities in storing and broadcasting the repeated messages so necessary to the government. As the war ended and Germany was in rubble, the Allies

heard broadcasts which, because of their silent background and great length, were assumed to be "live." The Americans liberated the AEG files for the Magnetophone and discovered machines that had a bandwidth of 10 kHz using AC bias and a coated paper tape. The United States Alien Property Custodian held the patents on the Magnetophone but was unable at first to interest the large American corporations in the tape reorder.

In war-torn Germany of 1944, IG Farben Industries (of which BASF was a subsidiary and later a separate company) developed a tape which they called Luvitherm, using an non-plasticized polyvinyl chloride (PVC) film. The German war industry had developed PVC in their oil-starved search for a new binder for paints and other coatings. The war ended before Luvitherm became widely available. In the United States, the fledgling Ampex Corporation contacted 3M Company and requested they develop new and improved oxides and plastic tapes. Apparently modern tape recording was born when a tape (created out of research for a superior packaging tape) was coated with a magnetic paint and tested on a tape player brought to the laboratories by a Minneapolis radio dealer. Improving the tape was the "raven red" oxide coating—an upgraded red barn paint—which shed badly and lacked high frequency characteristics. Progress toward the perfected products now available was a slow but steady process.

The Germans had somewhat arbitrarily selected seventy-six centimeters-per-second as their tape speed. This seemed the ideal speed to compensate for the deficiencies and limitations of their earlier tapes. When the United States began manufacturing machines based on the German Magnetophone, they selected for a tape speed the closely convenient thirty inches-per-second. As tape was improved lower speeds became possible, and the somewhat capricious thirty was progressively halved to 15 inches-per-second (ips) and then to 7-1/2, 3-3/4, 1-7/8 and finally 15/16 ips.

For analog recording machines there were, at the end of the twentieth century, three common spooling systems. Reel-to-reel systems became the standard for professional and high-end machines. The 7-1/2″ or 10″ tape spool (though larger and smaller sizes are manufactured) stores the tape. The loose end is threaded through the tape machine past the heads and between the capstan and the pinch wheel (which provides the traction) to the take-up spool. The reel-to-reel machines tend to be large and not portable but are convenient for editing within the spool of tape or onto different reels. The first "home recorder" tape machines, introduced after WWII, were reel-to-reel. In 1956, RCA Victor began marketing prerecorded stereophonic tapes for home consumption. The quality was excellent, but the somewhat cumbersome equipment and high cost of the tapes limited sales. The introduction of the stereo long playing disc two years later doomed open-reel tapes for mass home consumption.

In early 1943, Helmut Krüger, chief engineer at the Reichs Rundfunk Gesellschafts, began experiments with two-channel stereo recording on tape. He made perhaps as many as 300 or so stereo tapes but only five are known to have survived the destruction of bombings, confiscation by the Soviets at the

war's end, or the natural deterioration wrought by time and improper storage. Of the five surviving recordings, only one is of a complete work: Beethoven's Piano Concerto no. 5, "Emperor." The recording, made in a Berlin studio on 23 January 1945, features pianist Walter Gieseking with Arthur Rother conducting the Grosses Funkorchester. (The recording has been reissued on CD.) In addition to a splendid performance in quite brilliant stereo, the microphones have also captured the firing of the anti-aircraft guns frantically trying to dissuade the daily raid of Allied bombers from dropping their load on beleaguered Berlin.

— TAPE IN AMERICA

The story of tape recording arriving in the United States is a mess of conflicting stories, some almost lore, and a deep-seated, almost desired, science fiction. Certainly for the Nazis, the Magnetophone was not a top military secret. It had been displayed in the Berlin Radio Fair as early as 1935. Articles had appeared in German magazines including *Rundfunk*. There was a full-color feature in the German Army magazine, *Signal,* which was translated into the languages of overtaken countries. There was an English version for places like the Channel Islands which the Nazis occupied. A Magnetophone had even been tested by AEG colleagues at General Electric in Schenectady, NY, in 1937 or 1938, where it failed to impress. The report was obviously filed and forgotten. It is one of those quirks of fate that the Allied intelligence organizations were so ignorant on the subject. As the war was drawing to a close, two men appeared on the scene who would change the situation: Major John (Jack) Mullin (1913-1999) and Colonel Richard H. Ranger (1899–1961).

Jack Mullin, from San Francisco, was an engineer for Bell Telephone when the war began. He enlisted in the Army and rose to the rank of major in the Signal Corps. Stationed in England in 1943, he worked with radar units trying to solve radio-frequency interference problems. After the BBC went off the air at midnight, Mullin would tune in to the classical music broadcasts from Germany. He wondered how the music appeared to be so "live" with none of the snap-crackle-and-pop of transcription discs. After the liberation of Paris, Mullin discovered the answer. The GIs brought in all kinds of captured equipment. Mullin examined the hardware and wrote reports for the Signal Corps and Allied Intelligence. One day both the DC-bias AEG Tonscreiber and Magnetophone tape recorders arrived with acetate and PVC tape. Mullin was not impressed with the quality of sound and so noted in his report.

Later that summer in Feldburg, Germany, Mullin chatted with a British officer who told him about the AC-bias high-fidelity AEG Magnetophones at Radio Frankfurt. Mullin went to the station, heard the machines, looked at the schematic drawings and photographed everything. Back in Paris, Mullin filed his reports and applied for official permission to send to San Francisco two of the older DC bias Magnetophones and fifty reels of blank BASF and Agfa PVC Luvitherm Type-L tape. He only sent the transports because he knew he could design and build the rest from American parts.

Back in the States, Mullin became business partners with Bill Palmer and set about to build his own tape machines with the improved AC bias. The Mullin-Palmer team gave a series of demonstrations to the Institute of Radio Engineers at the NBC studios in San Francisco and at MGM in Hollywood. One tangible product was the first entertainment disc professionally mastered on tape, the 1946 release on Sound Records of *Songs by Merv Griffin*. It would be almost a year before tape replaced the 78-rpm disc for studio recording.

One of the earliest people to become involved with the Mullin-Palmer equipment was Bing Crosby. Crosby was frantically searching for a high-quality recording method so he could have time-delayed broadcasts and not have to broadcast a second live show each evening to satisfy the different time zones. Bing and other members of Bing Crosby Enterprises heard the Mullin-Palmer demonstrations and two others. The fact that Ampex was already building machines based on Mullin's models convinced Crosby to invest $50,000 in the Ampex corporation to assure the deal.

Ampex had been founded in 1944 by Alexander Matthew Poniatoff who named his company with his initials plus "ex" (for excellence) which prevented confusion with the existing acronym used for the Aircraft Marine Products company. Mullin provided Ampex with information and his home-built machines as prototypes. The company also utilized the original German patent information available in the Field Information Agency Technical Reports (FIAT reports) distributed by the U.S. Government.

Beginning in 1947 and through the 1948 season Crosby's show was taped at both the dress rehearsal and the evening show with live audiences. The two shows were often mixed and edited to the correct length. One interesting piece of history resulted. If a joke or ad lib got a great laugh and it was later cut from the finished tape, Crosby would insist on inserting the better laugh on a lame joke—thus the laugh track was born. The finished show was then transcribed to sixteen-inch transcription disc for broadcast. The studio did not yet trust the tape system. There was also a limited supply of tape. However, ABC ordered twelve more tape recorders a few weeks into the season and soon other studios followed suit. The first two Ampex machines delivered in April 1948 to Bing Crosby have serial numbers 1 and 2.

The second tape company at the Crosby audition was that of Richard Howland Ranger. Ranger had become a major in the Signal Corps in WWI. After the war he became an electrical engineer who built electric organs. His claim to fame could rest on his 1932 three-note synthesizer, the "chimeless chime" which sounds the famous "G-E-C" musical signature of NBC radio. At the outbreak of WWII, Ranger returned to the Signal Corps and was in charge of the Army Air Corps Radio and Radar Test Labs in Orlando, Florida.

He was sent to Europe for technical investigations of the German advances in electronics. Sometime in 1945 during his study of the recently-captured Magnetophones, he decided to ship a few machines home. Upon his return stateside he built the Rangertone tape recorder, a hardly-disguised copy of the

Magnetophone. He demonstrated his Rangertone to people in the East and was invited to present the equipment to Bing Crosby Enterprises along with Mullin-Palmer and a maker of transcription disc recorders. The Ampex connection won and their rapid dominance of the market forced Ranger's return east to develop other equipment, including the portable lip-synchronous recorder and a 35 mm recording tape with sprocket holes, which became a favorite of Wilma Cozart Fine and the Mercury "Living Presence" recordings of the 1950s and '60s.

— REEL-TO-REEL LOOP MAGNETIC TAPE CARTRIDGE

The eight-track cartridge uses the standard 6.3 mm wide tape which runs at 9.5 cm per second for better fidelity than the 4.75 cm per second speed of the cassette. The eight tracks (four stereo programs) are placed 1:5, 2:6, 3:7 and 4:8 on the tape. An automatic changeover mechanism shifts the playback head at the end of each track. The eight-track is obviously better suited to programming popular music of four equal length programs thus avoiding unwanted gaps of silence.

Credit for the eight-track cartridge is usually given to Bill Lear, but there were others working on similar products. Bernard Corisino appears to be the first to solve the binding problems inherent in the systems, which pulls the tape from the center and re-winds it on the outside. He realized not only friction but also static electricity caused the loop of tape to bind. By coating the back of the tape with colloidal graphite, he removed not only the friction but let the graphite conduct away the static electricity. In 1952, he marketed the "Audio Vendor" and later the "Echomatic." The first fit onto a reel-to-reel tape player and the loop was fed into the machine's heads. The second was an enclosed, two-track cartridge that required a special player.

George Eash was also working on a similar cartridge which he patented and called "Fidelipac." This was designed to replace most of the personnel at a radio station through automated racks of "Fidelipacs" which would forever move from hit song to commercial without a human in sight (or sound). A variation on this, a four-track cartridge and player was introduced by Earl "Madman" Muntz in 1963 as an under-dash music machine for top of the line automobiles. The players were a hit in California and the auto-sound fad quickly spread east. A home player also appeared.

In 1965, Bill Lear, of Learjet business planes, introduced the eight-track cartridge, a variation on the "Fidelipac." He convinced Ford Motor Co. to install the improved eight-track player in 1966 and also got RCA Victor to put much of its catalog on the new cartridge. The superiority of sound and length of program was impressive and it continued to be popular into the 1970s. The success was, in hindsight, short-lived as the Philip's cassette made ever-deeper inroads into the portable music market.

The Elcaset, which hit the market in 1976, was developed by Matsushita. It was about 40% larger than the Philips cassette and utilized a 1/4-inch-wide tape. Both the recorded sound and its reproduction were superior. However,

the 1971 introduction of Mr. Dolby's noise reduction methods, when applied to the far smaller, and thus more convenient cassette, won the day. Another casualty of the improved cassette was the BASF Unisette, which hit the market with the Elcaset and also soon died. By the time of the CD launch, the cassette had greatly surpassed the LP in world-wide sales.

— THE CASSETTE

The next foray made by tape into the home of theAmerican consumer was the 1964 music-cassette with the CarryCorder 150. Both player and tape were distributed by Norelco, the American arm of Philips, the Dutch consumer products manufacturer that developed the machine in 1961. The first public demonstration was in Berlin, Germany, in 1963. This battery-operated machine was the first to use a 1/4-inch tape cassette format. This quickly became the standard for the consumer audio market. The analog cassette cartridge is commonly available in 30-minute (15 minutes per side), 45-minute, 60-minute, 74-minute, 90-minute, 120-minute and for a short while, 180-minute sizes. The length of the recording time is achieved through a thinner tape base, which can affect both quality of sound and durability.

Phillips avoided the tangle of stereo-mono incompatibility. Cassettes were recorded in quarter-track stereo with left and right signals in adjoining tracks (1:2 and 4:3). This allowed mono half-track machines to scan both tracks for an acceptable sound. The cassette epitomizes the rise of plastic in electronic equipment. The tensilzed Mylar tape on plastic hubs rode over plastic runners, guides and spools contained in a plastic shell. Much of the three-pound player was also plastic, originally powered by flashlight batteries. Unfortunately the sound quality was low-fidelity. However, steady improvement of tape formulae and better recording/playback heads increased the popularity of the cassette players. The greatest improvement was the 1971 introduction of the Dolby A system, developed by Dr. Ray Dolby, an employee of the Ampex Corporation. The system, based on the pre-emphasis of certain higher frequencies in recording and a de-emphasis during playback, removes most "tape hiss." Dolby A was first used in 1966 by the Decca studios in England.

Suddenly in the early 1980s the pre-recorded cassette sales became greater than those of the vinyl LPs. This was certainly more accurate for popular music than for classical. The tiny cassette is responsible for one of the biggest, and certainly one of the loudest innovations in popular music: Rap. Rap music blared forth from the portable and fairly cheap "boom box." Carried on the shoulder, this blare of music with levels of 120 db, matches the din of a jet plane. It has also been noted that the roar carried on the tiny cassette was neither conversation nor music.

— THE CD

The lore-of-the-land has it that the compact disc, CD, was developed through a joint venture by Philips and Sony. And, in truth, much credit goes to them,

but optical-digital data-storage technology, which is basic to the little silver disc, was invented years before by Jim Russell working at Battelle's Pacific Northwest National Laboratory in Richland, WA.

An article in the 29 November 2004 *Seattle Times* profiles Russell and his try to find a better way to store music which could be replayed without wear on the carrier. By 1965 he had developed much of the technology and filed many of his fifty-one patents. The following year the funding stopped.

Russell kept pushing Battelle, and in 1972 they interested venture capitalist Eli Jacobs, who sponsored additional research. In 1974 Russell recorded a television program onto a glass plate. Companies were invited to view and license the research. Both Sony and Philips saw the work but did not become involved. In 1980 Jacobs founded Digital Recording, a public company, to develop an audio player and storage media. Three years before, Sony and Philips had formed a consortium to develop the compact disc and with their launch in 1982, beat Russell and Digital Recording onto the market place. Russell felt his patents had been infringed upon, but his lawyers disagreed. Digital Recording's beleaguered assets were purchased by Optical Recording Corporation of Toronto in 1985 and Russell's contract ended two years later. The lawyers for Optical Recording went after Philips/Sony and a $130 million settlement was reached in 1988, though the giant admitted no wrongdoing. Of course Jim Russell, no longer with the company, received nothing from this. In the next few years his patents for the DVD technology expired, just before the mid-1990s take-off. He retired to Bellevue, WA, perhaps wiser, certainly poorer, but hopefully not a forgotten man.

— PHILIPS/SONY CD

In 1978, Philips announced the impending arrival of compact disc (CD) digital audio sometime in the early 1980s. Record companies were just then beginning to do experimental recording sessions with digital tape. The long-playing discs would be issued in the usual analog pressings. The difference in sound pleased many but was too clean for others. Of course multi-plays of the vinyl discs brought on the usual snap-crackle-and-pop.

In April 1981 there was a conference held in Salzburg on the impending compact disc. In June 1982 there was a DAT conference in Japan to set standards for both stationary-head (S-DAT) and rotary-head (R-DAT) digital audio tape recorders. Digital fever was in the air. In October 1982 the launch of the compact disc occurred in Japan. The rest of the world waited. In March, the CD was introduced to England and in September in the United States, a limited number of consumers were able to purchase a very expensive player and a few outrageously expensive discs. But manufacturing facilities were being built and pressing plants created. Philips/Sony, anxious to recoup their huge expenditure in research and development, had hoped to sell ten million CDs by 1985. They sold over fifty-nine million! By 2002 over eight billion CDs were sold. The long-play record was quickly phased out of the market and

even the more popular cassette tape was endangered. Prices began to drop on CD players and in a few years reasonably priced units were flooding the market. The price of the discs remained high as new owners of players were most anxious to hear the latest digital recording and to replace their cherished, well-worn LP albums. It was not until small independent companies, particularly Naxos, began to issue a steady stream of low-priced, digitally recorded discs, which many times out-performed the majors, that the price structure begins to crumble and settle into four realms: Still-Too-Expensive, Mid-Priced, Budget, and Super-Budget. Depending on the philosophy of the company, re-issues of older material could fall into any of the above price ranges as could the latest digital spectacular. This tiered pricing seems to cross all genres of music.

Demand for CDs has invigorated a sluggish re-issue policy and the amount of music available again in all genres is astounding. From the dawn of recording to the present, choices abound. The number of integral sets of specific performers crosses all areas. Music once thought relegated to its original issue format and housed in used bins is refurbished in sound better than ever heard, and often can be had for a fraction of the cost of the original, now only sold in the collectors market. This is an unexpected and most welcome bonus of the CD era—certainly a bonus to the sound designer. If only there were time to listen to it all!

> Anyone who has heard it will admit that its performance is as near perfection as it is possible to obtain. The records are unbreakable, light and practically indestructible and are predestined to absolutely revolutionize the…industry. So far as these records have been seen they have created a most profound impression and it has been universally conceded that nothing has ever been brought out of such an astonishingly realistic nature and the demand from the public will be enormous. The elimination of all foreign sounds in reproduction is quite sufficient to win for them the admiration of everyone, but there is much more than this: they represent the acme of perfect reproduction of vocal and instrumental music with no distortion or extreme noises.

The above quote could be proof that the more things seem to change the more they stay the same. It is from a 1906 Neophone catalog, but any number of other companies from any number of decades echo the statements.

The speed with which a new or improved technology can replace the old has increased. Flat discs took about fifteen years to really overtake the fully entrenched lead of cylinders, but it was Edison's closure of all his recording facilities in 1929 which signed the death certificate. Though, in truth, since WWI, the cylinder was out-produced and the future was clear. Electrically recorded discs quickly replaced the acoustic era's quarter-century-hold on record buyers. The wholesale thinning of catalog during the Great Depression further buried the past. The past had vanished so quickly that in 1932 a group of enthusiastic collectors formed the International Record Collector's Club (IRCC) to encourage re-issues.

The 1948 arrival of the long-play record had effectively replaced the 78 record within the next decade. Some of the earlier LPs were dedicated to restoring "golden age" opera and other recordings long since deleted from the catalog. The stereo LP of 1958 required a lighter-weight tone arm and a finer stylus. Soon the improvements were incorporated into all machines and mono duplicates were tossed into quick-sale-bins in 1966 in America and a year later in England. The LP continued to improve in sonic quality, disc durability and breadth of repertoire.

The cassette tape delivered by Philips in 1963 slowly made sonically inferior inroads until it had Dolby noise reduction incorporated and could rival the LP for high-fidelity delivery. Cassette sales did surpass the LP in the mid-1980s with 900 million units—54% of total sales—but certainly not for the buyer of "serious music," and it took the CD to eventually dislodge the LP—and all other commercial recording formats. In 1983, a year after the CD launch, world-wide sales of the LP exceeded 850 million units. These figures, slowly but steadily, dropped to about 600 million over the next five years as CD production and players flooded the market. Two years later, CD sales were over the 600 million mark and LP sales plunged to single digit millions in 1996 while the CD's sales exceeded 2.1 million. Part of the LP's rapid decline was manufacturer's ceasing to release anything on the old LP format and totally embracing the newest technology, thus forcing the consumer to upgrade. The choices were no longer with the fickle consumer. For cocktail party chit-chat, the first CD to sell over one million copies world-wide was *Brothers in Arms* by Dire Straits, led by Mark Knopfler. Released on 17 May 1985, the disc eventually sold more than thirty million copies.

The quality of sound improvement and length of playing time with each change of technology is remarkable. Cylinders and the first flat discs could each play about two minutes. Their range was somewhere between 1,000 and 2500 Hz. By the mid-1920s the range had widened somewhat: 164–2,088 Hz. The timing for the ten-inch disc was not much more than three and a half minutes while the twelve-inch disc could accommodate more than five minutes. The longest timing known for a standard 78-rpm twelve-inch disc was 6:45 and 6:15 for a total of thirteen minutes. This was on the HMV Haydn Quartet Society series issued in 1932. Certainly less than five minutes was the norm.

The length of electrically recorded 78s introduced in 1925 remained unchanged until the advent of the long-playing record. However, the sound quality improved. Sound waves between 150 Hz and 6,000 Hz were able to be captured.

The long-play introduction in 1948 presented the listener with a slower speed (33-1/3 rpm) microgroove disc which could accommodate twenty-five minutes of music per side. Some special discs almost doubled that timing and more than one company released Beethoven's lengthy Ninth Symphony on one disc. The recording range also expanded to reach 20–16,000 Hz as the LP grew to incorporate stereo recordings digitally recorded and pressed with DMM (Direct Metal Mastering).

The Compact Disc arrived in 1982 and with it came eighty minutes of pure digital recording. The range increased too, up to 20,000 Hz. Is the end in sight? Oh, probably not.

Almost twenty years after the CD hit the market, the final word in the sound perfection of reproduction seems to be evolving. The DVD, originally the Digital Video Disc has changed its name to Digital Versatile Disc. This latest disc has more flexible specifications and is ready for "all foreseeable applications." That statement alone makes one wonder what will be next because the future is blind to our eyes but, as Thomas Alva Edison knew, unlimited in our imagination.

— ASCAP AND BMI

Copyright laws extend back many centuries. In Britain the Copyright Act of 1709 put some enforceable teeth into the situation, but it was not until 1911 that public performance rights were integrated. In the United States, the Congressional Act of 1891 was greatly revised in 1909 and enforcement became more common. The music world realized a watchdog organization would be more effective than the lone author in trying to collect from the thousands of uses. Unions were more than a rage in early twentieth century America; they sprang into being to combat abuse. How one feels about their role today is certainly beyond the scope of this massive tome. But they are a firmly rooted part of our society, especially in the world of music.

ASCAP, the American Society of Composers, Authors and Publishers, began in New York City with a meeting in Luchow's Restaurant during October, 1913. The founding members were gathered by publisher George Maxwell and copyright lawyer Nathan Burkan. The composers Victor Herbert, Louis A. Hirsch, Raymond Hubbell, Silvio Him, and Gustav A. Karker were joined by lyric writer Glen MacDonough and publisher Jay Witmark to comprise the nine original members. The low turnout for the initial meeting is credited to a long day of heavy rain. Within a year, the founders were joined by 170 charter members and a number of publishing firms. Created to insure that performers paid for the right to play the members' music, the group grew rapidly. Soon vaudeville and later radio paid into the growing coffers of the organization as continual lawsuits reconfirmed the right of the organization to collect their just monies. In 1940, the ASCAP contract with radio was to expire. In negotiations, ASCAP, knowing their strength, demanded their fee be doubled. The stations balked and refused. All ASCAP music rights were withdrawn. Music in the public domain enjoyed a resurgence, especially that of Stephen Foster, and ASCAP finally had to admit defeat. They accepted less in a new contract than previously charged! A situation far worse than the loss of fees was soon upon them. A new organization rose in the void. Broadcast Music, Incorporated (BMI) was founded in 1940 with independent composers and ASCAP rejects. Later, additional musicians from other musical areas ignored by ASCAP (including hillbilly music and rock 'n' roll) joined BMI. Within a dozen years, BMI had more than 80% of

the market and it continued to grow. Today both these protective organizations insure the financial rights of the creators.

A third event affected popular music in the early 1940s. James C. (appropriately for Caesar) Petrillo, president of the powerful American Federation of Musicians, the music performers union, decided he should have a larger proportion of the industry profits and demanded a royalty on each record produced. To pressure the companies, he called a total, nationwide strike beginning 1 August 1942. No records could be made. The backlog of recordings in the company vaults was soon used up, and in September 1943, the first small companies capitulated. Decca, whose backlog was completely exhausted, quickly recorded popular vocalists and the Broadway hit, *Oklahoma!* The strike, combined with the enlistment and conscription of players in, was a major factor in killing off big band music. Americans turned to listening to their favorite singer and not dancing with him, their sentimental longings being more happily satisfied. Another AFM strike in 1947 was not as successful because record companies had foreseen the situation and backlogged a sufficient number of recordings to outlast that fifteen-month ordeal.

ASCAP main offices:
One Lincoln Plaza
New York, NY 10023
Tel: (212) 621-6000 Fax: (212) 724-9064

7920 W. Sunset Blvd., Third Floor
Los Angeles, CA 90046
Tel: (323) 888-1000 Fax: (323) 883-1049

There are also regional offices in: London, Nashville, Miami, Chicago, Puerto Rico and Atlanta.

BMI main offices:
320 West 57th Street
New York, NY 10019-3790
Tel: (212) 586-2000

8730 Sunset Blvd., Third Floor West
West Hollywood, CA 90069-2211
Tel: (310) 659-9109

There are also BMI regional offices in: Nashville, Atlanta, London, Miami and Puerto Rico.

— COPYRIGHT RULES AND REGULATIONS

Copyright law grants owners of copyright (authors and other creators and publishers) the sole right to do or allow others to do each of the following acts with regard to their copyrighted work: to reproduce all or part of the work; to

distribute copies; to prepare new (derivative) versions based on the original work; and to perform and display the work publicly.

Copyright protection covers both published and unpublished works. The fact that a previously published work is out of print does not affect its copyright.

Works able to be copyrighted include "original works of authorship" which are "fixed in a tangible medium of expression." Among the types of works subject to copyright protection are literary, dramatic, musical, choreographic and pictorial works, graphic works, pantomimes, *sound recordings*, sculptures, motion pictures, and audio-visual works.

Copyright protection does not include ideas, procedures, processes, systems, concepts, principles or discoveries, although these may be protected under patent or trade secret laws.

Civil and criminal penalties may be imposed for copyright infringement. Civil remedies include an award of monetary damages (including substantial statutory damages which, in cases of willfulness after 1 March 1989, may total up to $100,000 per work infringed, or actual damages, including the infringer's profits) and award of attorney's fees, injunctive relief against future infringement and the impounding and destruction of infringing copies.

A purchaser of a work, including recordings, does not own any rights in the copyright covering the contents of the purchased copy. Consequently, a purchaser cannot copy a purchased work, in whole or in part, without the copyright owner's permission unless such copying constitutes "fair use." "Fair use" permits the use of copyrighted works, including reproducing portions of that work, without the copyright owner's permission. There are four basic factors to be examined in determining whether a use constitutes "fair use" under the copyright law. They are:

- The purpose and character of the use, including whether such use is of a commercial nature or is for nonprofit educational purposes;
- The nature of the copyrighted work;
- The amount and substantiality of the portion of the work used in relation to the copyrighted work as a whole; and,
- The effect of the use in question upon the potential market for or value of the copyrighted work.

Note that "nonprofit educational" use is just one of the fair-use factors and by itself doesn't waive the need to get permission. When in doubt, request permission!

Works in public domain may be freely copied; however edited versions of works in the public domain may be protected by copyright. This could include re-processed recordings. Works in public domain are those which have never been the subject of copyright protection and works whose term of copyright protection has expired.

For works distributed prior to 1 March 1989 absence of a notice of copyright does not necessarily indicate that the work might be in the public domain. For works distributed after 1 March 1989 notice of copyright is not required.

The fact that the author is deceased or the work is out of print does not mean the work can automatically be copied.

The rules for deciding if a work has passed into public domain, and is therefore able to be used without getting permision and paying royalty, have changed through the years. They also differ depending on the country. It should not be the job or responsibility of a sound designer to research this information. That is why God created lawyers. However, no producer wants to spend money unless required to and a general understanding of the situation could be useful. It is incumbent upon any designer to point out the potential problem (and keep a dated note when told to butt out.) Lawyers.

Let's start with the easiest of the copyright protection laws for the United States.

- Works published before 1923 are in public domain. This includes recordings.
- Works published with a copyright notice from 1923 until 1963 are protected for twenty-eight years. They could be renewed for forty-seven additional years—now extended by twenty more years for a total renewal period of sixty-seven years. If the work's copyright registration was not renewed, it is in public domain. If a work was published without notice between 1 January 1978 and 1 March 1989 it can retain copyright only if registration was made within five years of its creation.
- Works published with notice between 1964 and 1977 are covered for twenty-eight years and are automatically extended for an additional sixty-seven years.
- If a work was created before 1 January 1978 but *not* published, it will be protected for the life of the creator plus seventy years or until 31 December 2002, whichever date is greater.
- For a work created before 1 January 1978 and published before 31 December 2002 the copyright protection is for the life of the author plus seventy years or until 31 December 2047, whichever date is greater.

And the killer is…

- For a work created after 1 January 1978 the protection is for the life of the author (and the longest-lived one in cases of multiple authorship) plus seventy years. Works created from corporate authorship are protected the shorter of ninety-seven years from publication or 120 years from the date of creation. This also includes works for hire, anonymous, and pseudonymous works.

Now you know why God created lawyers.

— INTERNET RESOURCES

The World Wide Web is an ever-expanding resource for just about everything. Caveats abound about the veracity and quality of the information one can find there especially when it comes to music. Below are a quartet of Web sites which will probably survive the whims of the marketplace. Let's hope!

Housed in the Special Collections Library at Duke University is a large collection of nineteenth- and early twentieth-century American sheet music. Digital access to over 3,000 pieces from the collection are available at http://scriptorium.lib.duke.edu/sheetmusic/.

The University of California at Santa Barbara houses a large (6,000 and growing) collection of cylinder recordings made between the late 1880s and the late 1920s. They have been digitally cleaned up and can be downloaded at no charge. The Web site (http://cylinders.library.ucsb.edu/index.php) is easy to use and is an excellent source for not only popular music but many other unusual bits of history.

Billboard magazine has been compiling lists (charts) of the best selling songs since 1946. These month-by-month lists are, obviously, most helpful. Current charts and samples of historical charts are available for free at http://www.billboard.com/bbcom/charts.jsp. There you can get a wealth of information about artists, their discographies, their upcoming concerts, listen to songs and even link to online stores where you can purchase CDs and digital song files. A complete historical charts archive is available on the Billboard paid subscription Web site at http://www.billboard.biz/.

Naxos, a classical music and jazz recording company, prides itself on being "a veritable encyclopedia of music." Its catalog is extensive, and, on its Web site (http://www.naxos.com), one can listen to short selections of music for free or complete tracks for the price of a subscription. The Web site includes biographies of hundreds of classical composers and, of course, opportunities to purchase the Naxos CDs which include music by the composers.